ICoLIS 2023

9th International Conference on Libraries, Information and Society

20th & 21st September 2023
The Everly Hotel, Putrajaya, Malaysia

Libraries at the Forefront of Open Science

Proceedings of the 9th International Conference on Libraries, Information and Society 2023 (ICoLIS 2023)

UNIVERSITI MALAYA

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Libraries at the Forefront of Open Science

20-21 September 2023 | Putrajaya, Malaysia

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September 2023

Suggested Citation

Samsul Farid, S. et al. (eds.). Libraries at the Forefront of Open Science: Proceedings of the 9th International Conference on Libraries, Information and Society, ICoLIS 2023, Putrajaya, Malaysia, 20-21 September 2023: pp.xxx-xxx
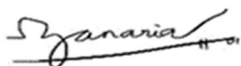
On behalf of the organizing committee, I would like to welcome everyone to the 9th International Conference on Libraries, Information and Society 2023. The last one we had in 2021 was organized virtually and it is nice that we are back together again physically seeing and meeting each other. It has been a real honor and privilege to serve as the Conference Chair for ICOLIS 2023. The conference this year has brought together academic researchers, librarians, and those in the information science community to interact and share their experiences and knowledge in this field.

The conference theme for this year is Libraries at the Forefront of Open Science. Libraries have always played a significant role in the realms of resource development, training, and research support within the continuous cycle of generating, exchanging and disseminating information and knowledge. However, in the era of open science, libraries are beginning to redefine or expand their roles, reinventing themselves by expanding the traditional information services as well as their educational and mediation functions. They play a key role in facilitating and promoting institutional research and knowledge openness, contributing to open science policy development, and establishing and maintaining infrastructure and services. Libraries have to re-invent themselves by launching expansions of traditional library services, adopting new data science roles, and expanding the library's educational and mediator functions. These challenges will be explored and discussed by the presenters in greater depth.

In conclusion, I would like to thank all of the people who have contributed to making this conference a success, particularly our sponsors, keynote speakers, session chairs, presenters, and participants without whom this conference would not have materialized. Again, it is a great pleasure and honor to welcome you to an inspiring, educational, and enjoyable program in this beautiful city of Putrajaya. We hope that you will find the conference informative and enjoyable and that you will also take the opportunity to establish future research collaboration, to those who are from out of town, we wish you a pleasant stay.

Programme Chair

Mrs. Zanaria Saupi Udin
Acting Senior Deputy Chief Librarian,
Universiti Malaya Library (DSIC),
Universiti Malaya

It is my honor to serve as the Co-Chairman of the 9th International Conference on Libraries, Information Society 2023 (ICoLIS 2023). I would like to sincerely thank and warmly welcome all the delegates and exhibitors of this conference. I am full of gratitude to Universiti Malaya Library for their strong support in chairing this conference, and the Institute of Information Management, University of the Punjab, Lahore, Pakistan as our international collaborator, and to all the participating local and international universities, libraries, and organizations, speakers, sponsors, as well as the Organizing Committee for their hard work and enthusiasm.

Libraries have traditionally been seen as bastions of information, offering vital tools, direction, and assistance to academics, professionals, practitioners, and students alike. The importance of libraries has never been greater than it is in the rapidly changing environment of today, where the ideas of Open Science are revolutionizing the way we produce, exchange, and use knowledge.

"Libraries at the Forefront of Open Science" is the theme of our conference, and it captures the urgent need for libraries to lead, innovate, and adapt at this time of transformation. We have assembled an audience that represents the full spectrum of this endeavor including librarians, practitioners, PhD students, lecturers, and researchers. Together, we will explore the challenges, opportunities, and best practices that will empower libraries to thrive as catalysts for Open Science.

Our program includes eminent keynote speakers, intelligent panel discussions, and a rich tapestry of research presentations, all designed to inspire and educate. We will delve into topics such as open-access initiatives, data management, digital scholarship, citizen science, and the evolving role of libraries as collaborative hubs for interdisciplinary research.

I urge all participants to take advantage of this chance to network, share their experiences, and develop new partnerships during the conference. I strongly believe that this conference will be a good opportunity for researchers, professionals, and students with passion and interest in Library and Information Science to present and discuss their research findings on a range of Open Science topics and learn from the best practices from other colleagues across the world.

Without a doubt, the accumulated knowledge and many viewpoints from this event will influence how libraries operate in the future of open science.

Let us keep in mind the larger goal we are pursuing—the search for knowledge, the progress

of science, and the improvement of society—as we embark on this intellectual adventure. Our contributions as librarians, practitioners, PhD students, lecturers, and researchers are instrumental in fostering an inclusive and open scholarly ecosystem.

Together, we will set sail toward a future where libraries stand resolutely at the forefront of Open Science. May this conference foster inspiration, collaboration, and lasting impact.

Programme Co-Chair

Associate Prof. Dr. Yanti Idaya Aspura Mohd Khalid
Head,
Department of Library & Information Science,
Faculty of Arts and Social Sciences,
Universiti Malaya

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YBhg. Puan Hazami Habib, J.M.W.

Chief Executive Officer,
Academy of Sciences Malaysia (ASM)

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Hazami Habib is currently serving as the Chief Executive Officer of the Academy of Sciences Malaysia (ASM), a 'Think Tank' body focusing on science, technology & innovation policy and strategy projects. She leads the Management of the Academy which comprises more than 700 STI experts in Malaysia. She joined ASM in 1996. In her years at the Academy, she has been involved in several national and international level studies and programs such as the National Astronaut Programme, National Science Challenge, ASEAN, and Asia-Pacific Economic Cooperation (APEC) Meetings related to STI, 1st, 2nd & 3rd Science and Technology National Policy and others. Among the ASM Flagship Studies that she oversees are Mega Science Framework Study, Foresight Study on Malaysia 2050, Science Education Study, Science Outlook, and several others. She has also been appointed as a member of the Board of Trustees of the Yayasan Pintar Negara (YPN) which focuses on designing learning modules for gifted children. Regionally, she has represented Malaysia in several talks and forums, including the China-ASEAN Technology Transfer and STI Cooperation Forum, Nanning, China; ASEAN Talent Mobility Workshop, Thailand; Asian Innovation Forum, Korea; and the 2019 AAAS Symposium, Washington DC. She is the Chair of the Science, Technology and Innovation Committee in APEC Policy Partnership on Science, Technology and Innovation (2017-current), the Secretary for Malaysia in IIASA Council (2014-2019), the Disciplinary Panel for Malaysian Medical Council (2018-current) and Council Member for Industry4WRD lead by Ministry of International Trade and Industry (2019-current). Her area of interest and expertise is on STEM Talent Development, Policies, Strategic Science Communication, Foresight, Science Diplomacy, and Governance.

DEFINING THE ROLES OF LIBRARIANS IN THE OPEN INNOVATION LANDSCAPE

Abstract: As the world progresses towards a post-normal age filled with uncertainty, shaped by complexity, chaos, and contradictions, how will the roles of libraries and librarians of tomorrow change? In order to face multiple upcoming challenges & risks, libraries will need to evolve to prioritize accessibility & inclusivity, shared cultural & intellectual preservation, holistic sustainability strategies, civic empowerment & media literacy, digital tools & training, and workforce development in its changes. Hence, in making this change a reality towards future-proofing the landscape, librarians need to change from only data keepers to data

curator & stewards – to be important thought leaders in managing data & information effectively to provide timely & accurate solutions for society. Therefore, it is of utmost importance that the librarians redefine their roles in this open innovation landscape.

Prof. Chérifa Boukacem – Zeghmouri

Professor of Information Science, Claude Bernard University, France

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Chérifa BOUKACEM ZEGHMOURI is a Full Professor of Information and Communication Sciences at Claude Bernard University Lyon 1 and a member of the ELICO research team. Based on the theoretical framework of cultural and creative industries, her research focuses on the mutations of scholarly communication towards open and collaborative models. New forms of production, circulation, evaluation, and legitimization of scientific research are her main research topics, with qualitative and bibliometric approaches. She is the Open Science Officer for her institution, a member of the French Open Science National Committee (COSO), and of the DORA National Evaluation Working Group. She is also the director of a Master's program that prepares students for Open Science and Open Research Data skills.

OPEN SCIENCE: NEW NORMS FOR RESEARCH, NEW CULTURE FOR PUBLICATION, SAME VALUES FOR SCIENCE

Abstract: Open Science is one of the most hotly debated topics in the academic world. It has brought together - and continues to bring together - all the stakeholders involved in research (universities, research institutions, scientific publishers, scientific communities, libraries, funding agencies, etc.) to discuss the renewal of the principles and practices of science in an open environment. Initially driven by rhetoric and narratives, Open Science is now legitimized by national and European policies. Its practices are developing within scientific communities and are now being taken into account by the current reform of research evaluation (COARA). Taking France (one of the European countries most committed to Open Science) as a case study, this presentation will examine the impact of the application of the principles of openness on research practices and institutional policies. In a recursive approach, the presentation will also consider the impact of the concrete implementation of openness on the redefinition of open principles for the purposes of adaptation and adjustment.

Professor Heidi Julien

Professor of Information Science, University at Buffalo Graduate School of Education

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Dr. Heidi Julien is a Professor in the Department of Information Science at the University at Buffalo, State University of New York (SUNY). Her research interests focus on digital literacy and information behavior. She has been a visiting professor at the Universiti Malaya, Swinburne University, Victoria University of Wellington, the University of Pretoria, Charles Sturt University, and Beijing Normal University. She has served as editor and on the editorial boards of several of the field's top journals. Dr. Julien is a past president of the Association for Library & Information Science Education (ALISE), and a past president of the Canadian Association of Information Science. She is also active in the Association for Information Science & Technology (ASIS&T), as chair of SIG USE and is a Distinguished Member. She is a winner of the Service to ALISE Award, the ASIS&T SIG USE Outstanding Contributions to Information Behavior Award, and the inaugural Canadian Association for Information Science Career Award.

LIBRARIES AT THE FOREFRONT OF OPEN SCIENCE – WHAT A SENIOR ACADEMIC WANTS YOU TO KNOW

Abstract: Open science is hailed as a critical corrective to multiple failings of modern science and its products. The open science movement has been embraced by academic librarians, who rightfully recognize their stakeholder position in the flow of scientific information, and who are keen to demonstrate their continuing value to their institutions. In scientific fields that are well-funded, embracing open science principles has been observably more enthusiastic than in those academic disciplines that are less well-resourced. This talk will focus on the value of open science, as well as its challenges, from the perspective of a senior scholar in a less-resourced discipline, information science. This perspective is an important one for libraries to hear and to understand if they are to serve the full breadth of their academic clientele.

Associate Professor Dr. Liew Chee Sun

Associate Professor
Faculty of Computer Science and Information
Technology, Universiti Malaya

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Chee Sun LIEW is the founder of UM Data-intensive Computing Centre (DICC) - https://www.dicc.um.edu.my/ , which facilitates the use of data-intensive computing and high-performance computing technologies in accelerating the advancement in scientific discovery. Using this platform, he engages the research communities and facilitates research across domains that ride on the data-intensive computing techniques and infrastructure. At the national level, Dr Liew is heading the Working Group on Infrastructure for the Malaysia Open Science Platform (MOSP) - www.akademisains.gov.my/mosp project. MOSP aims to develop a trusted platform that enables accessibility and sharing of research data aligned to national priorities and international best practices.

MOSP & ITS UNDERLYING INFRASTRUCTURE TO SUPPORT OPEN SCIENCE

Abstract: Open Science is a growing movement to make scientific research and data accessible to all. The international principle of making research data findable, accessible, interoperable and reusable (FAIR) will not only democratize knowledge; it will reinforce open scientific inquiry and integrity, enable better research management, and promote data-intensive research. Integrating the diverse data streams and huge datasets across multiple disciplines offers unprecedented insights and solutions towards local, regional and global complex challenges. Recognizing the importance of harnessing the potential impact of Open Science, MOSTI and ASM are paving the way towards realizing Malaysia Open Science Platform (MOSP) as a strategic transformative initiative to strengthen the STI Collaborative Ecosystem for Malaysia. In this talk, I'll give an overview of the MOSP, its architecture as well as the infrastructure to support Open Science.

INVITED SPEAKER 2

Prof. Dr. Abrizah Abdullah

Dean Institute for Advanced Studies
Universiti Malaya

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Abrizah Abdullah is a Professor at the Department of Library & Information Science, Faculty of Arts & Social Sciences, Universiti Malaya (UM). Abrizah graduated with a Bachelor's degree in Environmental Engineering from Temple University Philadelphia and obtained her Master's and Ph.D. degrees both in Library & Information Science from UM. Her research interests focus on digital libraries, information behavior, scholarly communication, and bibliometric. Professor Abrizah is currently the Dean of the Institute for Advanced Studies UM (1 Jan 2022 -) and was the Dean of the Faculty of Computer Science & Information Technology Universiti Malaya (UM) from July 2017 to August 2019. She was a teacher librarian and had ten years of secondary school teaching experience and was appointed as an Assistant Director at the Educational Planning and Research Division (EPRD) Ministry of Education Malaysia, before joining the Universiti Malaya in 2000.

OPEN SCIENCE WARRIORS: TRANSFORMING ACADEMIC LIBRARIES IN THE SCHOLARLY LANDSCAPE

Abstract: In this presentation, the speaker advocates the idea that academic libraries have evolved into powerful "Open Science Warriors" in the ever-changing world of scholarly communication. This metaphor vividly illustrates their unwavering commitment to advancing open science and reshaping scientific publishing. These Open Science Warriors embody qualities similar to experienced frontline fighters: dedication and fervor; adaptability and agility; guardians of knowledge; and empowerment and mentorship. How these qualities can be embodied by academic librarians within the framework of principles set by the International Science Council for the future of science publishing will be explored; specifically focused on universal, affordable, and timely open access advocacy, as well as the promotion of excellence in local research dissemination. Additionally, critical issues like the misuse of bibliometrics in science evaluation and the fight against predatory publishing will be addressed, with an emphasis on the pivotal role played by Open Science Warriors in advocating for transparent and ethical research practices. The presentation not only recognizes the transformative role of academic libraries in open science but also provides attendees with the knowledge and motivation to become proactive advocates for openness, transparency, and excellence in research.

Construction of an Open Science Thesaurus: A Library & Information Science Course Project

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ABSTRACT

Open science has emerged as a critical area of research in Library and Information Science (LIS), with increasing emphasis on sharing of research output and collaboration across disciplines and geographic boundaries. However, one of the main challenges in this area is the lack of a standardized vocabulary for discussing and organizing open science concepts. To address this issue, the Open Science Thesaurus was constructed as an output of a Masters in Library & Information Science (MLIS) course on Indexing, Abstracting and Thesaurus Construction. The aim of the thesaurus is to provide a standardized vocabulary for indexing and retrieving information related to Open Science. This paper outlines the construction of the Open Science Thesaurus that involves several key steps: (a) Using the Open Science Taxonomy developed by Foster to determine the core concepts and usable descriptors; (b) Conducting an analysis of existing terminologies within the domain, aiming to identify commonalities, gaps, and inconsistencies encompassing core literature, policies, and guidelines; (c) Compiling a comprehensive list of 250 terms related to Open Science; and (d) Establishing preferential, hierarchical, associative and relationships between descriptors. The resulting thesaurus is expected to provide a framework for more effective communication within the open science community, addressing the challenges that arise from the lack of standardized terminology. This paper highlights the importance of the Open Science Thesaurus in promoting a common understanding and effective communication among researchers, librarians, and other stakeholders in the Open Science community.

Keywords: Controlled vocabulary, Open Science, Open Science taxonomy, Standardized terminology, Thesaurus construction

INTRODUCTION

In recent years, Open Science has gained significant popularity. While debates continue regarding the precise definition of the term Open Science, there is consensus on the fundamental concept of openness and transparency inherent to Open Science. According to Bartling and Friesike (2014), open science refers to a scientific culture that is characterized by its openness in which scientists share results almost immediately and with a very wide audience. Open science broadly refers to the sharing of resources, ideas, and other outputs from research with an emphasis in making resources publicly and freely available (Zarghani et al. 2023). The purpose of making resources available and accessible by the public is to make full utilization of the resources towards maximizing the usage of it. Zarghani et al. (2023) further emphasize that open science promotes greater openness, accessibility, global collaboration, transparency, and integration in scientific endeavors. The UNESCO Recommendation on Open Science (UNESCO 2021) establishes a global framework for open science policies and practices, recognizing the diversity of open science perspectives across disciplines and regions. It presents an internationally agreed definition, a set of shared values and guiding principles. Furthermore, it outlines a set of actions aimed at promoting fair and equitable implementation of open science at all levels. Prior to its adoption in 2021, there was no universally accepted definition of open science, with standards often existing only at regional, national, or institutional levels.

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As Open Science continues to evolve and integrate into various research cultures, many terms have emerged and become dispersed across numerous platforms worldwide. Several Open Science thesauruses have been found on the Internet created by different organizations. One notable example was the one developed by the Institut de l'Information Scientifique et Technique (Inist), Centre national de la recherche scientifique (CNRS) and published on Linked Open Terminology Resources (Loterre) website. Loterre serves as a platform for exposing and sharing multilingual and multidisciplinary scientific terminology, covering diverse fields such as Humanities & Social Sciences, Geography, Physics, Chemistry, Engineering & System Sciences, Health Sciences, Life Sciences, Earth & Universe, and Taxonomies. This particular thesaurus is available in English, Spanish, and French. Loterre Open Science Thesaurus is a multilayered, multilingual thesaurus structure that is the central concept of Open Science. It was initiated on the premise of existing glossaries and taxonomies proposed within the FOSTER project framework. The thesaurus was constructed in March 2021 and has since undergone several updates. The subsequent updates occurred in June 2021 (36 terms), July 2021 (59 terms), February 2022 (17 terms), March 2022 (2 terms), December 2022 (6 terms), and the latest update was in March 2023 (24 terms) (Loterre 2023). These changes involved the addition of new terms, removal of terms, and adjustments to the term hierarchy. As of July 2023, the total number of terminologies (excluding duplicate terms) reached 486.

This paper serves as a descriptive account of an academic work in constructing the Open Science Thesaurus. It outlines the steps taken, the methods employed, and the sources consulted to compile a comprehensive list of 250 terms related to Open Science. The objective of this paper is to provide a detailed description of the process and methodology used in creating the thesaurus. The Open Science Thesaurus represents a capstone project

for a Masters in Library & Information Science (MLIS) program, specifically within the context of a course titled "Indexing, Abstracting and Thesaurus Construction". This project serves as a culmination of the students' academic journey, demonstrating their proficiency in the construction of a thesaurus tailored to the field of Open Science. Through this descriptive approach, this paper aims to contribute to the field by offering insights into the construction of a valuable resource for effective communication within the open science community.

METHODS

The same methods employed by Ogg et al.'s (1994) in developing their medical informatics thesaurus were adopted. These methods, as outlined by Lancaster (1972, as cited in Ogg et al. 1994), encompass four key approaches to the construction of a thesaurus:

1. Generate terms systematically based on indexing a representative set of documents.
2. Convert an existing term.
3. Extract the terms from existing, more general thesaurus or develop a specialized thesaurus within the framework of the general one.
4. Collect terms from diverse sources including authorized platforms, publications, related projects, or initiatives.

During the preliminary search on the concept of Open Science, diverse online platforms were encountered that presented distinct elements and related terminology. To initiate the exploration, the FOSTER (Facilitate Open Science Training for European Research) Open Science Taxonomy depicted in Figure 1 was consulted, providing a visual presentation of the areas encompassed within Open Science. However, it is important to note that due to the ongoing expansion of Open Science, there may be additional topics and terms not yet included in this taxonomy.

In the development of this thesaurus, the principles of literary warrant and user warrant were recognized and utilized. Literary warrant involved extracting terms generally used in the literature pertaining to Open Science. On the other hand, user warrant entailed selecting terms based on potential keywords or terms commonly used by users. The inclusion of both literary and user warrant was crucial to ensure the incorporation of relevant terms in the Open Science Thesaurus, ultimately serving the purpose effectively.

In addition, a structural warrant was employed, which involved selecting terms based on the structure and scope of the controlled vocabulary. To assist with this process, the FOSTER Open Science Taxonomy (Figure 1) was utilized as a starting point. This taxonomy provided a foundation for exploring a diverse range of topics related to Open Science by navigating through various associated terms (Pontika et al. 2015). The search for terms was expanded by exploring additional available sources.

The search process involved exploring multiple sources available on the Web. Published documents by authoritative organizations such as UNESCO, which provides comprehensive guidelines on Open Science, International Science Council, as well as resources from European Open Science Cloud (EOSC), PLOS on Open Science, Malaysia Open Science Platform and a few others were referred to . Additionally, selected articles that address the topics of Open Science and its sub-topics such as open access, open data, open educational resources, open metrics and citizen science were delved into. To gauge the extent of research in this area, Scopus database was examined to identify the number of articles specifically related to the keyword "Open Science" published in the year 2023 (the search was conducted in early June 2023). The results were remarkable, revealing nearly 1000. However, upon reviewing the abstracts, it was found that only 100s of the listed articles were directly relevant to the topic of open science.
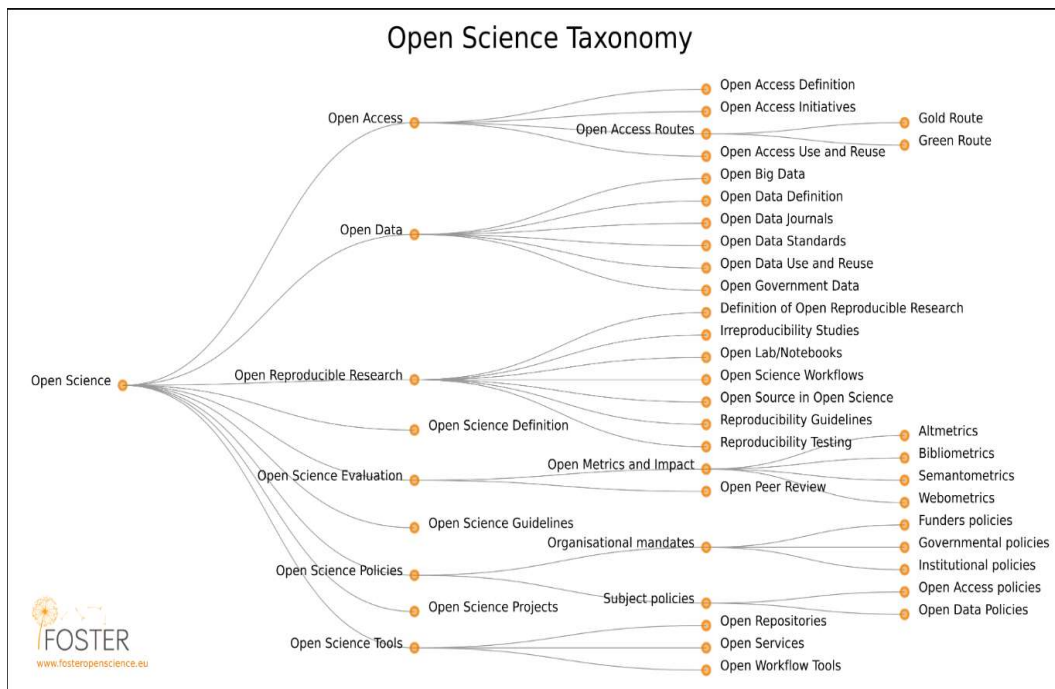
Figure 1: FOSTER Open Science Taxonomy

Throughout the search process, considerable effort was dedicated to consulting approximately 60 distinct resources, comprising web resources, policy documents and guidelines, and journal articles. The utilization of these resources enabled the enhancement of the inclusiveness and representativeness of the Open Science Thesaurus. The aim was to compile an all-encompassing list of 250 terms or descriptors associated with Open Science. Each term was categorized under specific subtopics of Open Science, guided by the authors' understanding and extensive reading of the referenced resources. Additionally, a hierarchical tree structure was constructed to facilitate and illustrate the relationships between the various terms, to show how different terms relate to and interact with one another in the context of Open Science. The identified descriptors were then meticulously organized

alphabetically to eliminate any duplication, and established the relationship (equivalent, hierarchical and associative) between preferred and non-preferred terms. Definitions or explanations for terms, and scope notes are provided for necessary to clarify the intended usage and boundaries of terms. The thesaurus was then reviewed by the course instructor to ensure accuracy and usability. Based on the feedback received, the thesaurus was carefully revised and refined.

RESULTS

Based on the methods and steps outlined previously, a hierarchical structure known as 'Hierarchical Tree Structure for Open Science Thesaurus (Figure 2) was created. Microsoft Visio in Microsoft 365 office suite was used to construct the tree diagram. Beginning with the main topic of Open Science, the process of categorization into several sup-topics was undertaken including Open Access; Open Data; Open Educational Resources (OER); Open Engagement; Open Innovation; Open Research; Open Science Evaluation; Open Science Infrastructure; Open Science Governance; Open Science Concept; Open Science Initiatives; Open Sources; Open License; and Open Science Policies. These 14 main topics are represented by blue boxes in Figure 2.
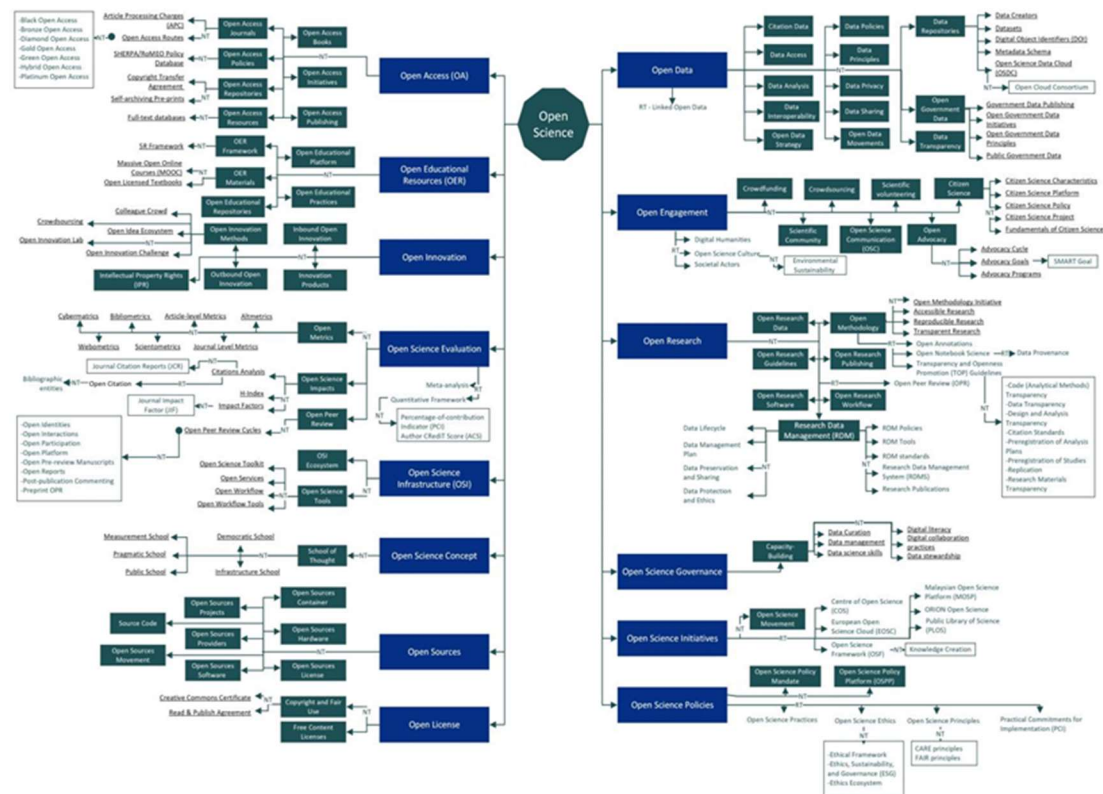
Figure 2: Hierarchical Tree Structure for Open Science Thesaurus

Each main topic is further expanded with narrow terms (NT) indicated by green boxes. The arrows in Figure 2 include labels denoting whether they represent narrow terms (NT) or related terms (RT). In the hierarchical tree, it is important to note that not all NTs and RTs are listed, because including all terms in the diagram could potentially lead to confusion and clutter. Therefore, only selected terms are represented in Figure 2. It is worth mentioning that while the terms depicted in the tree structure may not reach 250, the comprehensive thesaurus list does encompass the overall quantity of terms as initially specified.

For the thesaurus construction, a labeling system was implemented to enhance organization and comprehension. Each page displays a header label with specific abbreviations: 'UF' indicates "Use For," 'USE' signifies that a term should be used with another term listed, 'RT' represents "Related Term," 'BT' denotes "Broader Term," 'NT' stands for "Narrow Term," and 'SN' refers to "Scope Note." The scope note provides explanations or lists examples related to the terms that exemplify instance descriptors within its content (such as Git-Hub, Zenodo, OpenAire and Figshare under Open Science Providers).

To ensure clarity and ease of use, all terms are arranged alphabetically and grouped according to their main topic, subtopics, and further subcategories. This arrangement is determined based on literary warrant, user warrant, and the authors' understanding derived from thorough readings of the referenced sources. Only nouns have been selected for inclusion in this thesaurus. Instance relationships are also included showing relationships between a general category of things and events expressed by a common noun, and an individual instance of that category forming a class represented by a proper name (for example ORION Open Science).

The thesaurus consists of 250 terms or descriptors, organized across 21 pages, showcasing a straightforward hierarchical arrangement. This structure effectively demonstrates the interconnections among various terms associated with the Open Science concept. For instance, descriptors like 'citizen science', 'open access', and 'open science' are presented along with their corresponding broader and narrower terms. Examples of the descriptors display can be seen in Figure 3 and Figure 4.

OPEN SCIENCE THESAURUS

UF – Use For	USE - Use	RT – Related Terms	BT – Broader Terms	NT – Narrower Terms	SN – Scope Notes

CARE principle
SN   This principle an acronym for Collective Benefit, Authority to Control, Responsibility, Ethics
Centre of Open Science (COS)
RT   Open Science Initiatives
Citation Analysis
BT   Open Science Impacts
NT   Journal Citation Reports (JCR)
Citation Data
BT   Open Data
Citation Standards
BT   Transparency and Openness Promotion (TOP) Guidelines
Citizen Science
UF   Scientific Citizenship
RT   Citizen Scientists
BT   Open Engagement
NT   Citizen Science Characteristics
       Citizen Science Platforms
       Citizen Science Policies
       Citizen Science Projects
       Fundamentals of Citizen Science
Citizen Science Characteristics
BT   Citizen Science
Citizen Science Platforms
BT   Citizen Science
SN   Includes any platform initiatives of Citizen Science Projects such as PLOS, National Geographic Society, NASA Citizen Science, UNESCO, etc.
Citizen Science Policies
BT   Citizen Science
Citizen Science Projects
BT   Citizen Science
Citizen Scientists
RT   Citizen Science
Code (Analytical Methods) Transparency
BT   Transparency and Openness Promotion (TOP) Guidelines
Colleague Crowds
BT   Open Innovation Methods
Community Review
USE   Open Participation
Copyright and Fair Use
RT   Intellectual Property Rights (IPR)
       Open Access Policies
BT   Open License

Open Access (OA)
RT   Knowledge Dissemination
       Open Educational Resources (OER)
       Open Science Evaluation
       Scholarly Communications
BT   Open Science
NT   Open Access Books
       Open Access Journals
       Open Access Initiatives
       Open Access Policies
       Open Access Publishing
       Open Access Repositories
       Open Access Resources
Open Access Books
RT   Directory of Open Access Books (DOAB)
       Scholarly Communications
BT   Open Access (OA)
Open Access Initiatives
RT   Directory of Open Access Journals (DOAJ)
       Public Library of Science (PLOS)
       Open Science Framework (OSF)
BT   Open Access (OA)
SN   Includes any open access initiatives such as Budapest Open Access Initiative, Bethesda Statement on Open Access Publishing and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities.
Open Access Journals
RT   Copyright and Fair Use
       Open Journal Systems (OJS)
BT   Open Access (OA)
NT   Article Processing Charges (APC)
       Open Access Routes
Open Access Policies
RT   Copyright and Fair Use
       Open Access Publishing
BT   Open Access (OA)
NT   SHERPA/RoMEO Policy Database
Open Access Publishing
RT   Article Processing Charges (APC)
       Journal Publications
       Scholarly Communications
BT   Open Access (OA)
Open Access Repositories
RT   Institutional Repositories

Figure 3: Example of Pages from the Open Science Thesaurus

OPEN SCIENCE THESAURUS

UF – Use For	USE - Use	RT – Related Terms	BT – Broader Terms	NT – Narrower Terms	SN – Scope Notes

Open Science
UF   Open Knowledge
       Open Scholarship
       Open Scientific Knowledge
RT   Sustainable Development Goals (SDG)
NT   Open Access (OA)
       Open Data
       Open Educational Resources (OER)
       Open Engagement
       Open Innovation
       Open Research
       Open Science Evaluation
       Open Science Governance
       Open Science Infrastructure (OSI)
       Open Science Initiatives
       Open Science Concept
       Open Science Policies
       Open Sources
Open Science Cloud
USE   Open Science Data Cloud (OSDC)
Open Science Communication (OSC)
RT   Online Communication
       Scholarly Communication
BT   Open Engagement
SN   Includes all channel communication available for Open Science matters such as Social Network Sites (SNS)
Open Science Concepts
BT   Open Science
NT   School of Thought
Open Science Culture
RT   Ethics Ecosystem
       Open Engagement
NT   Environmental Sustainability
Open Science Data Cloud (OSDC)
UF   Open Science Cloud
BT   Data Repositories
NT   Open Cloud Consortium
SN   Includes any cloud platform for open data or open source such as Open Cloud Testbed
Open Science Ethics
RT   Research Data Management (RDM)
BT   Open Science Policies
NT   Ethical Framework
       Ethics, Sustainability, and Governance (ESG)

Figure 4: Another Example of Page from the Open Science Thesaurus

DISCUSSION

The present paper focused on the construction of the Open Science Thesaurus as a means to address the lack of standardized vocabulary in the field of LIS related to Open Science. The discussion section will delve into the significance of the Open Science Thesaurus, its potential applications, and its implications for promoting effective communication within the Open Science community.

The construction of the Open Science Thesaurus involved several key steps that were meticulously executed. First, the Open Science Taxonomy developed by FOSTER was employed to identify the core concepts and usable descriptors for the thesaurus. This taxonomy served as a foundational framework for organizing and categorizing the terminologies associated with open science. Pontika et al. (2015) also specified the Open Science concept with the use of FOSTER taxonomy. By leveraging the existing taxonomy, the thesaurus was able to capture the essence of open science and provide a comprehensive vocabulary for indexing and retrieving related information.

Furthermore, an analysis of existing terminologies within the domain of Open Science was conducted. This analysis aimed to identify commonalities, gaps, and inconsistencies in the literature, policies, and guidelines pertaining to this domain. This step was crucial in ensuring that the Open Science Thesaurus encompassed a wide range of terms and adequately addressed the terminological challenges faced by researchers, librarians, and other stakeholders in the open science community.

The compilation of a comprehensive list of 250 terms related to Open Science was another integral component of constructing the Open Science Thesaurus. This extensive list was carefully selected to cover various aspects and comprehensive concepts of Open Science, including data sharing, collaboration, reproducibility, open source, open data, open educational resources, open peer review among others, and not merely open access publishing (Chakravorty et al. 2022). Chakaravoty (2022) stated that Open Science and "Open Access" should not be treated as interchangeable terms, although Open Access does play a vital role within the broader framework of the Open Science initiative. The inclusion of such a diverse range of terms enhances the usability and relevance of the thesaurus, making it a valuable resource for researchers and practitioners in the field.

Manually establishing preferential, hierarchical, associative, and other relationships between descriptors within the thesaurus was a critical step in facilitating effective information retrieval and communication. These relationships provide a structured framework for navigating the terminology associated with open science, enabling users to explore related concepts and discover relevant resources. Such relationships also contribute to the organization and accessibility of information, thereby promoting knowledge dissemination and collaboration within the open science community.

The Open Science Thesaurus may hold significant importance for the field of LIS and the Open Science community as a whole. Grubb and Easterbrook (2011) reported a lack of consensus

on several concepts that are central to transparency advocacy initiatives (such as open science, computational provenance, and reproducible research) aimed at making science and scientific artifacts accessible to a wider audience. By providing a standardized vocabulary, the thesaurus promotes a common understanding of open science concepts and facilitates effective communication among researchers, librarians, and other stakeholders. The lack of standardized terminology has been a persistent challenge in the domain of open science, hindering interdisciplinary collaboration and impeding the sharing of research output across geographic boundaries. The Open Science Thesaurus may address this challenge by establishing a shared language, enabling researchers to articulate and discuss Open Science ideas more effectively.

Moreover, the Open Science Thesaurus has practical implications for various stakeholders. For researchers, it serves as a valuable tool for conducting literature searches, enhancing discoverability of relevant resources, and promoting interdisciplinary research. Librarians who do not have the time to create this tool can utilize the thesaurus for indexing and organizing open science materials, thus improving the accessibility and retrieval of information. Policy makers and funding agencies can benefit from the thesaurus by gaining a better understanding of open science terminology and using it to inform policy development and decision-making processes. Beyond this, it belongs to any research organization that needs to index the Open Science concept.

As the Open Science field is still continuously updating in the current era, the terminologies will continue to be created and outdated; the thesaurus is still open for updating to the up-to-date terminologies. In addition to the construction of the Open Science Thesaurus in the English language, there is a potential opportunity to expand the thesaurus to include other languages (such as in the case of Loterre (2023)), such as Malay. Creating a thesaurus in Malay language would have several advantages and implications for the Malaysia research community.

CONCLUSIONS

In conclusion, the construction of the Open Science Thesaurus represents a significant contribution to the field of LIS and the open science community. By addressing the lack of standardized vocabulary, the thesaurus promotes effective communication, collaboration, and knowledge sharing within the open science community. By constructing well-structured Open Science Thesaurus, it can offer better knowledge sharing and standardize terms. The comprehensive list of terms, the establishment of relationships between descriptors, and the utilization of the Open Science Taxonomy all contribute to the usability and relevance of the thesaurus. Moving forward, further research and refinement of the thesaurus should be undertaken to ensure its continuous relevance and utility in an evolving open science landscape.

This thesaurus was developed with 250 terms as an output of a Masters in Library & Information Science course on Indexing, Abstracting and Thesaurus Construction. One of the limitations of the Open Science Thesaurus, being a project within a Master's program, is the constraint of time. As a result, the development and scope of the thesaurus may be influenced by the limited duration of the project assignment i.e., seven weeks. Due to time constraints, it might not be feasible to provide an exhaustive list of terms or delve into every aspect of Open Science in a comprehensive manner. It is recognized that despite the efforts, the sources selected might not cover the entirety of terms related to Open Science. Nevertheless, this compilation is viewed as a significant starting point for charting an expanding array of terms that continue to emerge as time progresses.

Another limitation of the Open Science Thesaurus, as a Master's program project, is the potential lack of expert consultation in the field. While the lecturer teaching the course may have expertise and experience in Open Science, the absence of additional expert input could restrict the thoroughness and accuracy of the thesaurus. Expert consultation plays a crucial role in ensuring that the terminology and relationships captured in the thesaurus align with current practices and understandings within the field of Open Science. Furthermore, engaging with reliable and trustworthy resources, such as authoritative organizations and reputable scholarly publications, would enhance the credibility and reliability of the thesaurus.

Nevertheless, the involvement with this course has led to the development of a deeper grasp of the fundamental principles that underlie Open Science. The process of constructing thesauri, which has involved reading and retrieving information, has enabled the authors to achieve a more comprehensive understanding of the subtleties within the domain of open science. It is important to acknowledge that Open Science is a rapidly developing field, and therefore, the thesaurus should be periodically updated and expanded to accommodate new terms and evolving aspects. By continuously incorporating expert consultation, utilizing reliable sources, and allowing for ongoing updates, the Open Science Thesaurus can maintain its relevance and usefulness as the discipline continues to grow and evolve over time.

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Criteria for Inclusion in Directory of Open Access Journals: A Case of Malaysian Journals

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ABSTRACT

Since the release of the Budapest Open Access Initiative (BOAI) in 2002, open access has been developing for more than 20 years. As a distinct and comprehensive index of various open access journals from around the globe, the Directory of Open Access Journals (DOAJ) plays an important role in the global open access infrastructure. It is supported by an active community that is dedicated to making sure that everyone can freely access high-quality content. The DOAJ standards have emerged as the industry standard for open access publishing. While the number of indexed journals in DOAJ throughout Asia continues to grow rapidly, the number of open access journals that are indexed in DOAJ in Malaysia is relatively small, which means many editors of Malaysian journals are not very clear about DOAJ and its criteria for inclusion. This paper gives an overview of the DOAJ's history in the beginning. Next it focuses primarily on the applications and inclusion status of DOAJ in Southeast Asia, particularly for Malaysia as well as the global usage statistics of DOAJ. After the brief introduction, a set of DOAJ basic criteria newly updated in April 2023 regarding open access compliance, copyright & licensing, editorial, and business model are explained in detail. Meanwhile, the most frequently occurring questions during the application process of Malaysian journals are revealed and discussed in order to assist open access journals in Malaysia in better understanding the questions included in the application form.

Keywords: Open Access, Directory of Open Access Journals (DOAJ), Inclusion Criteria, Malaysian Journals

INTRODUCTION

The Directory of Open Access Journals (DOAJ) is one of the most internationally recognized open access journal databases with clear selection criteria and strict quality control measures.Journals included in DOAJ are considered to have high academic value. DOAJ is not limited by discipline, region, or language, and covers science and technology, medicine, social sciences, arts and humanities and other fields, with a wide range of coverage and journal diversity, which truly reflects the situation of open access journals worldwide. To date, the inclusion criteria for the DOAJ database have become an unofficial gold standard for evaluating open access journals.

DOAJ HISTORY

In December 2001, the Open Society Institute (OSI) convened an international symposium on open access in Budapest, Hungary, where they drafted and published the Budapest Open Access Initiative (BOAI). This initiative advocates for the development of open access on a global scale and promotes the use of the Internet for scientific exchange and the free dissemination of academic achievements. Following BOAI's publication, the idea of a directory of pure open access journals was proposed at the 2002 Nordic Conference on Scholarly Communication in Sweden. Lars Bjørnshauge, Head Librarian from Lund university at the time, undertook this task. DOAJ was subsequently founded on 12th of May 2003, with around 300 open access journals at the start (DOAJ, 2023). Lund University operated DOAJ until January 2013, when it was taken over by the Infrastructure Services for Open Access C.I.C (IS4OA) and has been in operation ever since. IS4OA is a community interest company registered in the UK with a branch in Denmark. As a non-profit community interest organization, DOAJ relies entirely on voluntary contributions from its supporters and is committed to being 100% independent, maintaining all of its major services and metadata for everyone, free of charge.

DOAJ has an advisory board and council whose members voluntarily perform their duties. Meanwhile, DOAJ is also supported by more than 100 voluntary editorial staff worldwide, and the volunteers provided 2500 hours of editorial effort in 2021 (DOAJ, 2023). Asides, DOAJ has 21 active ambassadors, who work with communities around the world. Ambassadors promote open access and best practices in their respective regions and help journal editors realize the value of standards in open access publishing; they boost DOAJ's profile and make the journals more appealing places to publish research.

DOAJ IN NUMBERS

By September 2023, DOAJ has included almost 20,000 open access journals, more than 13,000 of which do not charge any article processing fees (APCs), from 130 countries and covering 86 different languages, making it the largest open access journal database all around the world. In 2022, the number of total visits on DOAJ website is 11.5 million, and there will be 3.3 million visits during the period of January to September 2023. As of August 4, 2023, the top ten countries that visit DOAJ website most as shown in the following Table 1.

Table 1: Top 10 Countries Visited DOAJ Website Most

Country	Total visits
United States	2.1 million
Indonesia	1 million
United Kingdom	683k
China	682k
India	591k
Canada	398k
Philippines	387k
Australia	253k
Germany	245k
Mexico	216k

The official statistics from DOAJ demonstrate, in 2022, the number of applications that DOAJ

received from China was 127 and there were 73 journals were successfully indexed, which means acceptance rate is higher than 50%. Meanwhile, Table 2 shows the number of applications and the number of indexed journals in Southeast Asia in 2022. Among them, Indonesia has become the largest group of journals in the DOAJ platform. This is mainly due to the initiation of the DOAJ's Ambassador program from 2016 which aims to raise open access awareness and best publishing practice in regions that lack knowledge about DOAJ or open access publishing. So far the ambassador program covers 17 different countries and regions. The dramatic increase in DOAJ indexed open access journals from some countries such as China and Indonesia can be seen as the success of ambassador work (DOAJ, 2023). Besides, in recent years, an open access model that does not rely on APCs or subscription fees has emerged since the majority of Indonesian journals are anchored in universities and rely on institutional funding (Irawan et al., 2021). However, as shown in Table 2, the acceptance rate in Southeast Asia is generally only around 20%, which means there is an urgent need to control the journal quality in a stricter manner and clearly list the journal policies required.

Table 2: Journals Applications and Inclusion in Southeast Asia in 2022

Country	Number of Applications	Number of Indexed Journals
Indonesia	1979	361
Malaysia	64	8
Philippines	39	7
Singapore	36	9
Thailand	17	3
Viet Nam	11	3
Brunei	2	1
Cambodia	0	0
East Timor	0	0
Laos	0	0
Myanmar	0	0
In total	**2148**	**392**

As of the end of 2022, there are 93 Malaysian journals included in DOAJ. To clearly understand the overview of open access publishing in Malaysia, among them, this paper lists different journal parameters in statistics from the perspectives of subjects, languages, publication fees, copyrights, and DOAJ seals as Table 3 demonstrated.

Table 3: An Overview of 93 Malaysian Journals

Parameter	Number
Subject Classifications	16
Publication Languages	3（English, Malay-Macrolanguage, Arabic）
Without Fees	73
Authors Retains All Rights	40
With DOAJ Seal	0

DOAJ uses the Library Congress Classification system which currently contains 20 main subjects and 529 sub-subjects in the database. This paper only looked at the journal's distribution across main subjects. As Figure 1 shows, Malaysian journals cover 16 main subjects, with only four main subjects (i.e. History America, Military Science, Music and books on Music and Naval Science) still blank. Simultaneously, the volume of the open access journals included in DOAJ in the field of Auxiliary sciences of history, Bibliography, Library science, Information resource, Fine Arts and History (General) and history of Europe still stay relatively low level. This indicates an unbalanced development of open access in different disciplines.
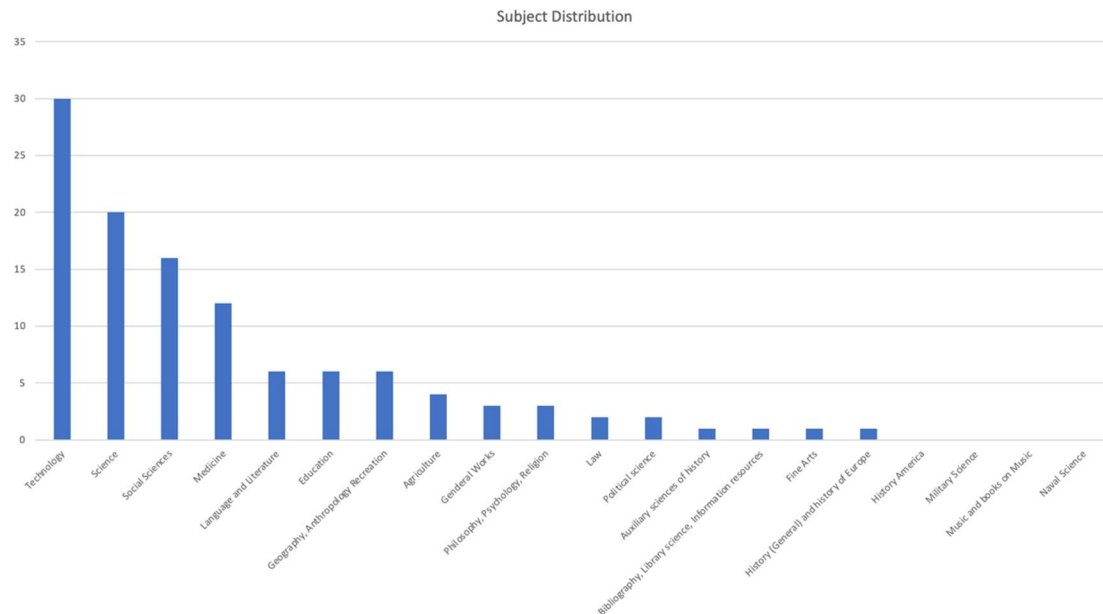
Figure 1: Subject Distribution among 93 Malaysian Journals

Considering the very small portion of open access journals in the Bibliography, Library science, Information resources category included in DOAJ, this paper further analyzes the inclusion of journals in this field by September 2023. The results show that there are 193 journals worldwide included in DOAJ, of which 176 journals are free of charge, 142 journal authors retain all rights, and 16 journals obtain the DOAJ seal. Besides, publishers' countries refer to the country or region where the journal publisher is located. Under this category, the largest number of publishers come from the United States (30), followed by Brazil (22) and then

Indonesia (14). However, only two publishers are from China and one publisher from Malaysia. The title of this Malaysian journal is Acta Informatica Malaysia, which has been indexed with DOAJ since 2018. Additionally, DOAJ accept journals of any publication languages, so the journals and their articles in different languages coexists on the DOAJ website, but English is still the dominant language, accounting for about 76.7% (148) The literature in Spanish (38), Portuguese (34), French (12) and Indonesian (12) is also relatively large. Some journals are published in more than one language. Furthermore, CC BY is the most commonly used license (86, accounting for around 45%), followed by CC BY-NC (37) and CC BY-NC-ND (35). And only two journals adopt the publisher's own license. In addition, one hundred and six journals employ double anonymous peer review, occupying around 65%.

According to Figure 2, the number of journals in the Bibliography, Library Science, Information Resources Category included in DOAJ shows an overall upward trend during the period from 2003 to 2022. The number of journals included reached the bottom in 2004 and 2014, but 2017 witnessed the peak, with 29 journals in this area being included by DOAJ.
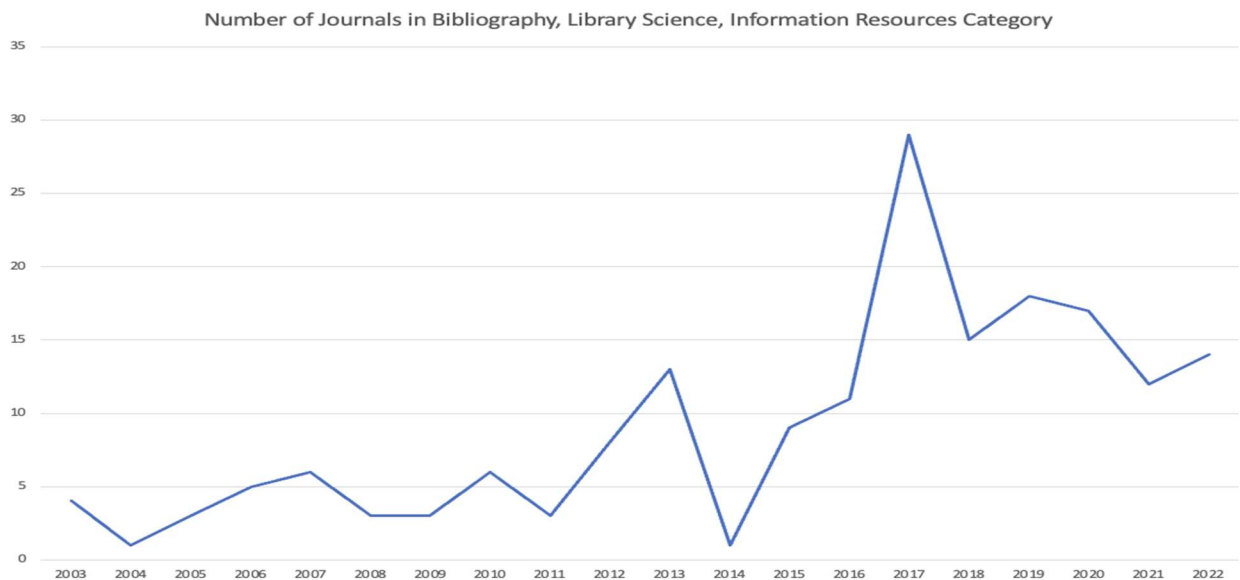
Figure 2: 2003-2022 Trends in the Number of Journals in Bibliography, Library Science, Information Resources Category

DOAJ BASIC CRITERIA
High standards for journal inclusion have earned DOAJ recognition on a global scale. The well-known database Scopus introduced the open access indicator, if a journal is listed in the DOAJ, it would be marked an open access journal in Scopus (Susanne & Ian, 2015). In September 2022, the Committee on Publication Ethics, the DOAJ, the Open Access Scholarly Publishers Association, and the World Association of Medical Editors jointly published the latest principles of transparency and best practice in scholarly publishing, which was originally issued in 2013 (DOAJ, 2023). These concepts were mostly taken from the DOAJ journal inclusion standards (Olijhoek et al., 2015).

Based on the application form, DOAJ published a guide to applying on its official website, which can assist applicants in understanding how to answer the questions on the application form. It has been translated into 12 languages. There are four versions of this guide, and since 2021, they have each been updated annually, as indicated by the updated dates for each edition in Table 4. The most recent revision was made by DOAJ in April 2023. It shows the inclusion criteria are dynamic and can adapt to the maturing open access field.

Table 4: Changes for the Guide to Applying

Version	Changes	Updated time
1.3	The following points received more clarification: endogeny, displaying journal rankings, information about author charges and reviewers, flipped journals and journals/publishers with multiple exclusions.	April 2023
1.2	Additional copyright and licensing details were transferred to a separate page.	February 2022
1.1	A clarification to the endogeny criterion was added.	December 2021

The new DOAJ criteria, as presented in the application form, are divided into 6 sections: (1) open access compliance, (2) about (basic journal information), (3) copyright & licensing, (4) editorial, (5) business model, and (6) best practice. Each section is made up of several questions, in order to make sure provided information is accurate, some questions require applicants to offer a related journal webpage's link. Among all the questions required to be answered in the application form, they typically fall into three categories: general inquiries for data collection, minimal requirements for DOAJ inclusion, and recommendations of best practices.

Open Access Compliance
Only fully open access journals can be indexed by DOAJ. As we know, there are lots of definitions and several types of open access. "Open Access" is used to refer to both gratis and libre open access (DOAJ, 2023), however, DOAJ accepts a form of libre open access which requires not only that digital content is freely accessible online but also user rights and copyright ownership need to be clear. For applicants, the DOAJ definition of open access must be met, and an open access statement on the journal website is needed to confirm this.

About (Basic Journal Information)
The second section aims to collect general journal information, like title, website, publisher, ISSN, subject, sponsor, and publishing language. The journal's information is required to be consistent with registration information in the ISSN center; applicants can check its ISSN record by using the ISSN portal. For non-English journals, the translated titles can be added as an alternative title. The quality of a journal website is also important, applicants should pay attention to the accessibility of the journal website. For example, the following information must be easily accessible from the journal homepage: open access policy, aims and scope, editorial board, instructions for authors, editorial process, licensing and copyright terms, contact details and author charges. Furthermore, an own dedicated URL and a homepage for the journal are necessary, each full text article must have at least one distinct URL and be in

PDF or HTML format. Journals are permitted to show the Scopus metrics and the Clarivate-calculated Journal Impact Factor, although DOAJ does not endorse the use of Impact Factors or ranking metrics. It is not necessary for the website to be in English. If the website is available in different languages, the information must be consistent in all languages

Copyright & Licensing
Journals are required to utilize some type of licensing because it grants official authority to use the contents of articles. For authors to select the license that is most appropriate for their paper, journals must provide at least one type of license. The DOAJ advises using Creative Commons licenses to specify to applicants how published work may be used. Although six of the nine options on the application form for the question of license are Creative Commons licenses, DOAJ has no preference for which license should be applied. Since the Creative Commons license is one of multiple public copyright licenses, its conditions cannot be amended, hence it is prohibited from placing limitations on authors or users that conflict with the license's requirements. If the Creative Commons license cannot meet the needs of the journal, the journal can choose CC0, public domain, and publisher's own license.

Journal must state the ownership of journal and published contents. Generally, the original copyright of a paper is owned by the authors. Once the article is published, the copyright may be retained by the authors or passed to the publisher. DOAJ suggests that journals let authors retain full, unrestricted ownership of their publications' copyright, and authors provide the publisher other non-exclusive publishing rights as well as the first right of publication. However, it is acceptable for DOAJ inclusion if the journal requires authors to transfer the paper's copyright to the publisher. In some cases, restrictions may occasionally be imposed by the publisher even when the author retains copyright, for example, an exclusive license is required by the publisher, this indicates that the author no longer has unrestricted copyright. It should be noted that copyright terms cannot conflict with the licensing statements or the open access policy. In relation to open access content, the phrase "all rights reserved" is never suitable. In addition, since "fair use" does not equate to open access, DOAJ does not accept journals that include these limitations.

Editorial
For the journal's quality control process, editors and an editorial board are necessary. The names and affiliations of the editorial board members must be posted on the website. Editorial board members who all come from the same institutions are not recommended. Before being published, each article must go through a peer review process. The common types for peer review include editorial review, peer review, anonymous peer review, double anonymous peer review, post-publication peer review and open review. The journals without peer review would not be accepted by DOAJ and it is required that at least two independent reviewers should review each article. Editorial review is only accepted for arts and humanities journals and at least two editors must be involved in the editorial review process. The journal should clearly state its peer review type and process. The usage of a plagiarism checking service is not mandatory for DOAJ inclusion, even though the application form asks applicants whether they screen for plagiarism.

Business Model

The business model focuses on the costs that authors ought to pay when publishing their work, including article processing fees and any other costs to authors. There are some examples for additional expenses: editorial processing charges, language editing fees, color charges, submission fees, page charges, membership fees, and print subscription costs. A journal must make it clear if there are no fees or if there are applicable waiver policies, related statements should be easily found on the journal website.

Best Practice

The section of best practice includes archiving policy, repository policy, persistent article identifiers, ORCID iDs, and I4OC standards. For the archiving policy, long-term preservation services are mainly provided by CINES, CLOCKSS, LOCKSS, PKP PN Pubmed Central, Portico and national library. Repository policy must specify how the authors are allowed to deposit their papers in submitted, accepted, and published forms. For unique article identifiers, the article can be located anywhere by using a persistent article identifier (PID). The digital object identifier (DOI) is the most typical sort of PID. An alphanumeric code called an ORCID (Open Researcher and Contributor) iD is used to identify authors specifically. I4OC is a standard that requires citations to be organized, distinct, and open.

Some best practice questions are a part of DOAJ's seal criteria. Journals which exhibit best practices in open access publishing are awarded the DOAJ seal. The Seal has been given to about 10% of the DOAJ-indexed journals. It should be emphasized that journals can be included in the DOAJ without having to meet the Seal requirements, which means the journal can be accepted by DOAJ once it meets all the basic criteria.

FREQUENTLY OCCURRED ISSUES DURING THE APPLICATION PROCESS AMONG MALAYSIAN JOURNALS

Some high-frequency problems occurred during the application process among Malaysian journals, and these problems are significant to be good publishing practices as well as being beneficial to both journals and authors.

Most commonly, there are not very clear copyright policy and licensing policy found on journal websites. The related information is either missing or inconsistent on the website. Secondly, some conflicts between journals' copyright policy and open access policy have occurred. Journals state their open access policy on the website, but at the same time they state that "all rights reserved by the publisher" for their copyright policy, which is fundamentally incompatible with open access content. Furthermore, some contradictions exist between journals' copyright policy and licensing policy. For example, CC BY license has been adopted but authors have to transfer exclusive rights to the publisher once accepted for publishing; The publisher holds the copyright, and CC BY license has been stated, but the publisher does not allow the author to use it for commercial purpose. Similarly, The publisher holds the copyright, CC BY NC license has been stated, but the publisher does not allow the third party to use the adapted work. Obviously, for such a case, the license that journal adopted is not consistent with the statement of rights allowed for the users on the website;

The author retains the copyright under a CC-BY-NC license, but the publisher does not allow the author to use the work commercially. Under such context, the author, as the copyright owner, is not bound by the license; The license is intended to restrict publishers and other users from using the published content for commercial purposes; Besides, the author retains the copyright and the publisher holds the commercial rights, but there is no official statement on the website indicating that this right is transferred to the publisher. The rights granted by the author, the copyright owner, to the publisher should be specifically stated in the Copyright Transfer Agreement announced on the journal website.

It's also often seen that the ISSN provided by applicants cannot match up with the registration record from the ISSN center. Since a few years ago, DOAJ and the ISSN international center have had effective cooperation. Having a properly registered and validated ISSN is one of the first checks the editorial team makes when evaluating applications. For journals submitting to DOAJ, the ISSN is a starting point. The issue might be caused by the journal's failure to activate their ISSN numbers with the ISSN center. It's strongly suggested that the journal check the ISSN information through the ISSN portal before applying. Since 2021, journal landing pages in DOAJ include links to the entry for the journal in the ISSN Portal.

There are different models of open access publishing, for example, green open access, diamond open access, hybrid open access, and bronze open access. However, DOAJ does not accept all types of open access, only fully open access journals can be accepted by DOAJ. Lacking an open access policy should be avoided, and publishers should clearly state what they define as open access on the journal's website. Actually, the first question on the application form is to check whether the applicants comply with the DOAJ's open access definition.

Applicants are required to fill out website links for relevant information in some questions on the application form. Editors would check all the links to see if they were available and accurate. It was frequently observed that publishers didn't provide the correct links. This issue might be due to misunderstandings or a lack of knowledge about the application form's questions.

CONCLUSION

Open access publishing plays an active role in promoting academic exchange and knowledge dissemination. DOAJ is currently the most internationally recognized open access journal directory, and the journals included in DOAJ have undergone rigorous and prudent review. We can promote the rapid development of open access and information sharing by referring to DOAJ's selection criteria and inclusion rules, constantly improving the corresponding journal policies and services. Since DOAJ provides authoritative open access journals data and collection services of metadata, many libraries choose DOAJ as the primary data source of their literature service offered. Journals are included in DOAJ, which means that the quality and open access policies have reached international standards, and it is of great significance to enhance academic influence and increase the journal discoverability and visibility.

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Current Landscape of Open Educational Resources (OER) in Malaysian Academic Libraries

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ABSTRACT

Open Educational Resources (OER) are intrinsically related to developments in Open Science due to the broader implications of access to knowledge in education in global societies. Librarians' contribution to the OER movement begins with the emerging world of Open Data and Open Science. Still, their involvement in the OER projects has thus far been limited, as their involvement is more generally in managing learning materials. Therefore, this study was conducted to investigate the current landscape of OER initiated by Malaysian academic libraries. This study used a qualitative research design. A total of 16 e-mails were sent out to each higher institution under Malaysia iOER National Policy to participate in the semi-structured, recorded, and transcribed interviews to allow new viewpoints to emerge freely. The findings revealed that current involvement in supporting OER initiatives at Malaysian higher education institutions was demonstrated in creating OER Library Guides. The focus of OER library guide on their library websites was to advocate awareness for their library users in using, searching, and finding OER resources. Although academic librarians at higher education institutions are aware and interested in OER and open educational practices, there are several challenges that need to be overcome to achieve their potential roles. Three main challenges encountered by academic librarians in supporting OER at their institutions; Lack of training and capacity building focusing on OER; Librarian's advocacy in promoting OER; Low involvement and engagement between libraries and faculty members. The study's outcome will particularly propose a better opportunity for more fostered collaboration where libraries and information professionals have an essential role in expanding the range of OER movement in fostering open education. The implications would also be helpful to redesign LIS curriculum in making future continuing professional development (CPD) that will contribute to the success of OER adoption.

Keywords: Open Educational Resources, OER, Open Education, Distance Education, Digital Library

INTRODUCTION

Open Educational Resources (OER) are intrinsically related to developments in Open Science due to the wider implications of access to knowledge in education in global societies (Ramirez-Montoya 2020). The term Open Educational Resources (OER) encompasses learning, teaching and research materials in any format and medium that reside in the public

domain or are under the copyright that has been released under an open license that permits no-cost access, re-use, re-purpose, adaptation and redistribution by others (Wiley, Bliss, and McEwen 2014). A healthy volume of OER is increasingly made available and can be accessible by many students. However, disabled students who typically depend on particular applications or devices with accessibility features require the OER to have an inclusivity design to gain the same benefits. Unfortunately, educational content that is free to access is still limited in many disciplines, and many need to be designed for inclusivity.

Librarian's potential contribution to the OER movement also began with the emerging world of Open Data and Open Science. Still, their involvement in the OER projects has thus far been limited, as their involvement more generally in managing learning materials (Darling-Hammond et al. 2020). On the other hand, academic libraries emerged much stronger from the COVID-19 crisis, and they were able to provide value and demonstrate their worth to support OER initiatives for higher institutions who want to adopt and adapt. According to (Bond, Huddleston, and Sapp 2021), libraries and other change agents should maximize this opportunity to promote OER as a possible alternative learning material compared to traditional textbooks.

Academic libraries are committed to improving the dissemination of scholarly and educational content for their users, and with that aim in mind, they regularly create and organize collections of learning and quality teaching materials (Kimball et al. 2022; Baas et al. 2022; Pontika 2019). The widespread use of OER makes a significant difference in democratizing access to more high-quality open education. The adoption, expansion, and enculturation of OER with the aid of information and communication technology in higher education will transform educational practices through the effective use of educational resources available with open licenses (Todorinova and Wilkinson 2020).

Purpose/Aim

The study aimed to investigate the current landscape of OER in selected initiatives by Malaysian academic libraries. This paper will examine the following research questions:

RQ1: What is the library's involvement in the delivery of OER services at Malaysian higher education institutions?

RQ2: What challenges are encountered by academic librarians in supporting OER initiatives?

LITERATURE REVIEW

OER Initiatives from Malaysian Higher Institutions

The National Inclusive Open Educational Resources (iOER) Policy, established by the Ministry of Higher Education (MoHE) in 2021, responded to the need to ensure inclusive learning

opportunities that benefit all learners in Malaysia. This innovative policy is aligned with implementing the 2019 UNESCO Recommendation on OER adopted by UNESCO's General Conference at its 40th session. The Inclusive Open Educational Resources (iOER) has been produced as a national policy statement to provide direction in the design, development, and use of iOER. It drives to increase access and support quality teaching and learning in Malaysia's higher education under a creative commons license which involves content, activities and resources that fit and can be adapted to everyone's unique needs with no or minimal barriers (Soon Fook 2019). Since 2019, UNESCO has been proud to have worked closely in Malaysia with the Ministry of Higher Education, core experts and key stakeholders to develop policy guidelines and build capacity for more inclusive OER s development based on Universal Design for Learning (UDL) principles (Huang et al. 2020).

To achieve this, higher education institutions in Malaysia have embarked on the OER movement to harness the full potential of open access to educational content in supporting online and distance learning, especially essential during the current pandemic Covid19 outbreak (Ossiannilsson 2021). In presence, to leverage OER for enriching learning experiences, Malaysian Higher Institutions had initiated the OER platform through OER dedicated web presence, MOOC@institutions, MOOC@Open Learning, Micro-Credential Courses and Open Courseware (OCW) Platform (Nurul Diana Jasni , Noorhidawati Abdullah, and Yanti Idaya Aspura Mohd Khalid 2022).

Bhandigadi (2020) holds the view that the adoption, expansion, and enculturation of OER with the aid of information and communication technology in Malaysian education will transform educational practices through the effective use of educational resources available with open licenses. The establishment of the OER in Malaysia is still in its infancy, which leads to issues of discoverability, accessibility, and retrieval. Several higher education institutions in Malaysia have reported embarking on the OER movement. However, there is no common understanding of how OER should be developed through open licenses due to the lack of specific guidelines especially for the educators (Zainuddin et al. 2017). The situation indicates low involvement and engagement between libraries and faculty members, which stipulate a crucial need for libraries to be more engaged with educators in supporting OER development.

Embracing the Role of Academic Libraries in OER
Academic libraries and information professionals have experimented with a variety of approaches in providing information resources and research assistance to their users because the recent shift in technology has brought changes in the way students use academic libraries and library resources (Clemons and Schonfeld 2016; Carlson and Johnston 2015; Soehner, Steeves, and Ward 2010; Hussain, Mahmood, and Shafique 2008). As such, university libraries utilize the new digital technologies and emerging pedagogical practice blend and can deliver their services at different levels in different environmental settings.

Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and other tools, materials or techniques used to support access to knowledge (William and Foundation 2008). The open provision of educational resources, enabled by information and communication technologies, for consultation, use

and adaptation by a community of users for non-commercial purposes is seen as an excellent platform to ensure the effectiveness of teaching and learning processes (UNESCO 2007). However, as much as OER initiatives come with positive opportunities, there are also challenges encountered over the same. In discussing the matters of OER and academic libraries, educators indicate that more libraries involvement, advocacy, and capacity-building need to occur in higher institutions due to the lack of understanding of librarians in promoting OER in higher education was seen as the largest perceived barrier to OER adoption.

Libraries' involvement can support OER initiatives within access services, technical services, collections development, digital initiatives, or departmental liaisons — all of which intersect with OER in one way or another. However, most academic libraries generally do not link OER with their library resources or initiate digital educational resources due to a lack of understanding about their roles and their advocacy about OER in higher education. There has been little research on the role of academic libraries in supporting OER, and previous research found there is a lack of OER awareness involving libraries, and few have involved libraries in developing OER policies in higher education institutions. Collaborations between OER initiatives and libraries about the storage of OER and improving their discoverability are not yet widespread due to lack of access, engagement to OER Policy, OER project initiatives programs and practices for instruction.

Academic librarians have an important role and a professional responsibility to take the lead in supporting faculty and students in expanding the range of OER movement in higher education (Ahmed and Othman 2021; Thompson and Muir 2020). Librarians can serve as information specialists and other roles on OER development teams alongside faculty subject-matter experts, instructional designers/ technologists, and media developers. With these skills, academic libraries and librarians can serve as leaders and providers of critical components for implementing OER. The study's outcome will remarkably propose a better opportunity for more fostered collaboration where libraries and information professionals have an essential role in expanding the range of the OER movement in fostering open education. The implications would also be helpful for LIS schools to redesign their curriculum in making future continuing professional development (CPD) or capacity building on libraries roles towards OER adoption. As the new partnership emerges, the outcome will foster collaboration among libraries and various departments, producing best practices in fostering open education.

RESEARCH DESIGN

This study used a qualitative research design. Sixteen (16) invitation emails were sent to each higher institution under Malaysia iOER National Policy. They were invited to participate in the semi-structured, recorded, and transcribed interviews. Only (n=4) respondents from four different academic libraries agreed to participate in the interview sessions to gather data about their current involvement and services in supporting OER initiatives. The selected academic libraries include a wide range of dissemination and promotion of OER, such as OER library guide, OER library portal, infrastructure support for OER projects and the aggregation of OER repositories. The interview session was held from January 2023 until April 2023 using

Online Meeting Microsoft Teams and face to face. Data analysis is still ongoing. This study has sought to sketch out some ideas and report on a preliminary survey exploring the current practice of Malaysian academic libraries in supporting OER initiatives in this area. The findings presented here are preliminary and may be subject to minor revisions.

RESULTS

When conducting an interview study, gathering demographic information from participants is essential to provide context and analyze data effectively. Throughout the study, to maintain participant anonymity, all demographic information provided by participants was kept strictly confidential and only used for research purposes. This section includes the demographic data of the respondents. Most of the respondents had working experience of more than 10 years in academic libraries. The findings are significant in embracing the role of academic libraries in OER, especially in providing OER services at their higher institutions.

Table 1: Demographic Information

Informant Code	Institutions Code	Age / Length of Service	Gender	Category
AL01	U1	47 years / 19 years	Female	Librarian
AL02	U2	38 years / 12 years	Female	Librarian
AL03	U3	40 years / 14 years	Male	Head of Library Department
AL04	U4	53 years / 27 years	Female	Head of Library Department

RQ1: Library's involvement in the delivery of OER services at Malaysian higher education institutions

Academic libraries are also involved, especially in supporting OER at their respective higher institutions. Findings revealed that current involvement in supporting OER initiatives at Malaysian higher education institutions was elaborate in two criteria as in Table 1. Respondents share their current involvement and support and what their OER services are.

Table 2: Library Involvement & OER Services

Respondent	Current Involvement & Support	OER Services
AL01	OER Library Guide provides and assists their user where they can search for a particular type of OER collections: OER Repositories; Open textbook collections; Open journal collections; e-newspaper; Photo images; Video and film; Malaysian collections; Open learning courses; Presentation templates	Advocates and promotes OER during library briefings for new students and during information literacy skills classes.
AL02	OER Library Guide provides a general introduction to OER, Creative Commons Licensing, where to find OER and Evaluating OER	-Introduction to OER, definition of OER, -The 5Rs of OER, why use OER, video on OER
AL03	An online OER platform built by Library (that collects, stores, and disseminates all OER materials published by faculty/academicians. The platform allows OER upload, endorsement, and impact analytics as well. This initiative was a collaboration project with the academic center as libraries had been appointed as the administration team	- Develop, test, and maintain OER platform -Facilitate OER training modules preparation and web usage -Administrator and help desk for OER Portal
AL04	OER Index Page contains information about what are OER, OER useful links, OER Commons, Open Textbook Library, videos, and promoting educational resources on sustainable development)	Promoting SDG Academy (free MOOCs educational courses and videos) during library briefings for new students and Academic Language Learning Service (ALLS) sessions.

Findings revealed that current involvement in supporting OER initiatives at Malaysian higher education institutions was demonstrated in creating OER Library Guides. The focus of OER library guide on their library websites was to advocate awareness for their library users in using, searching, and finding OER resources. In addition, libraries provide access to the OER resources via Library portal to facilitate access. To encourage the use of OER, librarians promote and advocate the use of OER in information literacy classes, social media and via their research support services. However, the library's involvement can support more OER initiatives such as assistance finding high-quality OER, OER consultation, copyrighted learning resources, expertise in publishing, and existing relationships with campus departments (Katz 2020, 2019).

RQ2: Challenges encountered by academic librarians in supporting OER initiatives?
The findings of this study indicate that although academic librarians at higher education institutions are aware of and interested in OER and open educational practices, several challenges need to be overcome to achieve their potential roles.

Three main challenges emerged from the research was:
•   Lack of training and capacity building focusing on OER
•   Librarians' advocacy in promoting OER
•   Low involvement and engagement between libraries and faculty members

• Lack of training and capacity building focusing on *OER* and librarians

> *"… since my library started OER guides, for this time being didn't experience or get any proper formal trainings about OER yet…all was by our self-learning through various OER platforms."* *(L01, April 5, 2023, line22)*

> *"…can't find any trainings organized dedicatedly for librarians. But I had experience attend many workshops talking about Open Science…"(L04, April 5, 2023, line35)*

> *"…not only academic librarian, but LIS professionals from any organizations should also be aware about OER. Get involved and enhance collaboration with OER projects…" (L03, February 3, 2023, line20)*

An effective training program is essential to improve librarian skills in (OER) to enhance librarians' knowledge and engagement in this area, which will lead and motivate librarians to collaborate on more ideas, tools, and strategies for OER initiatives. In addition, when professionals engage in training programs, they can realize positive professional outcomes and attain a personal sense of accomplishment (Thornton 2021) that would create a positive and encouraging synergy within departments and help establish clear policies.

• Librarian's advocacy in promoting OER

"…during library briefing especially for new students or during library skills sessions librarians can spread the word about the existence of OER in the first place.." (L01, February 3, 2023, line28)

"…librarians can help to increase the awareness of OER with faculty liaisons so that they can be infused along in the faculty outreach program." (L03, February 3, 2023, line50)

"…In the future, we hope we can help them with our expertise such as copyright advisor, OER subject metadata or helping them in promoting OER contents…"(L02, February 3, 2023, line79)

From the above findings, librarians are already making efforts and are one step closer to encouraging the adoption and creation of open educational resources (OER) at their higher institutions. For example, academic libraries in Malaysia have initiated OER library guides and advocates about OER for their students during library skills and library briefing programs.

> *" … as an academic librarian I am aware of OER but yes.. until today at my institutions, there is still no library involvement between the faculty or lecturers on any OER initiatives.." (L03, February 3, 2023, line68)*

> *"…why not faculties or lecturers approach us or contact us? I'm willing to get involved.." (L04, March 5, line56)*

> *"… I don't get any info. No librarian in my organization has been involved or experienced so far with any OER projects. Librarian also need to have skill and knowledge to support OER…"(L01, February 3, 2023, line42)*

> *"…showing OER support is no an easy task. But still, I'm ready to offer my support in helping faculty to find and locate quality OER materials …"(L02, February 3, 2023, line 50)*

● **Low involvement and engagement between libraries and faculty members**

The situation indicates low involvement and engagement between libraries and faculty members, which stipulate a crucial need for libraries to be more engaged with educators in supporting OER development. The findings indicated that academic libraries must promote their librarian's expertise and competencies among faculty members and stakeholders, which led to librarians' contribution to the OER initiatives. From the above findings, librarians are already making efforts and are one step closer to encouraging the adoption and creation of open educational resources (OER) at their higher institutions. Still, a few academic libraries initiated OER library guides and advocates for OER during library skills and library briefing programs for their students.

The situation indicates low involvement and engagement between libraries and faculty members, which stipulate a crucial need for libraries to be more engaged with educators in supporting OER development. Academic libraries can collaborate to guide faculty in discovering, creating, disseminating, identifying, adopting, and assessing open and affordable course content (Sutton and Geuther 2020). The conclusions of this study indicate that academic libraries need to promote their librarian's expertise and competencies among faculty members and stakeholders, which led to librarians' contribution to the OER initiatives.

CONCLUSION

The widespread use of OER makes a significant difference in democratizing access to high-quality open education. Although academic librarians at higher education institutions are aware of and interested in OER and open educational practices, several challenges need to be overcome to achieve their potential roles. In developing and managing OER, academic libraries may play a big role. However, it is debatable whether this role would be as a creator of OER or a helper in creating OER and making it accessible to the end users as other digital library resources. As future recommendations, the implementation of an OER program at campus or faculty should be collaborative in nature. Libraries should collaborate more about creating partnerships with other organizations with common goals and aspirations towards OER. More fostered collaboration among libraries and various departments will produce best practices in expanding the range of OER movement in fostering open education.

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Evidence of Open Science Principles in Library Disaster Management: The Malaysian Academic Library Experience

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ABSTRACT
Many institutions struggle to create effective preparedness, response, recovery, and mitigation plans despite the significance of disaster management in libraries. Open science offers potential solutions to these issues by providing libraries with access to real-time data, information, and best practices, as well as collaboration and knowledge-sharing opportunities. However, it is necessary to investigate how open science can be incorporated into library disaster management practices and to identify the potential benefits and obstacles of this approach. This paper explores how open science principles can be used to improve library disaster management. This paper presents qualitative findings from multiple case studies of academic libraries in Malaysia. Individual semi-structured interviews with library leaders and focus group discussions with librarians were used to collect empirical data from a targeted sample of respondents. Afterwards, the data were analyzed using thematic analysis. Academic libraries in Malaysia are perceived to have a strategy and their own plans to respond to a disaster crisis, but they lack a formal disaster management plan. The data findings also demonstrate how open science can assist libraries in gaining access to real-time data and information about disasters, in sharing their experiences with others, and in responding effectively to emergencies. The result of the study will be a greater understanding of how open science has been utilized in library disaster management, as well as recommendations for how libraries can integrate open science principles into their disaster management practices.

Keywords: Library Disaster Management, Open Science, Library Services, Library Policy

INTRODUCTION

Library Disaster Management
An unexpected event or incident can be defined as a disaster if it happens either suddenly or gradually, resulting in undesirable repercussions. These unpleasant consequences can include the loss of life and substantial detrimental effects on people, the environment, and property. Natural occurrences such as earthquakes, floods, droughts, storms, volcanic eruptions, and

human activity such as industrial accidents, wars, armed conflicts, and pollution can all be potential causes of natural disasters (Alajmi 2016; Braman, Suarez, and van Aalst 2010; Galbusera, Cardarilli, and Giannopoulos 2021; Harris 2021; Ilo, Nwachukwu, and Izuagbe 2020; Welsh and Higgins 2009; Winston and Quinn 2005). A disruptive event that impacts the operations of the community and the affairs of the state is meant to be understood as a disaster, as stated by the definition supplied by the National Security Council Directive (NSC) No. 20 (Majlis Keselamatan Negara 1997) . It entails the loss of lives, the destruction and damage to property, economic setbacks, and ecological devastation that are more than the community's power to cope, necessitating enormous efforts to mobilize resources. This is because the community's capacity to cope is exceeded.

From the library's perspective, the term "disaster" refers to any occurrence or incident that impedes or threatens to bring to a halt the activities and services provided by a library (Braman, Suarez, and van Aalst 2010; Ghosh 2013). These kinds of occurrences can take many forms, such as fires, floods, earthquakes, the theft of information resources, attacks over the internet (computer hacking), among others. The continuity of library services can be negatively impacted, library functions can be disrupted, operations can be suspended, considerable damage can be caused to the infrastructure of the library, collections can be destroyed, and facilities can be rendered inoperable when disasters strike (Cowell 2020; Galbusera, Cardarilli, and Giannopoulos 2021; Kosciejew 2020; Cervone 2006; Fani and Subriadi 2019). For example, the COVID-19 pandemic that occurred in the year 2020 caused the loss of millions of lives (Alabdulmonem, Shariq, and Rasheed 2020; Shah et al. 2020) and forced libraries to totally cease their physical operations, which caused chaos in the field of library services (International Federation of Librarians and Institutions (IFLA) 2020). In a similar vein, a significant flood struck multiple states in Malaysia on 20 December 2021 due to heavy rain pour (Media Mulia 2021), which caused operational difficulties for the country's libraries. In these trying times, it is absolutely essential for libraries to evolve and look for different ways to serve their patrons in order to remain relevant. In order to better prepare for, respond to, recover from, and mitigate the consequences of disasters, libraries need to develop comprehensive and holistic disaster management plans. These plans should include methods for preparedness, response, recovery, and mitigation (Clark and Guiffault 2018; Drabek 1985; Mulia and Programme 2004; Sylves 1994). However, the design of disaster management policies is made more difficult by the restricted access to recent research on disaster management and the poor knowledge within libraries regarding the significance of producing disaster management documentation. The participation of libraries in the idea of open science presents a potential solution to this problem. By giving libraries access to real-time data, information, and best practices, as well as chances for collaboration and the exchange of knowledge between libraries and academics, open science presents a potential answer to this problem. This highlights the essential requirement for teamwork, transparency, and the free exchange of scientific knowledge in order to effectively solve such situations.

Enhancing Open Science principles in Library
The term "open science" refers to a movement that is focused at increasing the accessibility, transparency, and reproducibility of scientific research and data. Open science, which

promotes unrestricted access to scientific information, open data, and the results of research (Camkin et al. 2022; Frederick 2016; Gallagher et al. 2019; Ignat and Ayris 2021), is an essential component in ensuring prompt and well-coordinated responses in the event of a any kind of disaster. Even under the most trying of circumstances, libraries, which are bastions of knowledge and information, continue to serve an essential role in assisting individuals, researchers, and students. Libraries, researchers, governments, and communities can collaborate to lessen the effects of disasters and improve their level of preparedness by adhering to the tenets of open science and embracing its guiding principles (Camkin et al. 2022). The United Nations Educational, Scientific, and Cultural Organisation (UNESCO) issued a recommendation on open science in November 2021. According to the diagram below, this recommendation establishes a universal notion of open science together with established standards and a recognized set of values and principles.
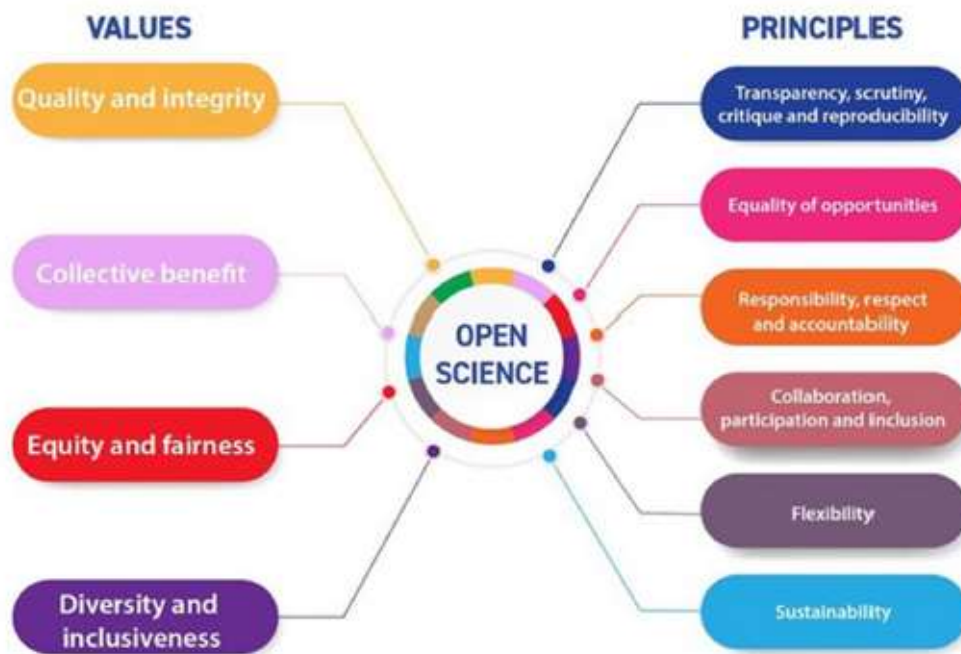
Figure 1: Values and Principles of Open Science (Sources : UNESCO (2022)

Open science principles can be applied to library disaster management to enhance the quality and accessibility of research and information, as recommended by UNESCO (2022). Here are some examples of how principles of open science can be applied: (1) Open Access: Making research publications and data freely available to the public without restrictions (SAMHSA 2022). (2.) Open Data: Sharing research data in a standardized format to enable other researchers to reproduce and build upon findings (Jillson et al. 2019). (3) Open Source: Sharing research software and tools, as well as the underlying source code, to enable others to modify and improve them (Jillson et al. 2019). (4). Open Education: Sharing educational resources and materials to improve access to scientific knowledge and skills(Santos-Hermosa and Atenas 2022). (5.) Open Reproducibility: Making research results and findings easily reproducible and replicable by other researchers (Edition 2014). (6.) Open Collaboration:

Encouraging collaboration and knowledge sharing among researchers, institutions, and organizations to accelerate scientific progress (Kennedy and Ruttenberg 2017) (7.) Open Access to Research Infrastructure: Making research infrastructure, such as scientific equipment, software tools, and data repositories, openly accessible and available for use by the scientific community (Karlstrøm and Heggland 2018).

The objective of this study is to examine disaster management in academic libraries and the applicability of open science principles to disaster management. This study focuses on the library disaster management cycle and the application of open science principles in disaster management by Malaysian academic libraries.

LITERATURE REVIEW

Disaster Management in Libraries

Academic literature contains a variety of definitions of disasters, each of which can be understood to mean something slightly different. The concept of cause and effect underpins each of these concepts. According to research conducted by the United Nations Office for Disaster Risk Reduction (UNISDR 2009), natural disasters are brought on by the simultaneous occurrence of a number of elements, the most important of which are exposure to hazards, susceptibility to damage, and a lack of preparedness for potential outcomes. Whereas a plan for dealing with and managing the consequences of a disaster is outlined in a document known as a Disaster Management Plan. The development of this document has been made possible via the combined efforts of many government and non-government organizations. The primary purpose is to decrease the number of lives lost in the impacted area by bringing relief supplies to those in need as quickly as possible. The overall objective of disaster management is to reduce the detrimental effects that natural catastrophes have on individuals and the communities in which they live (Chiderah and Iroeze 2021; Matthews and Eden 1996; Wong and Green 2007). Although there are many studies on disaster management plans or emergency plans in various fields of social sciences that have been conducted around the world, only a few studies that have been published in the literature address disaster management in libraries.

It was evident that libraries did not have access to all of the essential resources, especially in the event of a disaster such as a pandemic crisis; the transition from the physical to the online delivery of information services faced a number of critical barriers that needed to be overcome (Rafiq et al. 2021). Studies conducted by Wang & Lund, (2020) discovered that disaster response planning tends to be extremely advantageous in quick reaction enactment. These findings imply that the efforts made by libraries in preparing for emergencies are an important component of disaster management. The study investigates the collaboration that takes place between public libraries and governmental organizations. It highlights the potential for public libraries to play an important part in the emergency response teams that are located within their respective communities. Libraries and the librarians play an important part in the prevention and reduction of damage caused by disasters because of the responsibilities they play as institutional supporters, collection managers, information

disseminators, and internal planners. According to (Chisita 2020), libraries serve vital roles in society by acting as partners with the government, advocates for the community, educators, trainers, and promoters of the information community. In addition, the importance of libraries and librarians in times of crisis was emphasized, as was the role of librarians in promoting the distribution of high-quality reading material, preventing the spread of inaccurate information, and encouraging people to read when they are by themselves (Rafiq et al. 2021). The chat reference services and online infrastructure enables libraries to continue instruction and dissemination of factual information during pandemic closures, providing a feeling of normalcy and community to those who have been impacted by the pandemic (Wang and Lund 2020). It turns out that planning for disaster response can be quite useful when it comes to the execution of swift reaction, which shows that the efforts made by libraries in planning for disaster are an important component of disaster management.

As a country with a low rate of natural disasters, Malaysia must now be more vigilant against all types of disasters that can permanently disrupt library services. It is common knowledge that the library is a repository of knowledge and a resource for all information and references in any field. When a significant disaster, such as the Covid-19 pandemic, occurs, the physical operation of library services is completely shut down, rendering various services inaccessible to users. For instance, book loans, research consultations in person, reference services, and information literacy programs cannot be implemented. There have been many different views addressing the role of libraries in providing information and online support services during pandemic crises in literature (Ali and Gatiti 2020; Chisita 2020; Wang and Lund 2020; Rafiq et al. 2021). In response to the closure of physical libraries, digital libraries have become increasingly active in the provision of online information and support services to their user base in order to facilitate learning. According to Chisita (2020), public libraries have the potential to play an essential part by increasing their capacity to distribute knowledge to the general public, which in turn enables citizens to adopt preventative actions against COVID-19. Libraries raise people's awareness of health issues by producing new information and disseminating it to local communities through the use of their social media platforms, webinar programs, and a dedicated section of their websites devoted to the pandemic problem.

Mohd Khalid and Dol, (2015) revealed that 47.1% of Malaysia's academic libraries do not have a library disaster management plan and 58.8% do not have allocation for library disaster planning. They suggested for further research that can be done by other researchers is on: (i) the issues of developing disaster management plan policy, (ii) why academic libraries do not have written disaster management plan and (iii) the need to discover library disaster response and recovery among academic libraries in Malaysia. It is therefore considered timely to investigate Malaysian academic libraries preparedness, response, recovery, and mitigation plans in handling a disaster, no matter what type. The literature reviewed reveals that there are not many scholarly articles on disaster management among academic libraries. There is a need to develop formal policies or guidelines and identify open science practices among academic libraries which are scarce and limit access to scientific information, data and research results that can assist in dealing with any future disaster.

Application of Open Science in library disaster management

The principles of open science defined by UNESCO(2022) can be used as a foundation for the holistic and sustainable development or provision of disaster management in libraries. The movement towards openly accessible research data presents a transformative opportunity for libraries to significantly enhance their role in the academic environment. Moreover, in the realm of disaster management, libraries can play a crucial role by serving as invaluable informational hubs. By leveraging their resources and expertise, libraries can provide essential data for disaster prediction, response, and recovery efforts (Frederick 2016). For example, according to a study by Ozcan & Saritas (2022), during Hurricane Sandy in 2012, social media platforms were used to support traditional disaster response mechanisms. Geotagged Instagram photos, for instance, helped understand the location and severity of the disaster, aiding disaster response agencies in coordinating their relief efforts. The authors highlight how digital communities, social media, and mobile technologies can deliver real-time, lifesaving information, helping to develop a deeper understanding of requirements, which results in more efficient responses. The paper also delves into the role of big data analytics in disaster management, collecting crucial information and intelligence, and helping prioritize and optimize responses.

Through big data analysis that uses an open data approach and an open-source approach, libraries can encourage collective collaboration in the creation and sharing of data, which ultimately contributes to disaster management operations (Giustini et al. 2021). In order to extend their repository collection to the general public in the event of a disaster or calamity, libraries can incorporate open access policies into their disaster management plans. This will allow the general public to access the most recent information and data regarding a disaster via the library database or library repository. Libraries provide useful resources and guidance to help academics make their scholarly products open access and freely accessible to a wider audience. By providing a wide range of support services and programmes aimed at increasing awareness and encouraging active engagement among researchers, libraries play a crucial role in enabling open science. These services cover a variety of open science-related topics, including scholarly communications, open access, and open data (Borghi et al., n.d.).

Most libraries provide their patrons with a wide range of research facilities, as well as subscriptions to various types of research software, for their convenience. There is a possibility that non-members will be allowed access to these facilities in the event of a natural disaster. It is available for usage by researchers as well as anyone else who requires the utilization of software or research tools for the purpose of conducting research or modifying and improving an existing study. In times of crisis, libraries serve as vital information hubs, offering refuge and access to real-time data. They can collaborate with disaster response agencies, government organizations, and community stakeholders to disseminate up-to-date information about evacuation routes, emergency shelters, medical services, and other critical resources. Libraries can leverage their infrastructure to provide internet access, charging stations, and communication facilities, ensuring that affected individuals can stay connected and informed (Young 2018).

RESEARCH DESIGN

Population and Sample

The study's population under consideration are all public university libraries in Malaysia. An initial investigation into the practices and involvement of university libraries in disaster management, the sample was limited to five libraries that were actively involved in disaster management and who had agreed to participate. The informants under study are library managers who have the power in decision making and are involved in developing library policies related to risk management or disaster management. After designing the research questionnaire and considering the geographical location of each academic library in Malaysia, five (5) academic libraries were selected to participate in this study. These five universities libraries are Universiti Kebangsaan Malaysia (UKM); Universiti Sains Malaysia (USM), Universiti Teknikal Malaysia (UTeM), Universiti Teknologi MARA Malaysia (UiTM) and Universiti Malaysia Kelantan (UMK). All five university libraries are involved in projects focusing on their experience in related disasters, development of policy and guidelines; role and awareness of the importance of having disaster management plans. The study adopts a qualitative approach using an interview method to collect data from library managers at all five Malaysian public academic libraries.

Ethical consideration

Data collection was from March 2023 – April 2023 using a face to face interview method. The interview protocols and form was designed to collect informant's consent. A total of five (5) interview sessions were conducted. Thematic coding was used to analyze qualitative data. To protect the identity, subsequently each university library will be labeled as Lib1, Lib2, Lib3, Lib4 and Lib5 respectively whereas for the informant it will be labeled as INF1, INF2, INF3, INF4 and INF5.

Instrument

This study's interview protocol was devised and implemented to collect information and insights regarding the library's disaster management guidelines, policies, services and applying open science initiatives. The objective is to acquire a thorough understanding of how the library responds to emergencies and disasters, as well as how it extends its services to patrons during such occurrences. During the interview, participants were first asked whether they had personally experienced or encountered a library emergency or disaster, then the researcher expanded the question to open science practices practiced or implemented by the library.

RESULTS

Malaysian AL preparedness , response, recovery and mitigation in events of a disaster

In-depth interviews with AL managers to obtain information on how libraries prepare in the face of any disaster revealed various interesting findings. Library managers in Malaysian academic library shared their experiences in dealing with disasters such as major floods (Lib5),

Fire (Lib1), fungus / fungus attacks (Lib1, Lib2, Lib3, Lib4, Lib5), electronic interference (Lib3 and Lib4), library roof leakage (L Lib2, Lib3,) and health disaster (pandemic covid-19) (Lib1, Lib2, Lib3, Lib4, Lib5). Although leakage on the library roof (Lib2 and Lib5) is not suitable to be defined as a disaster, however, if it is not repaired and timely appropriate action is taken, it can become a major disaster such as damage to the library's furniture, equipment and collection and harm people if the roof collapses.

Table 1: Malaysian Public Academic Library with disaster experience

Library/Type of Disaster	Lib 1	Lib 2	Lib 3	Lib 4	Lib 5
Floods					√
Fire /	√				
Earthquakes					
Fungus / fungus attacks		√	√		
Electronic interference	√		√		
Library roof leakage		√			√
Pandemic Covid-19	√	√	√	√	√

Through interviews, it was determined that academic libraries in Malaysia follow four fundamental cycles (preparedness, response, recovery and mitigation) when dealing with a disaster, despite the fact that almost all academic libraries lack disaster management guidelines. As mentioned by INF1, Lib1 does not yet have a disaster management policy, but risks such as fire and other risks are placed under the risk management policy. The management plans to make a disaster management plan in the future, especially in the event of a landslide, to determine the actions that need to be taken. For pandemic disasters, it was placed under risk management policy. Same like Lib4, the library has policies related to Library Risk Management and also adheres to ISO (International Organization for Standardization) compliance documents, but there is no specific policy for disaster management. While for Lib2, they do not have a specific policy, but focuses more on collection policies and library services. Meanwhile Lib3 does not have a risk management plan or disaster management in general, but has a risk policy on book loss and related to library services. For disasters such as fire, the library merely follows the University's OSHA (Occupational Safety and Health Administration Committee) guidelines.

Disaster Management Cycle

(a) AL Preparedness
Preparedness in the face of a disaster is very important for libraries to reduce the risk of damage to their collections, facilities, and services. To prepare for the possibility of a fire catastrophe, Lib1 has planned at least two fire drills per year. According to INF1, in the event of a fire, a level-appropriate incident officer will instruct users to adhere to the predetermined instructions to prevent accidents, injuries, or fatalities. The Information Technology Office provides staff and students with guidance and information regarding the risk of cyber-attacks through the distribution of posters, emails, etc. in the event of disasters such as cyber-attacks.

While for Lib2, the library uses the medium of email to inform users of the guidelines that need to be followed throughout the pandemic crisis, the guidelines are also pasted in the elevator, toilets, notice boards, and other places that are easily seen by staff and other users.

According to INF2, *"If the risk suddenly comes back, we are already aware of it. I think if COVID comes, the procedure is ready, and we won't be surprised anymore, right?"*. Likewise, with Lib4 and Lib5, they use SOPs that have been re-adjusted based on the University's master SOPs to deal with the Covid-19 pandemic. According to INF4 *"...we have never announced that our services are closed (during covid-19), because we are ready with digital library services".* Likewise with INF5, he stated *"It's just a coincidence that people say that in this library there are some things that we have done before the MCO, for example we are used to doing it online so we don't feel very strange (to provide services online when the library need to shut down the physical services)... (then) in 2021 we have released another procedure which is that we will quarantine all books whether they arrive by hand or by post".* As for flood disasters, Lib. 5 has a disaster management policy. According to INF 5, *"in October and November the library's response team will be activated, so we will have 1 group that does cover that thing, to provide information at all times, whether it rains, the water rises or not... we will raise books, electrical equipment, we will turn off all the lower ones, stored... in October we will remove 2 or 3 lower shelves and we will keep them".*

(b) AL Response
When a disaster occurs, libraries must respond effectively and swiftly. It is to minimize damage, expedite the recovery process, and ensure library services are restored as soon as possible in order to effectively serve the community. According to interviews conducted at five academic libraries, the average library has a response activity plan to deal with disasters such as fire, flood, the Covid-19 pandemic, and other events caused by human error. For instance, when there is a flood in Lib5, the response team will be activated automatically. This response team will always provide information, whether it rains, the water rises or not and so on.

According to INF5, *"We continue to work, no off duty … in a disaster situation we come to work to clean the building, we come to clear what we can save, we save first. Three to four staff will be on standby, we want to see how bad the condition of water level is because of floods because we are worried about other things, the important things are still there"*. The staff who came to the library continued to take immediate action by rescuing equipment such as computers, TVs, and other equipment that were on level one and taken to level two. That is the most immediate initial step that staff can take to reduce destruction. The fire disaster that occurred in Lib1 did not result in extensive destruction and damage because fire-extinguishing equipment, such as water sprinklers, functioned properly and put out the blaze. In contrast, Lib1 officers promptly reported the incident to the university's risk and security unit and filed a police report.

In response to the COVID-19 pandemic, the National Security Council has ordered the closure of all non essential services. Some libraries quickly offer and consolidate online or digital library services following the discontinuation of physical services. According to INF2, "a*t the*

time of MCO (Covid-19), our first action was to close the library. And then all our services were done online; book loans were through the staff, so if a student wanted to borrow a book, they had to fill out an online form so the staff would search, and then we would call the student to come and pick it up…". The same goes for Lib5, according to INF5, *We follow the instructions from the government … so we take caution and issue an advance notice to all the students that we will shut down (physical services). For the time of the pandemic, we have a machine to make face shields, which can contribute to society. Combine several faculties; there is a faculty to make sanitizer and a face shield with PPE".* While in Lib1 during the beginning of the COVID-19 outbreak, the situation was a bit chaotic, and most of the officers were a bit nervous with the situation where there was still no determination to continue operations or close down physical operations.

According to INf 1, *"when the university management ordered all departments to close physical operations, only then did the library management think about how to work…, how to provide services for outsiders, so we asked the management. Go to work as scheduled, get materials, and return. Finally, we also created a postal service, and the service has run until now".* Slightly different from the response from Lib3 to face the Covid-19 pandemic disaster. Lib3 is a little slow to respond in making sure they service their users (during pandemic crisis). According to INF3, *"When there's a lockdown, we really don't have any preparations, things are sudden, right... We close for 2 weeks (lockdown/MCO). So, after 2 weeks, it's continued and continued, we follow. We will follow university SOP or guidelines. At that time there was a university crisis committee that was authorized to conduct adjustments to deal with this pandemic, so we joined the committee. (if) They issued a circular saying that students can enter (into the campus)..we will let them in..if the committee doesn't allow..we won't let them in. I think the library acted after that.. almost a month or so. Only then do we act before we think about our service".*

(c) AL Recovery
In the aftermath of the flood disaster, one of the things that academic libraries do to begin the process of recovery is to carry out cleaning operations and determine the degree to which the library building can once again be utilized without risk. According to INF5, when the water had subsided and it was safe to enter the library building, the condition inside the library was very poor and severe because the library floor was filled with thick mud in addition to a lot of waste. The condition inside the library was very bad and harsh because the library floor was filled with thick mud and a lot of junk. As a first step in the recovery process following the flood disaster, a community work crew was assigned to the library's cleaning duties. In terms of services, when a flood occurs that prevents users from coming to the library, Lib5 activates fully online services and carries out aggressive promotions so that library users can continue to use the various services that have been provided online, such as access to electronic resources (e-books, online databases, etc.), as well as consulting and reference services. This allows users to continue to make use of the library's extensive collection of resources that have been made available online.

For the incident with the leaking roof that resulted in damage being done to the library collection, Lib2 was allocated a special budget to replace the roof, but they were unable to

use it because of other financial reasons. According to INF2, the condition of the roof of the library has severely deteriorated, which has led to an even more serious problem, which is an attack by fungi on the book collection of the library. Because of this, the Infrastructure department has produced a special instrument to control or reduce the damage caused by fungi attack , but it does not function very well. As a direct consequence of this issue, the management was compelled to fork over thousand in order to purchase a substantial humidifier *"we spent some money to put in a sizeable dehumidifier so that there is a special software for the dehumidifier that absorbs it so that it can be controlled the fungi attack".*

During the recovery activity or process in disaster management due to the COVID-19 pandemic outbreak, all academic libraries involved have the same goal of restoring services or re-operating. This collective action includes various activities aimed at ensuring the safety and well-being of library staff, users, and society. The collective efforts of all libraries in implementing this recovery response play an important role in creating a safe and effective environment for library users. The following are some of the actions that are carried out during recovering process: (1) Sanitizing Equipment and Hardware, (2) Social Distancing Measures, (3) Temperature Check, (4) Face Mask Requirements, (5) Adherence to National Security Council Guidelines, (6) Communication and Public Awareness, (7) Embracing Work from Home and Work from Office practices. Libraries navigated through unprecedented challenges, continuing to serve their communities during difficult times. As the recovery activities unfold, libraries remain committed to balancing the benefits of remote work with the invaluable connections formed through in-person interactions, ensuring that their services are accessible, inclusive, and responsive to the ever-evolving needs of their patrons.

(d) AL Mitigation
All of the libraries in this study have a plan for mitigating disasters in their libraries focused on mitigating their effects and averting their occurrence. This plan includes measures such as regular inspections and maintenance of library buildings to identify and address potential hazards, installing fire suppression systems, implementing proper storage and shelf arrangements to minimize the risk of damage to collections, developing emergency response protocols and training staff on how to respond to different types of disasters, and establishing a disaster communication network to ensure effective communication during emergency situations. According to INF 1, *"Since the fire incident in the library, I, as the chair of the risk committee, have taken action by monitoring electrical items in the library, even though they are not included in the library's risk register. I monitor all units that have this electronic equipment and make sure that the officer in charge closes all of these devices when not in use. (While) Incident officers at each level will periodically check fire extinguishers".*

Meanwhile, INF2 said, *"In order to avoid damage due to the library's roof leaking onto the library's collection, we cover our shelves with plastic, so that thing becomes like a control. Even though we are not near there, we have already protected our collection. If a wall is damp, for instance, the infrastructure department staff will paint the damp wall to prevent fungus, which we specifically identified for the media section that has microfilm, from attacking the library collection".*

For the flood disaster that occurred in Lib5, the library already has a mitigation plan to reduce the effects of damage to their collection, furniture and equipment. According to INF5 *"The flood was very big at that time. If we see the initial effects, we know the level of the flood. It is true that half of the building (library) is lost, but the management has taken control and prevention measures to reduce the effects of the flood disaster".* Since 2007, the territory surrounding the university has experienced flooding, according to the source. Although floods are expected to occur annually, they did not have a significant impact on the library's equipment and collections because the library was prepared and followed the established procedures. Typically, in October of each year, the library will remove three spaces from each shelf and store the affected collection on the upper floor, while the lending of the book collection will be suspended for one to two months, depending on the weather and flood conditions. Regarding electronic equipment, staff will transport all electronic equipment to the second floor of the library building. In addition, Lib3 has changed the flooring from wood to stone to make it more durable and simpler to clean in the event of a flood. Similarly, most of the furniture has been substituted with iron, a resilient material that can be used during natural disasters.

All academic libraries have developed emergency response protocols for pandemic-related disasters based on National Security Council, local government, and university-mandated guidelines and standard operating procedures. According to INF 1, the informant was directly involved in developing guidelines to deal with the Covid-19 pandemic. Every modification based on the most recent directives from MKN will be presented at the department chief meeting. Guidelines and SOPs pertaining to this pandemic are posted inside and outside the library so that staff and patrons are aware of all changes and adhere to the SOPs…"*If it occurs again, we may be able to manage it, as there are phase-by-phase guidelines. Perhaps we simply revise it. We already know what we will do because we've already done it."* Likewise with the statement from INF2…*"I think if covid-19 happens again, the procedure is ready, we won't be surprised anymore right".*

Application of Open Science Principles in Malaysian Library Disaster Management
In library disaster management, an open science approach should be utilized so that valuable collections may be protected and library services can be maintained without interruption. This strategy has a strong emphasis on transparency, collaboration, and the sharing of data. It also places a strong emphasis on preparedness, response, recovery, and mitigation in an effort to lessen the effects of natural disasters and build resilience. The findings of the study also demonstrate how open science enables libraries to obtain access to real-time data and information regarding disasters, as well as share their experiences in dealing with the aftermath of disasters with other libraries. It was discovered that almost all the informants intended to directly or indirectly adopt open science principles in their libraries. However, there are challenges in applying this initiative. As mentioned by INF 4, *"we want to start with open science... We want to reveal aspects of the library but our staff cannot differentiate between technology and the role of the library itself... it is one of our efforts to strengthen our services towards the vision and mission university".* According to INF5, "*we present an open science initiative to the management, so we want to go in that direction; it's just that in Malaysia the problem is that our mentality is not open yet, in (the international community)*

overseas it's okay." Although library managers have a limited understanding of open science, it has been found that aspects of open science principles have emerged indirectly as a result of the sharing that took place during the crisis. This is shown by the table presented below.

Table 2: Implementation / Application of Open Science Principles at Malaysian Public Academic Library

Open Science Principle / Lib	Library	Initiative
Open Access to Research Infrastructure	Lib5	Users from any university can access the subscription database and other research facilities provided in-house by the library.
Open Collaboration	Lib1	Collaboration with the Information Technology Centre for the organization of a discourse or webinar programme
	Lib4	The library has mobilized efforts to establish network relationships with strategic partners, such as the faculty and external organizations, by holding teaching collaborations, research writing collaborations, and organizing international seminars.
	Lib5	presently planning various modes of collaboration between public university libraries.
Open Data	Lib2	All research data are compiled by the university; if researchers from other organizations require university research data, they will consult the library. Additionally, the library collaborates with the ICT department, which has created a database similar to the current e-publication for retrieving research data.
	Lib5	Library would like for people to be able to track their research development, and at the end of their research, the data can be used immediately.

DISCUSSION

The findings of the study indicate that academic libraries in Malaysia do not have their own policies or guidelines that are particularly applicable to any disaster, since they define or classify the disaster in the risk management document. Most disaster-related policies or guidelines in libraries refer to their respective parent organizations. Certain clauses, selected according to the suitability and needs of the library, will be added as sub-items to the university's risk policy based on interviews with all informants. Regarding disasters caused by the COVID-19 pandemic, policies or guidelines related to disaster management, and safety measures to prevent the spread of the COVID-19 virus, each library will first adhere to the guidelines established by the National Security Council (MKN), the Ministry of Health Malaysia (Ministry of Health), the State Health and Safety Committee, and the University-level Committee. However, the library is seen as providing input and collaborates to think about

what is best to implement during the covid-19 crisis period. The creation of collaborative networks that bring together libraries, parent organizations and other stakeholders to share information and work together to develop effective disaster management strategies is one of the principles of open science. In addition, libraries serve as vital information centers in times of crisis, offering refugees access to real-time data. They can collaborate with disaster response agencies, government organizations, and community stakeholders to disseminate current information regarding evacuation routes, emergency shelters, medical services, and other essential resources(Young 2018). The infrastructure of libraries can be utilized to provide internet access, and communication facilities to ensure that affected individuals remain connected and informed. For example, according to one of the study's informants, during the post-covid period, library staff were involved as volunteers in giving vaccines to the community and also jointly made face shields and distributed them to the community as a form of collaboration with other stakeholders.

Changes in providing new standards for library services and administration are a significant obstacle for libraries in addressing this pandemic crisis. A suitable contingency plan is required for future crises of this nature. In the future, these modifications will make the service transformation process more applicable and functional in any circumstance. The results of interviews with library administrators and also librarians through a focus group discussion revealed how academic libraries extend/change their public service policies in response to the effects of natural disasters and the Covid-19 pandemic. Despite this, academic libraries must plan and establish a more detailed disaster management policy based on past disaster management experience as a guide for the future. It is crucial that library services and operations can continue and be provided as soon as possible, as libraries are central locations where the public can obtain trustworthy information. 78% of respondents believe that libraries assist them in finding credible and trustworthy information, as indicated by a survey conducted in 2017 by the Pew Research Centre (Horrigan 2017). It was found in this research that libraries always provide information relevant to infodemic either current research on covid-19, real-time data about pandemic in countries, etc., and this information was fed either through the library's website or through chat services.

In addition, role changes in the provision of services and facilities are more needed during disasters. Library management and librarians are seen to be very quick and agile in applying digital technology as an alternative service when physical services cannot be provided. Librarians are also seen to be very active in connecting and providing services to their users. They are also seen to be very active in organizing webinars in various fields of knowledge that are open not only to their internal users but also open to the public. The organization of these numerous webinars is also carried out in partnership with a variety of parties, which provides the library with an opportunity to apply the concept of open education to their community (Chisita and Chizoma 2021). It enables libraries and librarians to provide more effective value-added services, particularly as facilitators, moderators, and knowledge aides, as a result of these efforts. Even when the library was physically unavailable to its patrons, the library's ability to be flexible and adaptable was the most important factor in providing seamless service to those patrons. Libraries are required to keep their websites and social media accounts up to date on a consistent basis in order to develop a platform for their user services,

which may include the most recent news services, information services that can be relied upon, virtual reference services, digital resource services, education and training services, and so on.

As a result of the interviews, it was found that the need to create disaster management policies or guidelines should be given high emphasis. Libraries should also look at opportunities to implement open science principles in the development of library disaster management policies or guidelines. Open science principles can be utilized to enhance library disaster management in several ways (UNESCO 2022; Gallagher et al. 2019; Ignat and Ayris 2021) such as :

(i) Data sharing and collaboration - libraries can adopt open data practices by sharing relevant information about their disaster preparedness plans, response strategies, and lessons learned from past incidents. By openly sharing this information, libraries can facilitate collaboration and knowledge exchange among institutions, enabling them to learn from each other's experiences and improve their own disaster management efforts,

(ii) Transparent documentation - maintaining detailed documentation of their disaster management protocols, including guidelines, policies, and procedures. Transparent documentation ensures that the library's strategies are well-documented and accessible to staff members, enabling them to effectively respond to emergencies. It also facilitates knowledge transfer during staff turnover or when new employees join the library,

(iii) Community engagement - involving library users, staff, and stakeholders in the development and review of their disaster management plans. By soliciting input, feedback, and insights from these stakeholders, libraries can ensure that their plans are inclusive, responsive, and address the specific needs and concerns of their community during disasters,

(iv) (Open access to information - Libraries can contribute to this principle by ensuring that critical information related to disaster management is easily accessible to their users and the broader community,

(v) Crowdsourcing and citizen science - Open source technologies allow libraries to adapt and modify tools according to their specific needs, ensuring flexibility, interoperability, and long-term sustainability,

(vi) Open education and training - developing and sharing open educational materials, online courses, or training modules related to disaster management. These resources can be made freely available to library staff, users, and the broader community, enabling them to enhance their knowledge and skills in preparing for and responding to emergencies. By integrating these additional aspects of open science into library disaster management, libraries can enhance their preparedness, response, and recovery efforts, while fostering collaboration, knowledge sharing, and community resilience. Through this study and the experience shared by library managers it can be used as a benchmark for other libraries to use as appropriate in their libraries.

CONCLUSION

Library disaster management is a crucial component that must be taken into consideration to protect and maintain the integrity of precious information resources. It involves preparing for, reacting to, and recovering from a broad array of possible disasters that might have an effect on the library. This disaster may be natural, like flooding or earthquakes, or man-made, like fires or cyber-attack or pandemic crisis. The use or application of open science principles in disaster management guidelines is widely seen as a crucial step towards enhancing the efficacy of library disaster management practices. For instance, libraries may lead to improved preparedness via more cooperation and the sharing of information. The dissemination of research findings via open access channels enables the global library community to exchange and adopt best practices in disaster planning and recovery. As a conclusion, the exponential growth of open science, which is founded on the primary values of accessibility and transparency, presents an opportunity for libraries to build disaster management guidelines that are more comprehensive, efficient, and sustainable. The spread of open science compels libraries to rethink their traditional responsibilities and develop creative techniques to aid researchers, students, and the public in getting access to and exploiting research results even in the case of a disaster that causes physical services to be closed. It is a unique and exciting idea that the library has the potential to evolve into a thriving center of knowledge, which would allow for unrestricted access to publicly available materials for study and foster cooperation across academic lines. The integration and use of Open Science principles in the development of disaster management guidelines enhances the capacity of libraries to effectively align their services and resources with the ever-changing needs of their users. The ongoing significance of a library will be predominantly influenced by several aspects, including the extent of its collection, its dedication to open access and transparency, and its capacity to use diverse data sources for the betterment of the community during times of disaster.

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Exploring Libraries, Citizen Science, and the Sustainable Development Goals (SDGs): Insights from Researchers and Project Managers

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ABSTRACT

To promote and accomplish the Sustainable Development Goals (SDGs), research in citizen science and the SDGs is crucial. This study is focused on the experiences and perspectives of Researchers and Project Managers in Citizen Science projects that are connected to the SDGs, as well as the role and engagement of libraries in these projects. This research uses the online interview to gather data and then analyzes the responses to identify the participants' motivation, challenges to overcome, best practices, acquired abilities, and attitudes. The researchers and project managers selected as respondents for this study come from Research Universities' (RU) citizen science projects. The study's findings point to the possibility of enhancing cooperation between libraries and citizen science initiatives to support and advance the SDGs. This research will provide valuable insights into the potential of Citizen Science, Libraries, and the SDGs and make recommendations for future research and opportunities for improvement.

Keywords: Citizen science, libraries, social agents, Sustainable Development Goals (SDGs)

INTRODUCTION

Citizen science (CS) is the practice of members of the public helping with research that has historically been conducted by scientists (Cigarini et al. 2021). According to SciStarter, 2020 in the United States, CS is part of the ongoing "Libraries as Community Hubs for Citizen Science" project. CS toolkits are being developed, evaluated, and made available for and through public library partners, while associated resources are being developed to train, support, and communicate with librarians and citizen scientists. Citizen Science provides a

means for open, holistic, and participatory knowledge generation processes; on the other hand, it promotes openness, which, as opposed to secrecy or exclusion, is critical for the sustainability, accessibility, and quality of scientific knowledge produced through citizen participation (Cigarini et al., 2021). Recent initiatives indicate that libraries in the United States and Europe are expanding their existing activities and programmes, capacity, and infrastructure to provide opportunities for their communities to participate in scientific research through CS (Ignat et al. 2018). According to Cigarini et al. (2021), the implementation of CS in libraries, which are a fundamental component of the Open Science infrastructure, may make it easier to move towards more open knowledge. Citizen science initiatives are often community-based and led in developing countries, especially in sustainable development contexts. Policy acceptance at higher levels is low due to several complex and interconnected challenges, such as lack of institutional capacity, mistrust of project leaders, and potential overlap with existing initiatives (Hecker et al. 2019; Irwin 2018). Thus, the purpose of this study is to understand the potential of libraries' involvement in Citizen Science and SDGs from the perspectives of Researchers and Project Managers in Citizen Science projects.

LITERATURE REVIEW

Recently, there has been a noticeable surge in citizen science programs around the world, with citizens participating in scientific initiatives as novice investigators, supporters, and even observers. Citizen scientists can create experiments, gather information, examine findings, and find solutions. Most citizen scientists use equipment offered by the project directors to obtain data, which is later used by professional scientists and resource managers to address pressing issues and find scientific solutions (Shirk and Bonney 2020). A wide range of new options for community involvement in a relevant variety of issues is being developed because of the rapid growth of crowdfunding techniques, data analysis, and graphical technologies.

Concerning this growth of community involvement in citizen science projects, libraries all around the nation are developing into significant centers for citizen science by providing access to literary materials, proper planning, technology such as computers and the internet, and experts with scientific expertise; while some other libraries even host citizen science programs with specific tools and modules that allow the participants finish their projects using equipment like light detectors and telescopes (SciStarter, 2020). Cigarini et al. (2021) also emphasized that libraries have provided guidance and support in designing information management systems to give citizens their acquired data back after processing. The institutional repository services provided by the library can also be used by these amateur researchers to archive and share their findings (Cigarini et al., 2021). There's a study claiming that academic libraries can provide leadership, information services, research data management services, and research collaborations to support open science by sharing available data, open access resources, educational resources, and even open methodologies (Tzanova 2020).

As all nations are focusing on realizing the sustainable development goals (SDGs), citizen science is seen as another platform that can be further explored to prioritize the goals.

According to the United Nations (UN) in 2015, Sustainable Development Goals is "a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity" (UNDP 2022) .Liu et al (2014) believed that citizen science can play a significant role in sustainable development by helping to bridge the knowledge gap between the public and environmental management (Liu and Kobernus 2016). They further stressed how citizen science can empower people by providing them with environmental knowledge and data to make accurate decisions. All these factors support the fundamental goals of citizen science in sustainable development.

RESEARCH DESIGN

This study aims to highlight the potential of libraries' involvement in Citizen Science and SDGs from the perspectives of Researchers and Project Managers. Also, the research analyses were based on the following research questions: how are current Citizen Science projects connected to libraries and the SDGs from the researchers and project managers' perspectives? The emerging potential role of libraries in citizen science and getting engaged with SDGs was explored through the in-depth interview. In-depth, open-ended, and on-the-ground interviews with a variety of participants in this study, including the researchers and project managers from three research universities (RU) in Malaysia were conducted. The selection of the participants was based on the years of involvement in Citizen Science which must be involved more than 2 years actively in citizen science projects in universities. The respondents are two researchers and two project managers. The focus of the citizen science project was more on biodiversity, environmental, and water quality monitoring. The roles of project manager and researcher are similar for both of them, which were following the four characteristics of citizen science that are typical: i) A vast community of scientists and volunteers collaborate and exchange data, to which the general public, as well as scientists, have access, ii) Participants adopt the same procedure, iii) allowing data to be integrated and be of high quality, iv) Data can help real scientists reach actual findings.

Data were gathered using a semi-structured interview approach from February 2023 and continuing until the end of the month. Each respondent underwent one session of online interview through Zoom Online meeting. Video recording, audio recordings, coding, transcription, and accuracy checks were all done during the interviews. To find trends in respondents' experiences and to pinpoint the main topics raised in the interviews, the transcripts of the interviews were coded using the software, Atlas.ti. This study has observed the ethics protocol and all respondents have consented to the interview.

RESULTS

Based on the interviews conducted, the respondents have a wide range of experience in their respective fields from the beginning of the citizen science project at their university. The focus of the citizen science projects was more on biodiversity, environmental, and water quality monitoring. The findings also show that the respondents' roles involved citizen science

projects from the beginning and put a lot of effort into sustaining the CS projects. The following responses were obtained, recorded, and summarized based on the interviews with the respondents. This study aims to highlight the potential of libraries' involvement in Citizen Science and SDGs from the perspectives of Researchers and Project Managers plus, the research analysis was based on the following research questions: how are current Citizen Science projects connected to libraries and the SDGs from the researchers and project managers' perspectives?

Current Citizen Science projects connected to libraries and the SDGs from the researchers' and project managers' perspectives

The in-depth interviews with managers and researchers for citizen science projects revealed that many SDGs were considered when planning and implementing projects, with a focus on SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), SDG 14 (Life Below Water), SDG 15 (Life on Land), and SDG 17 (Partnerships for the Goals).

Increasing the public's knowledge and understanding of scientific issues, as well as encouraging engagement and learning among individuals, were the main goals of citizen science programmes addressing SDG 4. One of the main findings from the research was that citizen science initiatives support SDG 4 (Quality Education), with a particular emphasis on encouraging inclusive and equitable quality education and opportunities for lifelong learning for everyone, was described by one respondent as follows:

"Our CS projects promote ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, especially Goal 4.7, to ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and culture's contribution to sustainable development" (R2, 1b)

Monitoring and enhancing water and sanitation systems, as well as involving local populations in water management, were the main objectives of projects implementing SDG 6.

"In terms of Place-Based Water Quality Monitoring, I think the main focus was on SDG 6, clean water and sanitation" (R2,1b)

Another respondent stressed how important it was for their initiative to focus on SDG 6, saying:

"Basically, our focus was on SDG6, clean water, and sanitation, because we want to look into the water qualities of our rivers and how it impacts on the water supply" (R3,1b)

The study's key finding was that SDG 8 can benefit from citizen science activities (Decent Work and Economic Development) by fostering sustainable economic growth and opening job opportunities. Respondents outlined how their initiatives would produce attractions that would encourage visitors to explore the surrounding areas, which in turn might boost the local economy and create jobs and have observed:

"Our projects could be slightly contributed to promoting sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all, where both projects can create some attractions for people to explore the areas" (R4,1c)

The study's findings indicate that by fostering inclusive, secure, resilient, and sustainable human settlements, citizen science initiatives can significantly aid in the accomplishment of SDG 11 (Sustainable Cities and Communities). According to one respondent, data on the effects of urban growth on regional flora and wildlife can help citizen science programmes achieve this goal:

"Data from iNaturalist can contribute to an overview of the impact of city development on the flora and fauna species surrounding us through mapping of water and air pollution" (R1,1a)

Place-Based Water Quality Monitoring initiatives were also considered to be pertinent to SDG 11 since they can support responsible production and consumption by addressing the issue of poor waste management and its effects on water quality. Two respondents remarked,

"Somehow, Place-Based Water Quality Monitoring Monitoring can be linked to SDG 11, I think, make cities and human settlements inclusive, safe, resilient and sustainable" (R2,1b)

"We want the community to be responsible and understand their place, so the Place-Based Water Quality Monitoring Monitoring project was slightly related to SDG11's goal to make cities and human settlements inclusive, safe, resilient, and sustainable. Also, responsible consumption and production because water quality is mostly affected by improper waste management" (R3,1b)

To stop the loss of biodiversity, the Sustainable Development Goal (SDG) 15 focuses on preserving, restoring, and promoting the sustainable use of terrestrial ecosystems. Our research shows that citizen science initiatives like iNaturalist, Place-Based Water Quality Monitoring, and EcoHub are all in some way related to SDG 15:

"iNaturalist supported Citizen Science and generated awareness, especially on Life on Land and Life below Water" (R1,1a)

"Place-Based Water Quality Monitoring was very much related to Life on Land because part of that is to understand how water quality is related to the land ecosystem" (R3,1b)

"The main goal of the EcoHub project is promoting Life on Land. Most of our activities involved terrestrial area" (R4,1c)

The goal of partnerships for the objectives was perceived as an overarching objective that cut across all the other SDGs, according to further findings on SDG 17 from the perspective of citizen science projects:

*"Both Place-Based Water Quality Monitoring and Di Sekitar Kita Biodiversity projects involved partnerships with agencies and local authorities. After the project ended, we are still working together, and are currently reframing Urban Biodiversity" (*R2,1b)

Researchers and project managers' comments revealed the connection of the library with CS projects is through SDG 4 and SDG 17. According to one respondent:

"The findings from the CS project may be physically displayed by the library. Instead of a virtual exhibition, the library may, for instance, show images of biodiversity species from the iNaturalist database" (R1,1a)

Such exhibits might be an effective way to engage the public and spread a lifelong learning culture of the value of protecting biodiversity and other SDGs. As stated by another respondent:

"Browse the iNaturalist database to see the artistic multimedia-typed shot, which is available for free download. A virtual exhibition is less effective at raising awareness about CS than a real one." (R1,1a)

"Our previous three projects had not involved libraries. But, I believed library can be as a venue for sharing session and exhibition related to CS project" (R2,1b)

"Nowadays, people like to search for information online instead of going to the library and searching for the materials. So, what the library can do to bring people to the library is by promoting and creating awareness of CS projects. I believe the library definitely has roles to play in CS. Think of how to engage people to come to the library physically and virtually through the CS project" (R1,1a)

Overall, this study provides insights into how current citizen science projects are connected to libraries and the SDGs. The results can guide further study and the creation of citizen science initiatives that support libraries and work towards sustainable development goals.

DISCUSSION

The purpose of this research question was to examine the relationship between the SDGs and current citizen science initiatives concerning libraries. According to the research, citizen science initiatives can be a powerful tool for libraries to support sustainable development objectives and interact with their local communities. By connecting with the SDGs, citizen science programmes can assist in achieving sustainable development outcomes while also providing important educational and research opportunities for library users. This

relationship to SDG 4.7 aspires to guarantee that all students gain the information and skills necessary to promote sustainable development (Fritz et al. 2019). The emphasis on SDG4, Quality Education, indicates that citizen science initiatives are supporting educational opportunities and skill development, both of which are essential for attaining sustainable development. To raise awareness of SDG 4, the libraries can organize training on information literacy, supply pertinent materials to promote students' learning, and involve library users in recurring information literacy initiatives (Dei, D.-G.J. and Asante 2022). Libraries can also engage their patrons in ongoing information literacy projects that can foster a community of learners and proponents of sustainable development.

These findings show how citizen science initiatives can help to realize SDG 6 by giving residents the chance to monitor and gather information on water quality, find potential causes of contamination, and promote better water management techniques (Dörler et al. 2021). These initiatives can also increase public knowledge of the value of clean water and sanitation, foster community involvement, and empower residents by including individuals in water quality monitoring. Libraries can offer a venue where locals can access and exchange knowledge on water management strategies, sanitation practices, and water quality. Also, libraries can offer instruction and materials so that anyone can take part in citizen science initiatives for monitoring water quality (Scistarter, 2020). SDG 8 was addressed by initiatives that promoted entrepreneurship and innovation as well as the development of STEM-related employment opportunities. SDG 11 projects seek to encourage sustainable urban development, for example, through neighborhood-led planning and green infrastructure projects. The result indicates that citizen science initiatives can help communities become more resilient to environmental threats and advance sustainable urban development. These initiatives can aid in the creation of more equitable and sustainable municipal policies and practices by including individuals in the monitoring and management of local resources (Wuebben, Romero-Luis, and Gertrudix 2020).

Based on findings, citizen science initiatives can be crucial in advancing SDG 15 by raising public awareness of the significance of terrestrial ecosystems, assisting in the gathering and analysis of data, and encouraging the preservation and sustainable use of land resources. iNaturalist raises public awareness of biodiversity and its significance for sustainable development by involving the public in data collecting and species identification(Callaghan et al. 2022). Meanwhile, the significance of capacity-building and knowledge-sharing, which were seen as crucial components for developing effective partnerships and advancing sustainable development more generally, emerged as another major subject regarding SDG 17 (Wuebben et al., 2020). The study's main finding is that through Citizen Science initiatives, libraries can significantly advance scientific understanding connected to the SDGs. Libraries may play a role in ensuring that Citizen Science projects are effective and contribute to the attainment of the SDGs by acting as a resource center, a storage hub, and by offering support in data management and analysis. Libraries in the US and Europe are expanding their programmes, capacity, and infrastructure to give their communities CS research opportunities (Ignat et al., 2018). Yet, they also indicated a desire to work with libraries and showed support for the notion of libraries taking a more active part in Citizen Science programmes. To encourage community participation, libraries can serve as a hub for citizen

science programmes related to SDGs by offering assistance, resources, and knowledge. Libraries can help accomplish the SDG while also giving their users beneficial educational and research opportunities by collaborating with citizen science initiatives.

CONCLUSION

To conclude, this study shows how citizen science initiatives can be used by libraries to engage their communities and support sustainable development goals. According to the findings, to achieve the SDGs, libraries, and citizen science initiatives should work more closely together and actively pursue this alignment. The conclusions of this study can guide future investigations and the creation of citizen science initiatives that support libraries and work toward reaching sustainable development objectives. The major goal of libraries is to support education and research that improves society, which is in line with the objectives of citizen science, which is now acknowledged as a potent tool for environmental study. One of the main recommendations from this study is that libraries work with citizen science initiatives and coordinate their initiatives with the SDGs to contribute to the goals of sustainable development. To promote citizen science and accomplish sustainable development objectives, libraries can be vital partners. Libraries may provide their users with worthwhile educational and research opportunities as well as increase community engagement by adding citizen science initiatives into their programmes. Public libraries can serve as community centers and as a source of leadership in the promotion of citizen science (Cigarini et al., 2021). Libraries are advancing their infrastructure and innovating their services to achieve the UN 2030 SDG goals, and citizen science is a crucial component of this. Therefore, academic libraries must understand their capacity to assist citizen science and to take a proactive approach to its promotion and progress.

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Exploring the Roles and Responsibilities of Librarians in Data Visualisation:
A Road to Open Data Service

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ABSTRACT

Data visualization, as a library service, can help users present complex data in a more understandable visual form and promote data sharing and reuse, which is in line with the core principle of open science - the concept of open data. This study aims to explore the role and corresponding responsibilities of Chinese academic librarians in data visualization to promote the development of open data services. The study purposefully invited 12 librarians with experience in providing data visualization services from 10 top-tier universities in China, collected data through semi-structured interviews, and analyzed the data using NVivo software to gain insights into the roles and responsibilities of librarians in the process of data visualization services. The findings suggest that the role of librarians in the context of increasingly embedded DV implementations in libraries is becoming more diverse, including but not limited to Steward, Trainer, Collaborator, and Advocate. Meanwhile, librarians are taking on more responsibilities related to data visualization, such as enriching open data platforms, guiding users on data features and visual services, helping users develop data visualization skills, and promoting data-driven innovation, etc. This study provides valuable insights into the evolving role of librarians in the age of open data and offers practical guidance for librarians who wish to use and implement data visualization services to support such initiatives. Meanwhile, the continued promotion of data visualization in the open data environment will also help researchers better communicate their findings and ideas and make their work understandable to a wider audience, which is an invaluable way to promote transparency and collaboration in scientific research.

Keywords: Data Visualisation; Open Data Service; Academic librarian; Role and Responsibility

INTRODUCTION

The rise of open data has led to an exponential growth of publicly available and accessible datasets, while the effective interpretation and integration of these heterogeneous, vast, and distributed datasets poses new challenges for research and decision-making processes. Data Visualisation (DV), employing visual elements such as charts, graphs, and maps, has evolved into a pivotal tool for facilitating open data integration by intuitively presenting intricate underlying data (Carvalho et al. 2015). (Carvalho et al. 2015). In recent years, as academic libraries have progressively engaged in open science and open data initiatives, they have taken on the responsibility of acquiring, managing, and storing research data. They have emerged as fundamental hubs for research data services and have evolved into vital proponents of research data visualization (Tenopir et al. 2013). Within this context, data visualization aims to facilitate users' enhanced understanding of data, the discovery of patterns and insights within datasets, and the extraction of deeper insights. This pursuit serves to advance research, facilitate decision-making, and foster innovation. It signifies a novel approach that encourages broader access to and utilization of data within the researcher and academic community.

Increasing evidence suggests that Data Visualisation Services (DVS) as a library practice is an inevitable trend (Ogier and Stamper 2018). According to the Association of College and Research Libraries (ACRL) publication "Top Trends in Academic Libraries 2020", most libraries that offer advanced research data services have already provided support and training in DV and related areas (ACRL Research Planning and Review Committee 2020). Given the demands and transformations in the development of DVS, librarians, as the primary providers of library services, have unique position opportunities and professional advantages to contribute to the exploration of DV in libraries and play a crucial role in promoting access to open data services. The library field in the United States has also investigated the various factors influencing library services, with results showing that librarians' influence exceeds that of resources and the environment by 75% (Chen and Ke 2018). Clearly, researching the role positioning and responsibilities undertaken by librarians in specific service contexts is of utmost importance and should not be overlooked.

In light of the significant influence of technological advancements, evolving tasks, changing user demands, and the transformation of library services, the roles and responsibilities of librarians are undergoing dynamic shifts and expansions, surpassing the traditional realm of information services, resulting in more diverse role descriptions (Luo 2018). However, despite the growing discourse on data visualization services in academic libraries, there remains a dearth of analysis regarding the role positioning, and responsibilities of librarians in the context of providing such services, which will not be conducive to the development of a positive library service model in the new technological change environment.

Therefore, this paper intends to explore the multidimensional role of librarians in data visualization and the potential responsibilities they may face by capturing the real-world perceptions and insights of actual operational participants. By facilitating an open discussion, it is hoped that this research will inspire librarians and information professionals to embrace

data visualization as a strategic tool for their open data services, recognizing its potential to drive innovation and empower development.

LITERATURE REVIEW

Research has shown that the human brain is more efficient in processing visual images than numerical information. Therefore, it is possible to transform complex data into visually clear representations through visualization techniques, enabling users to obtain valuable information with greater speed and sharper insights (Murphy 2013; Finch and Flenner 2016). With the rise of big data and open data, data visualization has gradually emerged as a crucial tool for enhancing data comprehension, gaining insights into emerging trends, and driving data-driven decision-making. As a result, it has garnered significant attention within the library industry (Wen et al. 2020).

Numerous studies have consistently indicated that in recent years, data visualization has increasingly been integrated into libraries, making it a new exploratory trend in library services (Eaton 2017; Zakaria 2021). Scholars have discussed the significance of data visualization services, noting that it extends research data management provided by libraries (Stamper 2019) and represents a powerful transformation from information services to knowledge services (Chu and Zhao 2019). It is believed that data visualization can also facilitate transparency, collaboration, and accessibility in the research process. By making data and research findings easier to access and understand, researchers can encourage others to build upon their work and foster an open and collaborative culture in scientific research (Suwanworaboon et al. 2020). Similarly, researchers from different countries and regions have conducted surveys on data visualization from a supply perspective, finding that its services encompass various aspects, including information support, resource services, Consultancy analysis, and literacy education (LaPolla et al. 2020; Zakaria 2021; Su et al. 2022). This reaffirms the increasing importance and prevalence of data visualization in library services, particularly in the context of current demands for data openness, which warrants further exploration.

The study of librarians' roles has been a prominent topic in library science. Whether it pertains to improving service models or exploring library development, numerous researchers have emphasized the indispensable role of librarians as service leaders in the evolution of library services (Shupe 2015; Huo and Lu 2020). As the social, technological, and demand landscape within libraries continues to evolve, Luo (2018) conducted an analysis of bibliographic information from English-language journals and found that the responsibilities and roles of librarians have undergone transformational changes. Librarian roles have shifted from information assistants to trends of trainers and technical support experts, and that the new, highly professional role of librarians is also being given a more diversified set of responsibilities. Moreover, based on case analyses of data management services, Choudhury (2008) identified novel roles and relationships between libraries and academia, with a specific emphasis on the collaborative relationship between librarians and researchers in the realm of research data. According to the research by Thomas and Urban (2018), data librarians can

assume various roles in library services, including data manager, data engineer, data steward, data curator, and data scientist, among others. Chinese researcher Gu (2020) further emphasized the significance of categorizing the professional roles of data-related librarians based on the level of data resource handling in an open science environment, and this perspective is derived from a summary of previous studies. Notably, the influential role of librarians in enhancing users' literacy and promoting civic engagement has been acknowledged. Researchers propose that roles such as resource integrator, partner, and facilitator can significantly shape the direction of librarians' work (Kine and Davidsone 2022).

As data visualization technology becomes deeply embedded in libraries, studies in this field have attempted to analyze how roles such as "Data visualization Experts" established at Ohio State University, "Embedded Librarians," and "Data and visualization Science Consultants" provided by Duke University Library assist libraries in offering users professional and personalized services (Wen et al. 2020; Zakaria 2021). The emergence and evolution of these specialized titles provide librarians with a more defined dimension to their roles. However, they also bring about heightened responsibilities, necessitating continuous updates and improvements based on real-world practices.

RESEARCH DESIGN

The aim of this study is to examine the roles and responsibilities of librarians in data visualization from a service perspective, thereby analyzing their potential as catalysts for open data services. To achieve this research objective, the following research questions are addressed in this research:

(a) What roles do librarians play in the data visualization services provided by the library within the context of open data?
(b) What specific responsibilities should librarians assume in the data visualization services, corresponding to their professional role?

This is an exploratory study that collects qualitative data through semi-structured interviews. One major advantage of selecting a semi-structured interview approach is that it provides interviewees with considerable freedom to deviate from and expand upon the research topic, allowing for a more flexible exploration based on participants' responses (Polit and Beck 2010; Bryman and Bell 2015). For this study, a web survey and environmental scan were conducted on the official websites of academic libraries affiliated with 42 top-tier universities announced by the Chinese Ministry of Education (MOE). Ultimately, 16 academic libraries (ALs) with more extensive experience in providing data visualization services were selected as the potential sample for this study (The flow is shown in Fig. 1). Academic librarians with experience in providing data visualization services or possessing academic backgrounds in data visualization were purposely sampled as they were believed to provide more insightful perspectives on data services and visualization support, thus serving as better research participants for generating high-quality responses related to the study.

The selection of the sample primarily included the following inclusion criteria:
(a) They have shown interest in the study and are willing to be interviewed.
(b) They are librarians from the sampled academic libraries.
(c) They have a certain level of work experience or academic knowledge related to data visualization.
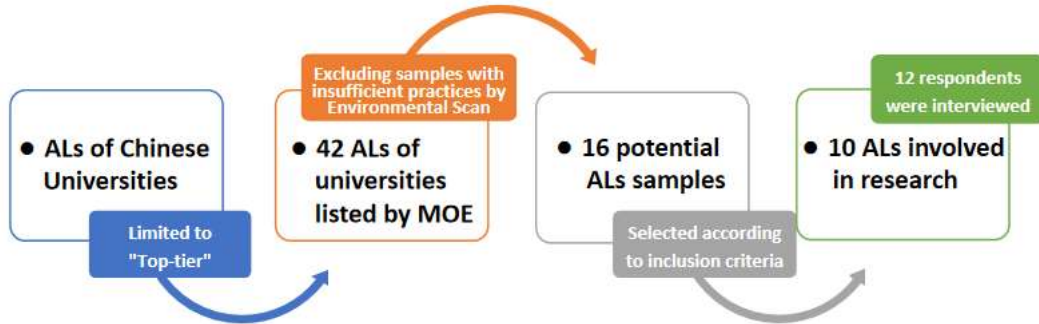
Figure 1: The Flow Diagram of Sample Selection

Ultimately, 12 librarians from 10 university academic libraries who met the above criteria were invited through email invitations and recommendations and were interviewed between November 2022 and March 2023. The demographic attributes of the participants are listed in Table 1. To ensure the anonymity of the respondents, each Academic Librarian participant was given a serial number from AL1-AL12 and the 10 universities to which they affiliated were coded as A-J. Due to the pandemic management policies in China, interviews were conducted through online meetings and face-to-face interviews, with each interview recorded using both recording software and digital recorders, ensuring clarity and accuracy in data collection.

Table 1: Demographic Attributes of the Participants

Code	DVS experience	Code	DVS experience
AL1A	Consulting Report	AL7F	Digital Resource Construction
AL2B	DV Software Lecture	AL8F	Data Analysis & DV Seminar
AL3C	Project Planning & coordination	AL9G	Annual Reading Report
AL4D	Core curriculum instruction	AL10H	Information Consultation Services
AL5D	Open Resource Platform	AL11I	Literacy Competitions & Training
AL6E	DV Service Platform & Project	AL12J	Literacy Education Support

RESULTS

With the transformation of the library's technological environment and service functions, the professional identity of librarians has undergone dynamic changes, and the responsibilities they face are continuously evolving (Luo 2018). In the context of open data, the emergence of more data visualization-related service scenarios is disrupting the role positioning of

librarians, shifting from a supportive role to a more dominant position. Leckie et al. (2016) pointed out that, apart from certain specialized roles, professionals often play many different roles throughout the day, including managerial, advisory, and even research-related roles. This study describes the job roles of librarians in providing Data visualization Services (DVS) to analyze the tasks they need to undertake based on their roles. It is a repositioning of the responsibilities and functions of librarians and provides support for the subsequent capabilities of librarians in Data visualization Literacy. By understanding and analyzing the perspectives of participants, the preliminary findings reveal that librarians in academic libraries in Chinese universities play four main roles in data visualization services: Steward, collaborator, trainer, and advocate (see Table 1). The specific responsibilities they may need to assume are as follows:

Table 2: Librarians' Roles and Responsibilities in providing DVS

Role	Responsibility
Steward	Coordinate relevant resources and enrich the open data platform
	Establishing effective bidirectional interaction with stakeholders
	Improving management efficiency and service quality
Collaborator	Building collaborative partnerships throughout the research lifecycle
	Promote knowledge integration across disciplines and stakeholder
	Assist users in capturing data features and visual representations
Trainer	Provide a diverse range of training and educational activities
	Developing high-quality open educational resources for DV
Advocate	Advocating actively for the significant value of DV & open data
	Promote innovation in data-driven decision-making and services

Steward

The role of a steward has traditionally been defined as "the person who directs, supervises, or manages something", while more proactive accountability of "prudent and responsible administration" has elicited development in recent years (Constantinescu 2018; Fagan et al. 2020). From the perspective of providing data visualization services, stewardship is the fundamental mission of librarians. It should be based on David Siewert's concept of "sustained attention" and should involve stewardship in multiple dimensions such as planning, guiding, and managing applications. This role maximizes the utility of library resources and services, providing support for the transformation of the open science environment and the exploration of open data services. Analysis of the interview data revealed three responsibilities described below.

As stewards, librarians have the crucial task of providing appropriate leadership in their work, macro-organizing, and managing various resources such as data and information. As more and more libraries are building and improving open data platforms to assist researchers in storing, sharing, and reusing datasets, providing corresponding statistical data and visualizations will be one of the important directions in the future transformation of library services.

In terms of our current library development direction, if he wants to do this data visualization, perhaps our focus might be on the construction of this discipline and academic support. This is the focus of future development... This data visualization is definitely based on our resources. At least it should touch all the data in the entire library, including resources, services, and most importantly, various types of user data. All data should be clearly mapped and then connected to the system. Then, his visualization work will be carried out quickly and effectively. (AL3C)

Furthermore, data visualization as a library service also implies its orientation towards different stakeholder groups and diverse user needs. It is necessary for librarians to enhance their communication and application skills, establish direct and two-way interactive relationships with stakeholders through proactive development, feedback-oriented improvement, and continuous refinement. This enables correct service positioning and navigation, resulting in mutual benefits.

Actually, we have always adhered to a user-centered approach... In recent years, there has been an increasing demand from library users for intelligence analysis and data services... I believe we must fulfill this intermediary role, integrating users' research data and information resources more closely through our services. (AL6E)

Pursuing higher levels of management efficiency and optimizing the operational effectiveness of library services should be a constant work guideline for librarians. As the suppliers of library services, librarians can contribute to the development and sustainability of the library by organizing and managing resources, human resources, time, and other aspects through rational workflow planning, optimized task allocation, and the utilization of visualization tools.

It can be said that we are currently in an era of information explosion with abundant resources and human resources in the library... How to efficiently allocate and coordinate these resources, how to help users efficiently obtain what they need, or how we can help them save time, these are what we need to do... (AL9G)

Collaborator

Collaborators are individuals who actively and reliably utilize their professional abilities to assist others in achieving plans, organizing, guiding, evaluating, and other work tasks with higher quality and efficiency (Nolen et al. 2021). Various studies have emphasized the benefits of collaboration between research teams and librarians, leading to better research outcomes and easier problem-solving (Reynolds et al. 2013; McBurney et al. 2020).

As collaborators in the field of data visualization services, the primary responsibility of librarians is to establish close partnerships with researchers, data providers, social organizations, and others throughout the research lifecycle. They collaborate with various stakeholders to facilitate data acquisition, management, and sharing. Librarians actively engage in collaborative and co-creation projects, providing expertise in data management,

analysis, and visualization. They assist partners in data processing and visual presentation to achieve shared research goals.

> I believe this should be a role of a research collaborator, offering assistance in research to students and faculty in areas they are not familiar with, and providing professional collaboration. (AL2B)
> Just like many foreign universities have similar specialized librarian positions to connect disciplines, departments, and researchers, playing a bridging role in scientific research. (AL7F)

Moreover, librarians' subject-specific services can serve as effective liaisons for disciplines. With their professional understanding of research trends and information architecture in specific disciplines, they possess the expertise to help address interdisciplinary research by providing researchers with solutions and seeking answers to questions (Noren et al. 2021). This demonstrates their role in serving the discipline's development. Librarians engage in interdisciplinary collaboration, integrating knowledge and expertise from different fields. They collaborate with researchers from various disciplines, facilitating the application of data and cross-disciplinary research. By providing targeted support and collaboration through data processing and visualization, they foster cooperation and innovation across different disciplines.

> The library is now far beyond the scope of the original purely documentary resource service...like our university, maybe the important aspect of the library is not only to serve the teachers and students but also to focus on the development of multidisciplinary integration and first-class construction. (AL1A)

In the context of data visualization services, librarians collaborate by assisting partners in capturing data features and facilitating visual representation. They provide guidance on data visualization tools and techniques, offer cutting-edge intelligence analysis reports in specific disciplines, and assist in data acquisition and knowledge resource integration. These efforts help collaborators extract data features, accomplish visual transformations, and drive data-driven decision-making.

> In fact, we play a role as a medium, relying on the information resources within our library and the library platform, providing our users with these large-scale basic data based on scientific research literature, factual data, patent data, or patent indicators...thus helping our users, whether they are researchers, academic leaders, or external institutions, to obtain more accurate and intuitive data features and information. (AL10H)

Trainer

A trainer refers to someone who helps stakeholders improve their knowledge and skills and fulfill their motivational needs by providing teaching or practical opportunities (Manuell and Adams 2016). With the ongoing reforms in higher education, universities are placing more emphasis on cultivating student competence (Kirker 2022). University libraries, not only serving as traditional information resource institutions but also carrying important training

responsibilities, are instrumental in meeting the demands of higher education. By assuming the role of trainers, librarians can assist users in acquiring data visualization literacy necessary for learning, research, or future work, enhancing their data analysis and decision-making abilities, and thus better utilizing open data while promoting the development and quality of library services.

On the one hand, the starting point for cultivating users' data visualization skills lies in providing training and educational activities. Librarians can design training courses suitable for different levels and content based on users' needs and proficiency. Through well-organized skill enhancement programs, workshops, customized embedded courses, and competitions, librarians can popularize users' awareness of data visualization, impart basic knowledge and skills in data visualization, and actively promote the cultivation of data visualization literacy, thus playing the role of literacy trainers.

> From a curriculum point of view, it is clearer that we play more of a role as a literacy educator. However, if we think about it from a competitive point of view, I think it is more diversified, not through one event that can play an educational role, but through a systematic chain and a process... We can fully integrate multiple educational models such as courses and competitions with each other to get students actively involved. (AL11I)
>
> For universities, the library is essentially an educational and research environment, and we librarians are constantly exploring better ways to enhance user literacy in many ways, from awareness-raising to basic pedagogy to advanced seminars. (AL12J)

On the other hand, in the context of open science, the development of open educational resources will undoubtedly be a key direction for the future cultivation of data visualization. Librarians can develop and provide various educational resources such as instructional manuals, online tutorials, video lectures, etc., to support users' learning and independent exploration. These resources can include fundamental knowledge of data visualization, operating guidelines, sample codes, and datasets, providing users with reference materials and practical materials for learning. At the same time, by organizing learning groups, online communities, and other means, users are encouraged to share experiences, learn from each other, and collaborate, thereby promoting the dissemination and sharing of data visualization knowledge.

> We are currently working on a cloud-based teaching and research project, which aims to provide more convenient teaching and research opportunities and diverse shared resources for members through the collaboration of multiple university libraries and online communication and discussions. We are also continuously inviting more libraries to participate. (AL4D)

Advocate

An advocate is someone who understands the value and importance of what they advocate for and consciously pleads for a cause, voluntarily conveying or presenting ideas. Librarians are among the important advocates in the development of library services. When librarians

advocate for the services they provide, they are essentially advocating for the values of the profession (Hicks 2016).

In the trend of open data and sharing, as advocates, librarians should be committed to upholding the positive value of data visualization. They encourage the visual representation of data through data visualization by advocating for open data policies and urging governments, organizations, and research institutions to provide data resources in an open manner to the public and research communities. Librarians actively participate in data visualization initiatives and raise awareness and understanding of open data and its application through popularization, promotion, and dissemination activities.

> The important task requires that we play an active role by ourselves as librarians...assist the school's discipline construction, talent introduction, decision-making consultation, and help colleges and researchers to study topics and facilitate the smooth implementation of projects. (AL5D)

In the context of data visualization services in libraries, promoting data-driven innovation is equally important. This means that librarians should actively utilize data visualization techniques and methods to stimulate and support innovative thinking and drive and guide decision-making and problem-solving processes based on the potential of data. By applying data visualization to specific projects or domains, librarians can uncover new insights, develop new service models, and provide more innovative and targeted services, thereby enhancing the value and impact of the library.

> In a data-driven context, there is a pressing need to change our understanding of the functions, nature, and roles of libraries. Whether it is data services or visualization services, the main purpose is to enhance the soft and hard capabilities of our libraries, requiring our librarians to use their own initiative to help optimize it more effectively. (AL8F)

The findings generally affirm the irreplaceable role of librarians as service providers and emphasize the important role of librarians in data visualization and the description of targeted responsibilities. It is evident that librarians have multiple roles depending on their different service requirements, with each role involving intersecting and complementary tasks, including Steward, Trainer, Collaborator, and Advocate dimensions. Furthermore, it is evident that the participants generally hold an optimistic attitude towards the development path of data visualization provided by libraries. They believe that data visualization, as a library service, will bring new opportunities to libraries in the data-driven era through continuous optimization of service models and exploration of service depth.

CONCLUSION

Data visualization has become a powerful tool in the era of open data, enabling organizations and individuals to effectively understand and communicate complex information. Library

Data visualization Services (DVS) can assist users in presenting complex data in a visual format, creating clear and meaningful visual representations. These visualizations can be used to facilitate scientific communication, showcase research findings, and attract more scientists to a specific field of study, thereby promoting collaboration and data sharing. The findings of this study indicate that under the influence of multiple factors, some traditional roles of librarians are gradually being integrated or replaced by technology. The role description of librarians has become more diverse, with overlapping and multiple role orientations. The roles of library administrators, trainers, collaborators, and advocates have their own background characteristics and task requirements. As they integrate and grow together, higher demands are placed on the corresponding data visualization skills of librarians.

While emphasizing the positioning and differentiation of librarians' roles and responsibilities, we should also recognize that driving library practice and achieving excellence in the library profession necessitates librarians to continuously enhance their knowledge and skills, optimize their professional attributes and conduct, encourage the ongoing professional development of colleagues, and foster the ambitions of potential industry members. By bridging the gap between data creators and data consumers, librarians can effectively interpret and utilize data, thereby facilitating the transformation and upgrading of library knowledge services and enhancing competitiveness in open data services.

The insights gained from this study will better position librarians for their new roles under data visualization services, provide a description of the job responsibilities to which they may be exposed, as well as suggest new ideas for optimizing and upgrading librarianship under the requirements of open data services. Nevertheless, it should be noted that the scope of this study only attempted to explore the views and perceptions of academic librarians in selected universities in China, and the sample size was relatively small, which may limit the general applicability of the findings, and we expect to be able to consider in-depth service scenarios and invite a wider group of respondents to participate in future studies in order to gain a more comprehensive understanding of our research questions.

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Exploring Research Data Management in Academic Libraries in Nigeria: Drivers, Challenges, Stakeholders and Influencing Factors

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ABSTRACT

As Nigerian academic libraries generate larger and more complex datasets that require effective management and sharing, a holistic and strategic exploration in the area is required to understand the challenges of research data management and the key activities involved in each stage. This study aimed to explore stakeholder awareness as well as the drivers, challenges, and influences of RDM in Nigerian university libraries. The current study is unique in scope and methodology as it employs a pragmatic triangulation approach to obtain quantitative and qualitative data from many respondents (N = 171) and from different institutions (N = 13). A population of 197 respondents including 171 librarians across 13 academic libraries in North-East Nigeria was drawn for the quantitative phase and 26 heads of research and IT departments from each institution for the qualitative interview. The study concluded that there is a high level of awareness of RDM and librarians are the major stakeholders in the RDM process. The study found that Data-driven Research and Data privacy, protection, and security (mean=4.41), collaboration, and partnerships (mean=4.10) are the required drivers and influencing factors for academic libraries to adopt RDM practices. The study revealed a dearth of specialists/experts (mean=3.85), which leads to ineffective RDM application while adequate stakeholder support (mean=4.44) and compliance of policies with funding agencies can aid in addressing the challenges of application of RDM in academic libraries. This study may inform the development of similar initiatives in other African countries facing similar challenges in managing and sharing research data.

Keywords: Research Data, Research Data Management, Nigerian Academic Libraries, Drivers of RDM, RDM Stakeholders, and Influencing Factors of RDM.

INTRODUCTION

Libraries are the best agents for handling research data management (RDM activities as the library professionals are trained in the skills of organizing and preserving information for posterity (Payal & Tripathi, 2019). Anduvare (2019) reported no framework to guide RDM and data support services among Kenyan private universities as he submitted that researchers managed their data in different formats and scattered it all over the shelves and computers.

Singh, Bharti & Madalli (2022) opined that with the emergence of Data Librarianship as a new role for LIS professionals, academic and research libraries around the world have begun to adopt new services, such as RDM or RDS, along with the traditional ones, to establish themselves as leaders and respected collaborators in the field of research data management. Research Data Management (RDM) has recently gained increased traction among facilitators of academic activities, including researchers, institutional administrators, academic libraries, and funding organizations (Huang et al., 2021; Reichmann et al., 2021). Many studies highlighted the established. However, Sheikh, Malik & Adnan (2023) revealed that data-sharing practices and the development of RDM services in libraries are more prevalent in developed countries.

Several studies discuss research data management (RDM) services in libraries, particularly in academic libraries in Nigeria (Ekeh et al., 2023; Eke et al., 2022; Nwabugwu & Godwin, 2020; Zotoo & Liu, 2019; Abdulyadan, 2018). These articles highlight the importance of RDM in organizing and preserving research data, and the role of academic libraries in providing RDM services to their stakeholders. However, there is limited information on the awareness of stakeholders in Nigerian libraries about RDM. Hombali (2022) supported that libraries in Nigeria play a crucial role in RDM ensuring that research data is well-organized, easily accessible, and preserved for the long-term is to assist researchers with developing data management plans.

In academic libraries, Research Data Management (RDM) services include the process of sensitizing researchers on research data creation, collection, management of institutional data repositories, developing data management plans, and applying metadata for describing datasets. Masinde, Chen & Muthee (2021) argued that researchers are turning to academic libraries to manage their data owing to paradigm shifts in scientific research that are being propagated by cyberinfrastructure, funder mandates for research data sharing, and the proactive role of libraries in shaping scholarly communication. The services of Research Data Management include a range of tools and support systems that libraries offer to help researchers and faculty members organize, document, and preserve their data during and after their research activities are finished (Payal & Tripathi, 2019).

Insignificant studies were conducted to examine how academic libraries in Nigeria collect, manage, and apply metadata for the discovery, sharing, and reusing of research data (Masinde, Chen & Muthee, 2021; Payal & Tripathi, 2019; Nhendodzashe & Pasipamire, 2017). However, even though there is growing momentum in research data management activities in academic libraries in Nigeria, the level of application of RDM activities has not been consistent due to a lack of clear-cut policy guidelines and influencing factors. Academic libraries play vital roles in research data management activities (Sheikh, Malik & Adnan, 2023; Tang & Hu, 2019; Faniel & Connaway, 2018; Perrier, Blondal & MacDonald, 2018), but their level of application is still in the early stages. In the same vein, Ekeh et al (2023) argued that managing research data is an emerging area of activity, where responsibilities and practices within libraries are generally not yet firmly established.

The limited information on the awareness of stakeholders in Nigerian libraries about RDM calls for the need to determine the level of awareness and understanding of RDM among stakeholders in Nigerian libraries. There are just a few institutions in Nigeria that are engaged

in generating evidence-based research on the nature and direction of data governance in Nigeria (Eke, 2022). This is evident in the dearth of literature on data governance and data ethics in the Nigerian university curriculum which may hinder effective research data management in Nigerian libraries. According to Nwabugwu & Godwin (2020), technology obsolescence and fragility are some of the challenges facing effective RDM services in Nigerian libraries. This means that libraries may not have access to the latest technology or may experience technical difficulties that hinder their ability to manage research data effectively. There may be a lack of awareness of RDM practices among librarians in Nigeria which may extend to other stakeholders in Nigerian libraries, such as researchers and students.

The major research questions (RQs) of the current investigation were as follows:

RQ1: What is the level of awareness about the Research Data Management (RDM) activities in academic libraries in North-Eastern Nigeria?

RQ2: Who are the relevant stakeholders involved in the RDM activities responsible for effectively managing and preserving research data?

RQ3: What are the drivers and influencing factors contributing to the application of the Research Data Management (RDM) process in academic libraries in North-Eastern Nigeria?

RQ4: What are the challenges hindering the successful implementation of RDM practices and the strategies to overcome such challenges in the academic libraries under study?

By addressing these research questions, the current investigation will contribute to the understanding of the state of RDM in Nigerian academic libraries and provide implementable recommendations that will enhance RDM activities, increase awareness, define stakeholder roles, and improve the IT infrastructure for the effective adoption and implementation of Research Data Management (RDM).

A study on the drivers, challenges and influencing factors of research data management (RDM) in Nigerian academic libraries is an important step toward understanding the current state of RDM services in Nigerian libraries and identifying ways to improve them. Several empirical research suggests that while some RDM services are being offered in Nigerian libraries, there are also challenges that need to be addressed, such as technology obsolescence, funding, and lack of awareness. By identifying the stakeholders and drivers for adopting RDM in Nigerian academic libraries, this study can help to improve the effectiveness of RDM services and ensure that Nigerian libraries are equipped to manage research data effectively.

METHODOLOGY

The study adopted the pragmatic assumption of conducting an empirical investigation due to the specific objectives and nature of the research problem. However, considering the aim of exploring the drivers and influencing factors of Research Data Management in academic libraries in Nigeria, a mixed-methods research design was considered suitable. The design

allowed the integration of qualitative and quantitative approaches, providing a comprehensive understanding of the topic. The 'Quantitative Phase' included the conduct of a survey among the librarians and IT-supported staff in the 13 academic libraries under survey and assessed the level of awareness and understanding of RDM practices, information on the availability of IT infrastructure, and resources for data management. The second method was the 'Qualitative Phase' involved an interview with the key stakeholders, including 13 heads of libraries and 13 heads of IT departments of the libraries, to explore their perspectives on the drivers, challenges, and influencing factors related to RDM adoption in academic libraries.

DATA ANALYSIS

The quantitative survey responses were analyzed using descriptive statistical techniques to identify patterns and trends between variables related to awareness, IT infrastructure, and RDM adoption. The qualitative data was analyzed through concept-driven qualitative data coding using a predefined set of codes. Relevant policy documents, guidelines, and reports related to RDM practices and IT infrastructure in Nigerian academic libraries were also analyzed using document content analysis. A triangulation mixed-methods research design was followed in integrating the findings which captured the comprehensive view of the factors influencing RDM adoption, addressing the limitations of a single-method approach

The integrated findings were used in developing themes, emerging patterns, and discrepancies between the survey data and qualitative insights. A deeper understanding of the research problem was established including strategies and recommendations for overcoming the challenges and promoting the adoption of RDM process models in Nigerian academic libraries.

Study Area

The study was conducted in 13 academic libraries in North-Eastern Nigeria (7 Federal-owned University Libraries and 6 State-owned University Libraries). The study purposively selected these academic libraries which stand as hubs for providing research services to the region and practice research data management activities, including research partnerships and expert guidance in research-related activities.

Population and Sampling

Therefore, the researchers expect resourceful and high-quality data on the drivers, challenges, and influencing factors of RDS due to the combination of the relevant stakeholders. A population of 197 RDM stakeholders including 171 librarians across the 13 academic libraries were drawn for the quantitative phase and 26 heads of research and IT departments for the qualitative interview. Stratified random sampling was used to select librarians who filled out the questionnaires while participants from the qualitative interview were selected using judgmental sampling.

Pilot Study

A pilot study was conducted among 21 librarians and one head of IT at the Federal University Dutse Library. The researchers chose a different library but similar characteristics to check

the applicability of the instrument in addressing the research problem. The number was informed by the findings of Hill (1998) and Isaac & Michael (1995), who suggested samples of between 10-30 participants for pilot studies. Experts' assessment was also conducted to validate the application of constructs on the instruments. The outcome was then used to test the internal consistency of the instrument using the Cronbach alpha which produced an average above 0.7 for all constructs.

Table 1. Cronbach's alpha coefficients

S/No	Major Constructs on the Questionnaire	Number of Items	Cronbach's alpha
1	Level of awareness about the RDM process	9	.964
2	Relevant Stakeholders in the RDM activities	6	.715
3	Drivers and Influencing Factors for the Application of RDM Activities	7	.876
4	Status of RDM policy infrastructure	6	.826
5	Challenges and Strategies	12	.876
	5 Research Questions	**40**	**.851**

The Cronbach's Alpha computed for the five (5) items was **0.851** considered high enough to make the instrument reliable and acceptable for empirical investigations.

Return Rate

From the 171 distributed questionnaires, 149 were returned, representing an 87% return rate. This response rate is considered excellent according to Morton, Bandara, Robinson, and Carr (2012), that a return rate approximating 60% is considered good, and a 50% return rate is considered suitable for analysis, 70-85% return rate is considered very good, while a return rate above 85% is regarded as excellent. Out of the 26 respondents for the qualitative interview, 16 heads of research and IT department participated in the interview.

DATA ANALYSIS AND DISCUSSION

The quantitative data collected were cleaned to identify any errors, missing values, or outliers, which ensured that the data was complete and consistent for analysis. Descriptive statistics such as mean and standard deviation were used to summarize the data on the respondents' level of awareness about the RDM process, policy, and infrastructure for the implementation of RDM. This helps in providing an overview of the variables and understanding the distribution of responses. For the qualitative analysis of the study, the collected data were analyzed using concept-driven qualitative data coding involving assigning descriptive labels to the specific ideas, concepts, and themes that emerge from the data. Interviews were conducted with heads of research and IT departments to establish their skills and knowledge in fostering a culture of responsible data management and supporting the broader research ecosystem.

> **RQ1:** What is the level of awareness about the Research Data Management (RDM) activities in academic libraries in North-Eastern Nigeria?

Table 2: Level of Awareness of RDM Activities

S/No	Awareness of RDM) Practices	N	Mean	SD	Decision
1	I am aware of Research Data Management (RDM) activities in this library	149	4.5888	.85133	**Accepted**
2	RDM practices enhance research integrity and reproducibility	149	4.2303	.98148	**Accepted**
3	I understand the concept of RDM practices through workshops and training	149	4.2039	1.06451	**Accepted**
4	I am aware of institutional policies and guidelines for RDM activities	149	3.4638	1.55175	**Accepted**
5	RDM practices are adequately supported by institutional policies and guidelines	149	2.4276	1.29279	Rejected
6	RDM practices improve the discoverability and accessibility of research data	149	2.0329	1.35908	Rejected
7	RDM practices contribute to the long-term preservation of research data	149	2.3355	1.36163	Rejected
8	I am aware that RDM practices facilitate data sharing and collaboration among researchers	149	3.5066	1.30496	**Accepted**
9	RDM practices facilitate data sharing and collaboration among researchers	149	2.5625	1.78073	**Accepted**

The study revealed that there is a high level of awareness of Research Data Management (RDM) activities in academic libraries in North-East Nigeria. The respondents were aware that RDM practices enhance research integrity and reproducibility (mean=4.23), and RDM practices facilitate data sharing and collaboration among researchers (mean=3.50) and also facilitate collaboration among researchers (mean=2.56). These findings also corroborate the studies of Sheikh, Malik & Adnan (2023), and Mavodza (2022), that creating awareness among researchers about the benefits of data sharing is a challenging task for libraries. On the contrary, the findings showed that the respondents were not aware that RDM practices are adequately supported by institutional policies and guidelines (mean=2.42), improve the discoverability and accessibility of research data (mean=2.03) and contribute to the long-term preservation of research data (mean=2.33). This finding is critical to the study as a significant number of the respondents were adequately aware of the application of Research Data Management (RDM) activities in academic libraries in North-East Nigeria.

RQ2: Who are the relevant stakeholders involved in the RDM activities responsible for effectively managing and preserving research data?

Table 3: Stakeholders Involved in RDM Activities

S/No	RDM Stakeholders	Available Response	Not Available Response
1	Institutional Researchers	**149**	**0**

2	Data Managers	**149**	**0**
3	Data Architects	**0**	**149**
4	IT Professionals for RDM	**149**	**0**
5	Network and Data Repository Managers	**149**	**0**
6	Librarians	**149**	**0**

The study revealed that 'Data Architects' are not available as stakeholders for RDM activities in academic libraries in North-East Nigeria. Ekeh et al (2023) also supported that librarians are the major stakeholders in the RDM process, responsible for developing policies, providing guidance on best practices, and assisting researchers in organizing and preserving their data. The IT professionals and repository managers contribute to the understanding of the institutional landscape for RDM in the university libraries, providing valuable insights into the adoption and integration of RDM policies, ensuring compliance with funding agencies, and offering a technical perspective on RDM practices in the university libraries. Students: Students, particularly those engaged in research or postgraduate studies, generate research data and interact with RDM practices. Their perspectives on data management, data sharing, and the availability of support services can provide insights into the specific needs and challenges faced by the student community in university libraries.

> **RQ3:** What are the drivers and influencing factors contributing to the application of the Research Data Management (RDM) process in academic libraries in North-Eastern Nigeria?

Table 4: Drivers and Influencing Factors Behind Application of the RDM Process

S/No	Drivers and Influencing Factors	N	Mean	SD	Decision
1	Institutional Support and Policies	149	2.4836	1.22665	Rejected
2	Research Integrity and Reproducibility	149	2.5132	1.32996	**Accepted**
3	Funding Agency Requirements	149	4.0691	1.35163	**Accepted**
4	Collaboration and Partnerships with Researcher Needs and Expectations	149	4.1086	1.05839	**Accepted**
5	Data privacy, protection, and security	149	4.4112	1.03663	**Accepted**
6	Data-driven Research	149	4.4112	.90032	**Accepted**
7	Open Science Research Data Sharing Initiatives	149	2.3289	1.38962	Rejected

The study found that the drivers for the application of RDM vary across institutions but are largely influencing factors in the successful application of Research Data Management (RDM) activities. Many funding agencies and grant providers in Nigeria (mean=4.06) such as the Tertiary Education Trust Fund (TETFund), the Education Trust Fund (ETF), and the Petroleum Trust Development Fund (PTDF) are increasingly mandating proper RDM practices across academic libraries as a requirement for research funding. Compliance with Data-driven Research and Data privacy, protection, and security (mean=4.41), collaboration, and partnerships with researcher needs and expectations (mean=4.10) are the requirement drivers and influencing factors for academic libraries to adopt RDM practices to meet the funding agency's guidelines. RDM practices contribute to ensuring research integrity by

promoting data sharing, and proper documentation of research findings. The global shift towards Open Science, which emphasizes the open sharing of research data, is also seen as a driver for the application of RDM activities for transparency and collaboration in making RDM practices more essential for academic libraries.

RQ4: What are the challenges hindering the successful implementation of RDM practices and the strategies to overcome such challenges in the academic libraries under study?

Table 5: Challenges hindering the successful implementation of RDM practices

S/No	Challenges to the Implementation of RDM	N	Mean	SD	Decision
1	Lack of investment in research capacity and training of stakeholders	149	4.2204	1.12610	**Accepted**
2	Inadequate research data Management Specialist	149	3.8586	1.28577	**Accepted**
3	Intellectual and license property issues	149	3.1743	1.37608	**Accepted**
4	Lack of professional preparation from institutions	149	2.4178	1.56060	Rejected
5	Fragmented Data Management Policies	149	2.6283	1.23614	**Accepted**
6	Lack of policy infrastructure	149	3.8487	1.42472	**Accepted**
7	Lack of priority among researchers and institutional mandates	149	4.2961	1.13066	**Accepted**

The research capacity and training are integral to the research data management landscape becoming increasingly complex and challenging. The finding revealed that a lack of investment in research capacity and training of stakeholders (mean=4.22) is undermining the research abilities of individual researchers, institutions, and systems in motivating the stakeholders to engage in the process of research data management. The findings also supported the conclusions of Sheikh, Malik & Adnan (2023) that institutional commitment, collaboration, academic engagement, technological infrastructure development, lack of policies, funding, and storage, skills, and competencies required for librarians to offer RDM-based services are some of the other significant challenges.

The main asset and driver for quality RDM activities are highly qualified human resources. However, the study revealed a dearth of specialists/experts (mean=3.85), which led to ineffective research data management application. The RDM policies involving training and support, access and reuse, security, and long-term preservation among other elements are seen to be fragmented (mean=2.62) as well as lack of policy infrastructure (mean=3.84). This causes a lot of problems for the successful application of RDM activities in academic libraries in Nigeria. Xu (2022) identified a lack of quantitative research, especially statistical analysis, on the effect of RDM interventions. However, the findings showed that lack of professional preparation from institutions (mean=2.410 and lack of priority among researchers and institutional mandates were not among the challenges of application of research data management in academic libraries in North-East Nigeria.

Table 6: Strategies for Overcoming Challenges of Implementing RDM

S/No	Strategies for Overcoming the Challenges	N	Mean	SD	Decision
1	Adoption of comprehensive RDM policies	149	4.7303	.52615	**Accepted**
2	User training of library staff and other stakeholders	149	4.4441	1.03575	**Accepted**
3	Adequate support from stakeholders, such as technical expertise	149	4.6678	.74781	**Accepted**
4	Voluntary submission of publications to the repositories	149	2.9145	1.69427	**Accepted**
5	Compliance of policies with funding agencies	149	4.7105	.99922	**Accepted**

Despite the aforesaid challenges, there are possible strategies to adopt research data management in academic libraries in North-East Nigeria. User training of library staff and other stakeholders (mean=4.44), adequate Support from stakeholders, such as technical expertise (mean=4.66), and compliance of policies with funding agencies (mean=2.9) can aid the addressing of the challenges of application of RDM in academic libraries. The findings corroborated the work of Gunjal, & Gaitanou, (2017), who highlighted strategies such as the adoption of policies, training of library staff, and support from stakeholders, such as technical expertise and academic fraternity can overcome the challenges of application of the RDM process.

Qualitative Interview Data Analysis

Reporting qualitative data in research requires ethical considerations. To ensure confidentiality, no individual library's research finding was reported but a general finding through pseudonyms. The data makes use of non-numerical data to generate themes deductively, starting with a predefined set of codes, and then assigning the codes to the new qualitative data collected.

Table 7: Concept-Driven Interview Report on RDM in Academic Libraries

Concept-Driven Code	Comments
The current state of RDM practices	*Respondents 1, 4, 5, 7, 13, 14, 15, & 16 majorly emphasized that libraries in North-East Nigeria are currently offering RDM services but these services are fragmented. T*here is a need for library staff to update their knowledge of RDM. *They are currently engaged in supporting communication among researchers, providing disciplinary and institutional resources, and emphasizing the importance of data and knowledge sharing.* *Respondents 2, 3, 6, 8, 9, 10, 11, & 12 revealed the current practice of RDM in the libraries has been motivated by internal and external factors, such as funding agency requirements and national policies. These to a large extent influenced RDM application in academic libraries in North-East Nigeria*
Drivers and Motivations for RDM Adoption	*Respondents 1, 3, 4, 5, 7, 9*, 10, 12, *13, 14, 15, &* 16 highlighted the drivers for *a*dopting comprehensive RDM policies to include; user training of library staff, *adequate support from stakeholders such as technical expertise and academic*

	brotherliness, voluntary submission of publications to the repositories, and compliance of policies with funding agencies; *While Respondents 2, 6, 8, & 11 were silent on the drivers motivating the adoption of RDM in their libraries*
Specific policies or guidelines in RDM activities	*Respondent 3, 4, 5, 7, 8, 9, 11, 12, 13, & 15 submitted that the "Policy on Data ownership" addressing issues relating to data rights and creation were available, while all the respondents affirmed that "Data Retention and Disposal Policy, Data Use and Reuse Policy, and Data Storage and Dissemination Policy" are available that outlined the rules and procedures governing data management in the libraries. Respondents 1, 4, 9, 10, 11, & 12 revealed that the "Data Software and Tools Management Policy" is put in place but in fragmented parts that address the management of software and tools used in data-related activities.*

Based on the summarized findings provided in Table VII, the research conducted in North-East Nigeria found that libraries offer RDM services but in fragmented parts by supporting communication among researchers, providing disciplinary and institutional resources, and emphasizing the importance of data and knowledge sharing as well, the librarians need to update their knowledge about RDM. This finding is in tandem with the submissions of Hombali (2022) and Nwabugwu & Godwin (2020) that library staff have a professional responsibility to update their knowledge about data management.

External factors and internal motivations, such as funding agency requirements and national policies, have influenced RDM application in academic libraries in North-East Nigeria. The drivers and motivations for RDM adoption include adopting comprehensive RDM policies, user training of library staff and other stakeholders, adequate support from stakeholders such as technical expertise and academic brotherliness, voluntary submission of publications to the repositories, and compliance of policies with funding agencies. Specific policies or guidelines in RDM activities include the policy on data ownership, data retention and disposal policy, data use and reuse policy, data storage and dissemination policy, and data software and tools management policy.

These findings suggest that academic libraries in North-East Nigeria are making efforts to provide RDM services, but there is a need for more comprehensive policies and guidelines to ensure effective RDM practices. These prove that policy guidelines are the backbone for RDM activities such as preservation, storage, quality, security, and jurisdiction to improve management and reuse research data (Nhendodzashe & Pasipamire, 2017). The findings also highlight the importance of external factors and internal motivations in driving RDM adoption in academic libraries.

The data retention policy on what kind of information or records should be processed for RDM should also be clearly outlined. Academic libraries in North-East Nigeria have fragmented data storage and dissemination policies which are not suitable for research data management activities. These findings can inform the development of RDM programs and policies in academic libraries in North-East Nigeria and other similar contexts.

Theoretical Implications:

The study contributes to the theoretical understanding of RDM practices in academic libraries, particularly in the Nigerian context. It provides insights into the drivers and

influencing factors of RDM adoption, as well as the challenges and barriers faced in implementing RDM processes. The findings can enrich existing RDM frameworks in the field of library and information science by providing empirical evidence and insights into the role of academic libraries in RDM activities. By exploring the drivers for RDM, the study sheds light on the understanding of how effectively RDM can foster collaboration, enhance data sharing, and promote open access to research outputs.

Practical Implications:

The findings of the study can inform policy development and decision-making processes related to RDM in academic libraries in North-East Nigeria. The identification of drivers and influencing factors can guide policymakers in creating supportive environments, developing RDM guidelines, and allocating resources to enhance RDM practices. Understanding the challenges, drivers, and influencing factors of RDM adoption can guide the development of capacity-building programs and training initiatives for librarians, researchers, and IT professionals targeting programs to enhance RDM knowledge, skills, and awareness among stakeholders. The findings have direct implications for promoting collaboration and partnerships between academic libraries and external organizations. This can lead to the sharing of expertise in RDM activities, ultimately fostering a culture of collaboration and knowledge exchange.

CONCLUSION AND RECOMMENDATIONS

The study concluded that there is a high level of awareness of Research Data Management (RDM) activities in academic libraries in North-East Nigeria. The study concludes that librarians are the major stakeholders in the RDM process, responsible for developing policies, providing guidance on best practices, and assisting researchers in organizing and preserving their data. While the IT professionals and repository managers as stakeholders contribute to understanding the institutional landscape for RDM in academic libraries.

The drivers and influencing factors for the application of RDM activities vary across institutions but are largely influencing the successful application of Research Data Management (RDM) activities. These include the influence of funding agencies and grant providers in Nigeria such as the Tertiary Education Trust Fund (TETFund), the Education Trust Fund (ETF), and the Petroleum Trust Development Fund (PTDF) are increasingly mandating proper RDM practices across academic libraries as a requirement for research funding. Others include collaboration and partnerships with researcher needs and expectations and the global shift towards Open Science, which emphasizes the open sharing of research data and best practices. RDM activities have become a new standard in academic libraries in North-East Nigeria for supporting research activity, international accessibility, and collaboration. It is crucial to create an environment where all academic libraries provide comprehensive RDM services and can play a substantial role in making all their research output visible and preserved.

Therefore, the study recommends the establishment of awareness campaigns and stakeholder sensitization strategies towards a robust research data management activity. An institutional support framework as a driver and motivating factor of RDM should be put in place to develop policy guidelines assembling all the needed capabilities (Funding Agency

Requirement, Data Privacy, Protection, and Security, Data-Driven Research, as well as RDM and IT Policy guidelines) to enable efficient managing, sharing, and reusing of research data in academic libraries.

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Global Visibility of Open Research Data Repositories:
A Case Study of China

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ABSTRACT

The operation of an open research data repository is an important element in measuring the extent of open science. China is one of the most populous countries and contributes significantly to research output. This paper explores the current status of open research data repositories in China by analyzing the characteristics of the repositories and reflecting on the process of open science in China.The data were obtained from the re3data database (re3data.org), and the search was limited to China. The data were further analyzed and tabulated according to the following criteria: subject, type of content, keywords, language, software, type of repository, institution responsibility, institution type, and type of provider.The study shows that China ranks 9th in the world in terms of the number of repositories, falling short of expectations. Of the 81 open research data repositories surveyed, 79 are nonprofit organizations, with a focus on life sciences, natural sciences, and medicine as the main subject repositories. The diversity of content types and the universality of the language interface also reflect the richness of the repository. However, the state of use of the software is promising and most of it is "unknown"; the mode of delivery is dominated by the provision of data and a lack of services.This paper has examined OA data repositories in China and provides an important reference for understanding open science initiatives in China by highlighting the current status of open data repository development.

Keywords: Open access, China, Open Research Data Repositories, Re3data

INTRODUCTION

The advent of digital technology and ICT has revolutionized the entire academic environment, increasing the visibility and availability of scholarly output on a wide scale (Singh, 2016). The rise in subscription and licensing fees and increased journal requirements forcing researchers to rely solely on pre-existing data for their research is undoubtedly a major burden and challenge. To remove this obstacle, the concept of open access was developed. Open access is a useful and affordable way to share knowledge. According to Filipi Matutinović, open access means that "any user anywhere in the world with Internet access has the right to read, download, store, print, and use the digital content of open access publications simply by citing them correctly" (Filipi Matutinović S, 2014). Open access for research data refers to the right

to access and reuse digital research data (Uribe-Tirado et al., 2020). In recent years, open access has received much attention from various industries and academic experts, and it has become a hot topic of discussion and investigation.

Research data is defined as "factual records (numerical results, textual records, images, and sounds) that serve as the primary source of scientific research. In the scientific research process, personal habits or constraints imposed by knowledge background lead to a diversity of formats for managing research data and the use of tools, a phenomenon that reflects a large number of researchers and outputs, but is not conducive to data sharing and collaboration among researchers (Ghosh & Bijan Kumar, 2022). The establishment of a research data management repository will solve this challenge. Research data repositories (Björk, 2013) unify metadata standards, content types, and software usage, enabling accessibility and usability of research data, thereby increasing transparency and credibility of the research process, improving citability, validating findings by re-analysis of data, facilitating reuse and repurposing of research data to answer different research questions, facilitating discovery, reducing duplication of effort and its ancillary costs, creating new collaborations between data users and data producers, and increasing the number of publications by authors(Misulis & Frisse, 2019).

China, recognized as one of the foremost technological leaders with unparalleled global productivity, assumes a pivotal role in driving data policies and practices (Tollefson, 2018). The "Law of the People's Republic of China on Science and Technology Progress," established in 2008, laid down foundational guidelines for research data management. Subsequently, the revised "Copyright Law of the People's Republic of China" enacted in 2010, along with the "Law of the People's Republic of China on Promoting the Transformation of Scientific and Technological Achievements" revised in 2015, further refined the legal framework. The "Measures for the Management of Scientific Data," introduced in 2018, propelled research data management and sharing to unprecedented heights. By the conclusion of 2022, 15 provincial-level administrative regions, including Hubei, Tianjin, and Hainan, had implemented regional governance regulations for scientific data in alignment with national-level laws.

Concurrently, various national-level research projects are actively advancing and being implemented. These include the National Science and Technology Infrastructure Platform, the Chinese Academy of Sciences Scientific Data Program, and the Chinese Academy of Sciences Earth Data Science Project. To cater to the requirements of institutions and disciplines for data management and services, corresponding repositories have been established, upholding stringent quality control and data-sharing practices. Notable examples encompass the Earth Science Data Repository GSCloud (www.gscloud.cn), the Spectroscopy Data Center GSA (big.big.ac.cn/GSA/), and institutional repositories such as the Peking University Open Research Data Platform (opendata.pku.edu.cn).

Re3data (http://www.re3data.org/) serves as a global research data registry center, indexing over 4,000 interdisciplinary data repositories. The Re3data database records and displays characteristics of registered research data resources, such as subject distribution, content

types, and institutional responsibilities. It has become an invaluable tool for researchers to understand and navigate open-access processes across different countries and regions.

Given the exploration and contributions in the open access domain, as well as the research gap concerning a comprehensive overview of Chinese research data repositories, an investigation into the features and operational status of these repositories in China has become particularly necessary and urgent.

LITERATURE REVIEW

To date, numerous studies have been conducted on repositories, focusing mainly on two types of repositories: Open Access repositories and open research data repositories, although some studies on Open Access institutions fall into the first category. Open Doar and re3data are the most widely used databases for repository registration. OpenDOAR (Open Access Directory Repository Catalog) is managed by the SHERPA service and is primarily intended to promote scholarship and research. The initial development of OA repositories was concentrated in the United States, Canada, and Australia, and was primarily institutional, multidisciplinary, and English-based, with access licensing likely to be a key element in the future development of repositories (Pinfield et al., 2014). After 2010, OA repositories emerged in various regions, especially in Asia, and the development of OA repositories in Asia has become an important research topic for scholars. Japan has the largest number of OA repositories but lags in terms of Web 2.0-enabled repositories. Most Web 2.0 repositories were found in Turkey, followed by China and India. It was also recommended that LIS schools should introduce "Web Design" as one of their graduate-level subjects so that LIS professionals can learn these skills and not depend on IT professionals (Khan et al., 2022). The most prestigious universities in Asia are not actively promoting the OA movement(Abrizah A. et al., 2010). Parray(2023)comparison of the current status of OA repository development in China and India based on characteristics such as repository type, software usage, repository interface language, year of development, subject coverage, content coverage, and use of Web 2.0 tools by repositories revealed that India and China focus primarily on institutional repositories, with DSpace still the preferred choice in both countries and India only English is used in repositories, while in China half of the repositories have a mixed language interface (English and Chinese). It is recommended that both India and China should implement the Turkish and Indonesian models to accelerate their growth (Singh, 2016).

Armbruster and Romary (2010) distinguish between different types of repositories, namely disciplinary repositories, research repositories, institutional repositories, and national repository systems.Re3data.org (a registry of open research data repositories) provide researchers with guidance in the heterogeneous landscape of RDR. It provides users with information about their different roles as data producers and data users(Schöpfel, 2022). Sheng et al. (2021) show that open research data repositories can effectively make research outputs visible and share them globally, providing important opportunities for the research community.

The U.S. government directs its national research agencies to maximize access to digital research data, (Office of Science and Technology Policy, 2013). The European Commission is planning a similar requirement in its Eighth Framework Program HORIZON 2020 (European Commission, 2012). In China, provinces have issued requirements and documents for building research data repositories following the release of the Measures for the Management of Scientific Data in 2018(Zhong & Jiang, 2016). In the 2019 survey of global open-access research data repositories, the United States, Germany, the United Kingdom, and Canada were the leading countries, with subject categories being the main repository type and most not following metadata standards(Bhardwaj, 2020). A survey of the BRICS countries (Brazil, Russia, India, China, and South Africa) shows that India is the pioneer and largest contributor to research repositories, and while China has done quite well over the last three decades, the country seems very reluctant to release research data through open platforms or under Creative Commons licenses (Misgar et al., 2020). However, the study only looks at characteristics such as the type of content, the language of the interface, and the distribution of disciplines, focusing more on comparing characteristics across these countries. Of the 45 RDRs in India, only 30 (67%) are open, with a concentration of disciplines in the life sciences (28), and only 20% of data repositories use metadata standards in their metadata (Khan, 2020).

In summary, the United States, Germany, and Canada lead in both types of open access and types of open research data, while India is somewhat more developed in the Asian region, and in terms of characteristics, English is the main global interface language, with difference differentiation in the use of software, disciplines, and so on. In the case of the study on open research repositories in China, it is only a comparison of the general direction of the characteristics of content types, interface languages, and disciplinary distribution, and no specific parameters such as software use and types of institutional responsibility have been addressed yet Have the content types been adjusted? Has the interface language remained consistent? These questions are also the focus of the research in this paper.

Objectives of the study

This study aims to analyze the current state of Open Research Data repositories and to describe their characteristics and performance. It addresses the following research objectives:
- ▪ To determine the subject coverage and content type archived by repositories.
- ▪ To ascertain software used and repository language being used in repositories.
- ▪ To discover the different types of repositories and Keywords.
- ▪ To identify the institution responsibility type and institution type of repositories.

RESEARCH DESIGN

The descriptive methodology used in this study is based on the following phases:

Phase 1: Selection of the data source

The research data is sourced from the world's largest indexed repository of research data, known as the Registry of Research Data Repositories (http://re3data.org/). This registry encompasses a variety of research data repositories from different countries across the globe. The research data utilized in this article was extracted from the re3data registry on April 27, 2023.

Phase 2: Data extraction, refinement and visualization

The re3data registration portal offers a range of parameters for investigating the listed data repositories. However, this study specifically gathered chosen metadata from these repositories, including subject domain, content type, repository language, software utilization, repository classification, keywords, institutional responsibility, and institutional and provider types.

The browsing tool provides three main avenues for exploring the database: browsing by subject, content type, and country. National contributions are directly derived from the repository's browsing section, yielding data that characterizes Chinese research data repositories. Based on the selected data types for this research, a targeted search and refinement process was carried out within the descriptions of Chinese research data repositories. The findings were meticulously recorded using MS EXCEL 2010 software.

In conclusion, the collected information was streamlined by eliminating extraneous details, resulting in a structured table that is primed for further analysis.

RESULTS

To the objectives of this study, the relevant data were selected for statistical analysis in order to draw conclusions and findings.

Country-wise distribution
As of April 27, 2023, a total of 4140 open-access repositories had been established worldwide. Most repositories are located in the United States (1169), followed by Germany (495), Canada (393), the United Kingdom (314), the European Union (286), France (126), Australia (101), Switzerland (84), and China (81).

What is clear is that the number of repositories is concentrated in the developed world, with the U.S., in particular, leading the world. China is in ninth place but is still far from the first-mentioned countries.
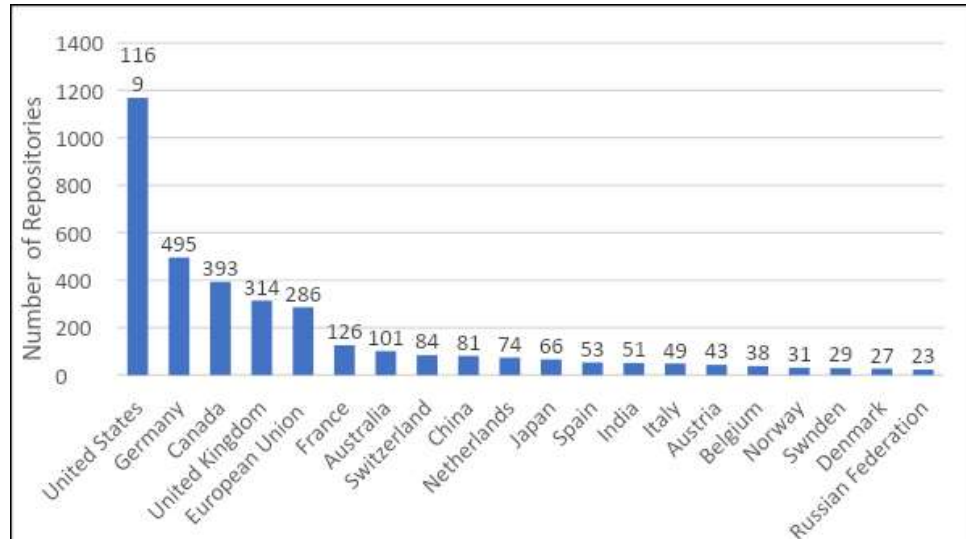
Figure 1: Distribution of Top 20 Countries in terms of Number of Open Research Data Repositories

Subject coverage and Content type

This study examined the distribution of subjects and types of content in Chinese repositories listed in re3data. Figure 2 shows that the distribution of disciplines is mainly in life sciences (44%) and natural sciences (46%), less in humanities and social sciences and engineering, with the proportion of life sciences decreasing and the proportion of engineering increasing compared to the 2019 survey. At the same time, Figure 3 shows that the distribution of specific disciplines is diverse and cross-fertilized, with genetics and cell biology generally having the most data.
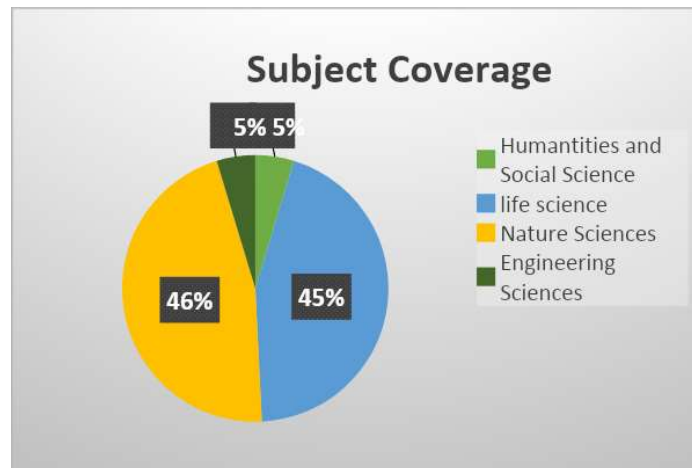
Figure 2: Discipline Distribution of China's Open Research Data Repositories

A total of 52 specific disciplines are counted, with the number of disciplines reaching 157, showing the diversity and interdisciplinarity of the distribution. The richness of the repositories is also reflected in the fact that some of them may contain multiple disciplines. Among them, general genetics (16, 10.18%), cell biology (11, 7.01%), geology, and paleontology (7, 4.46%) occupy the top three places numerically. The statistics on specific disciplines are also one of the gaps filled in the last survey.

Table 1. Discipline-specific distribution of China's open research data repositories

Subjects	Numbers	Percentage	Subjects	Numbers	Percentage
General Genetics	16	10.18%	Systematics and Morphology	1	0.63%
Cell Biology	11	7.01%	Biochemistry and Animal Physiology	1	0.63%
Geology and Palaeontology	7	4.46%	Microbial Ecology and Applied Microbiology	1	0.63%
Animal Ecology, Biodiversity and Ecosystem	5	3.20%	Public Health, Health Services Research, Social Medicine	1	0.63%
Human Genetics	5	3.20%	Physiology	1	0.63%
Oceanography	5	3.20%	Pathology and Forensic Medicine	1	0.63%
Geochemistry, Mineralogy and Crystallography	5	3.20%	Pharmacy	1	0.63%
Metabolism, Biochemistry and Genetics of Microorganisms	4	2.58%	Reproductive Medicine/Biology	1	0.63%
Geophysics	4	2.58%	Cellular Neuroscience	1	0.63%
Geodesy, Photogrammetry, Remote Sensing, Geoinformatics	4	2.58%	Developmental Neurobiology	1	0.63%
Geography	4	2.58%	Soil Sciences	1	0.63%
Water Research	4	2.58%	Plant Cultivation	1	0.63%
Astrophysics and Astronomy	3	1.91%	Ecology of Agricultural Landscapes	1	0.63%
Atmospheric Science	3	1.91%	Plant Breeding	1	0.63%
Social Sciences	2	1.27%	Basic Forest Research	1	0.63%
Economics	2	1.27%	Biological Chemistry and Food Chemistry	1	0.63%
Biochemistry	2	1.27%	Optics, Quantum Optics and Physics of Atoms,	1	0.63%

			Molecules and Plasmas1		
Anatomy	2	1.27%	Geochemistry, Mineralogy and Crystallography	1	0.63%
Plant Ecology and Ecosystem Analysis	2	1.27%	Thermal Engineering/Process Engineering	1	0.63%
Epidemiology, Medical Biometry, Medical Informatics	2	1.27%	Heat Energy Technology, Thermal Machines, Fluid Mechanics	1	0.63%
Particles, Nuclei and Fields	2	0.63%	Materials Science	1	0.63%
Fine Arts, Music, Theatre and Media Studies	1	0.63%	Computer Science	1	0.63%
Structural Biology	1	0.63%	Software Technology	1	0.63%
Plant Systematics and Evolution	1	0.63%	Systematics and Morphology	1	0.63%
Inter-organismic Interactions of Plants	1	0.63%	Biochemistry and Animal Physiology	1	0.63%
Plant Biochemistry and Biophysics	1	0.63%	Microbial Ecology and Applied Microbiology	1	0.63%

The diversity of data content types enhances the popularity among researchers of different disciplines. From Figure 3, it can be concluded that Chinese open research repositories contain a total of 14 categories of content types, numbering 314, reflecting the fact that a repository may contain a variety of content types. Of these, scientific and statistical data formats (59), images (40), structured text (38), standard office documents (32), and raw data (29) are the main content types.
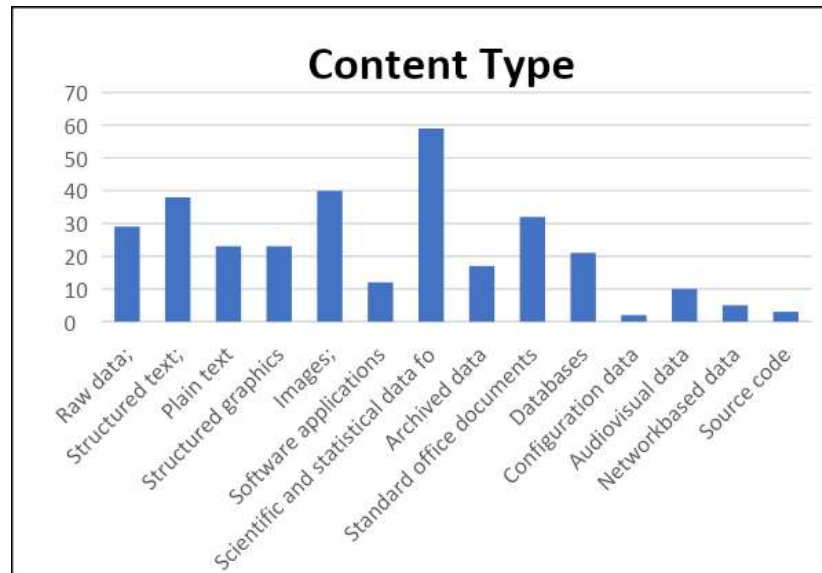
Figure 3: Types of Content in China's Open Research Data Repositories

Software used and Repostories Language

Research data repositories have been created in multiple languages to support users in their Language interface . A total of 24 languages have been observed across the 81 repositories. Of these, English, as the most spoken language worldwide, has the highest number, reflecting the wide applicability of the repositories; Chinese, as the native language of China, is in second place; the remaining language is only one due to "Fishbase", a global species repository with mirror sites in English, German, French, Spanish, Portuguese, French, Swedish, Chinese and Arabic, Swedish, Chinese and Arabic mirror sites. (However, the use of software is not encouraging, with most being "unknown" and only a few repositories using software such as MySQL and DataVerse tools.

Table 2. Language Interface and Software Usage of Open Research Data Repositories in China

Repostories languages	Numbers	Soft ware	Numbers
English	61	MySQL	6
Chinese	56	DataVerse	2
Arabic	1	other	3
Bengali	1	unknown	23
German	1		
Greek, Modern	1		
Persian	1		
French	1		
Gujarati	1		
Hindi	1		
Indonesian	1		

Italian	1
Japanese	1
Kannada	1
Lao	1
Malayalam	1
Marathi	1
Dutch	1
Portuguese	1
Spanish; Castilian	1
Swedish	1
Tamil	1
Telugu	1
Thai	1

Types of Repositories and Keywords

There are mainly three types of repositories enlisted in re3data.org: Other (a repository whose type has not yet been assessed), Institutional (an institutional or departmental repository), Disciplinary (a cross-institutional subject repository). The number of disciplinary categories is as high as 73, accounting for 90.12%; 6 are institutional categories, and 5 others. "Inspire-HEP", "Protein Lysine Modification Database", and "eLibrary of Microbial Systematics and Genomics "are both disciplinary and institutional types. The top three repositories are Genomics, Genetics, and Ecology, which are consistent with the number of specific disciplines.

Table 3. China's Open Research Data Repository Keywords

Keywords	Numbers	Percentage	Keywords	Numbers	Percentage
genomics	11	10.76%	environmnet	3	2.94%
genetics	9	8.82%	genes	3	2.94%
ecology	5	4.90%	germplasm	3	2.94%
FAIR	4	3.93%	metabolomics	3	2.94%
archaea	4	3.93%	molecular biology	3	2.94%
bacteria	4	3.93%	BLAST	2	1.96%
bioinformatics	4	3.93%	DNA	2	1.96%
genome	4	3.93%	atmosphere	2	1.96%
proteomics	4	3.93%	biomedicine	2	1.96%
RNA	3	2.94%	climate	2	1.96%
agriculture	3	2.94%	diseases	2	1.96%
algae	3	2.94%	epigenomics	2	1.96%
biology	3	2.94%	fungi	2	1.96%
cell lines	3	2.94%	geography	2	1.96%
chromosome	3	2.94%	geology	2	1.96%

Institution Type and Institution Responsibility Type

The nature of the institution and the responsibilities of its members are an important basis for understanding the internal organizational framework of a repository. Currently, there are 79 non-profit repositories and 3 commercial types, while "GigaDB" consists of the non-profit - Beijing Genomics Institute and GigaScience Press   and the commercial - China National Genebank together. The types of institutional responsibility are divided into general, technical, and funding and sponsorship, with the percentages shown in Figure 4.
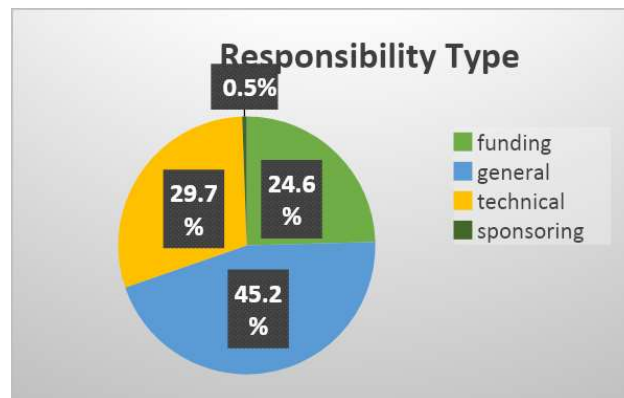
Figure 4: Institutional Responsibility for Open Research Data Repositories in China

Provider Type

The study analyzed the type of provider to determine whether the research data repository was a data provider or a service provider. Figure 5 shows that the majority of research data repositories in China are data providers 78 (96%), containing data only 40 (49%) and data and services together 38 (47%); and service providers 41 (51%), most of which are co-providers, while only three (4%) provide services only. This indicates that data provision is the primary focus. However, to ensure sustainability and encourage researchers to use the database, service capacity must also be strengthened, services expanded, user needs met, and necessary support and training provided.
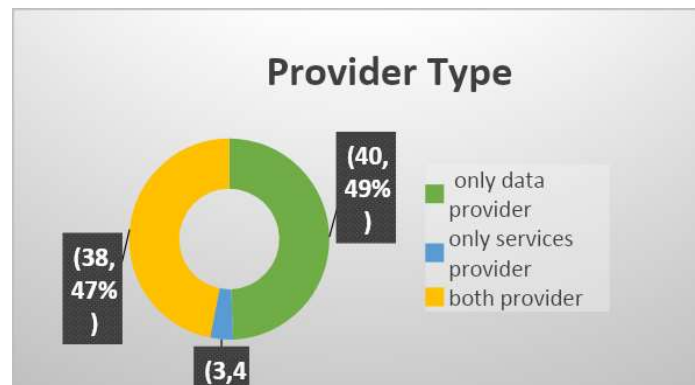
Figure 5: Provider Types of Open Research Data Repositories in China

CONCLUSION

The collection and recording of research data take on a diverse range of forms, but due to the lack of consistent standards, sharing can be challenging. Re3data.org serves as a registered platform for managing and storing scientific research data, providing us with a valuable data source for our research endeavors. Analysis reveals that China, as one of the most populous countries with a significant number of researchers, still lags behind developed nations like the United States, Canada, and Germany in terms of the quantity of registered research data repositories.

The distribution of disciplines and content types is varied, yet there exists an uneven distribution across disciplines. The predominant types are in the realm of life sciences and natural sciences, whereas humanities, social sciences, and engineering categories are relatively underrepresented. This phenomenon can be attributed to the contributions and leadership of repositories established by the Chinese Academy of Sciences and its affiliated institutions in China's open-access initiatives. These repositories predominantly cover life sciences and natural sciences, particularly focusing on biology and geography. Encouraging universities and other higher education institutions to establish more databases catering to humanities and social sciences is recommended. This initiative would strengthen data integration and sharing among repositories of different types, thereby enhancing overall accessibility.

As a country with Chinese as its native language, Chinese language repositories are expected to be prevalent. However, the number of repositories with English interfaces surpasses those with Chinese interfaces. This dual-language approach can be attributed to the usage of English as the international interface language for data repositories, catering to the world's largest linguistic community. It also underscores the broad applicability of Chinese repositories, as most of them utilize both English and Chinese languages. This approach fosters openness and inclusivity for sharing and exchanging data. Nonetheless, the state of software usage isn't entirely optimistic. The lack of uniformity and commonality in software usage can pose barriers to data integration and utilization, potentially leading to negative attitudes among users toward sharing data. It's advisable for disciplinary or industry associations, possessing authority and influence, to endorse software tools relevant to their respective fields or industries.

Repository types primarily align with disciplines, constituting a substantial 90.12%. This emphasizes the importance of disciplinary associations, higher education institutions, and similar entities as the main consumers and producers of research data. Some repositories feature dual types—discipline and institution—which reflect collaboration and sharing in aspects such as data utilization and platform establishment. The distribution of keywords mirrors the distribution of disciplines, reaffirming the pivotal role and status of discipline-specific repositories.

Among the 81 registered data repositories, 79 are non-profit organizations. This conclusion is closely tied to repository types. Higher education institutions, being the primary entities

associated with disciplinary types, are predominantly non-profit organizations and pivotal drivers of disciplinary advancements. It is anticipated that more commercial entities will sign up with a responsibility type focused on funding or technical support, enriching the landscape of research data management. The responsibility types for institutions include "general," "technical," and "funding," with instances where the "general" type encompasses the other two or is ambiguous. Given the functionalities and goals of repositories, data providers are the primary provider type. The proportion of both data and data service offerings is expected to rise in the future, aligning with the maturation of database establishment and catering to the deeper needs of users.

In the context of open access in China, this study utilizes data from the re3data website and draws insights from current research on similar repositories in different countries and regions to examine the characteristics of Chinese research data repositories. In comparison to prior studies on the development of repositories in various nations, this article engages in a more comprehensive exploration of specific aspects of repositories, including disciplines, repository types, and institutional responsibilities. Through data analysis, the research reflects the current state and trajectory of research data repositories in China, unveiling challenges such as uneven disciplinary distribution and suboptimal software utilization. This study provides a valuable reference for the development of repositories within the context of open access initiatives and offers a dataset for future academic research.

However, certain limitations should be acknowledged. First, this study does not extensively delve into repository policies. Although it touches on the existence of policies, a more comprehensive investigation necessitates content and textual analysis across multiple data sources to identify policy types and key points. Second, legal considerations, such as data licenses, database licenses, and data download availability, were not extensively explored. These legal factors dictate how users can interact with data within repositories.
To expand the study's scope, future research could consider the following directions:

Policy Inclusion: Include an in-depth analysis of repository policies, involving content and textual analysis across various sources to categorize policy types and summarize key aspects.

Legal Considerations: Expand the investigation of legal dimensions, including data licenses, database licenses, and data download availability, as these significantly influence how users can engage with repository data.

Comparative Studies: Conduct cross-regional and international comparative studies, with a focus on distinct regions and international organizations. Additionally, deeper longitudinal investigations in countries where open access efforts are just beginning, especially in developing nations, can contribute to creating an environment conducive to internationalization, disciplinary specialization, and integrated sharing within open access initiatives.

In conclusion, this study comprehensively explores Chinese research data repositories within the framework of open access. While some areas warrant further exploration, the research

findings contribute to a better comprehension of the present landscape and challenges, offering insights for advancing open-access initiatives.

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Indicators of Openness and Transparency in Scholarly Publishing: Early Insights from the Social Sciences

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ABSTRACT

The landscape of scholarly publishing is changing rapidly - alongside open science practices and established ethical standards in research. Increasingly, there are higher expectations for research to be deemed credible and rigorous research, with an emphasis on transparency in the research process. To date, there has been a lack of comprehensive studies examining the attitudes and practices of social science researchers in Malaysia, a significant and strategically important research community, regarding transparency and openness in scholarly publishing. This research gap is particularly crucial due to several significant factors, including scholarly digital transformation, the open access movement, the emergence of open science practices, and generational change. Therefore, there is a pressing need to address this gap and explore the consequences of these developments. Thus, this paper seeks to (a) contextualize the study by contrasting social science researchers with their compatriots in the sciences in terms of transparency and openness in publishing, and (b) report on the early insight's indicators of openness and transparency in scholarly publishing as a heads-up to the detailed analysis of the data. The study employed qualitative methodology, with interview as the primary data collection technique. A total of 100 most productive Malaysian-based social science researchers who identified the Web of Science database were invited to participate via e-mail, of which six (6) agreed to be interviewed. By utilizing the interview data and comparing it with the Transparency and Openness Promotion (TOP) guidelines, preliminary analysis shows that several indicators of openness and transparency in scholarly publishing emerge. These indicators include sharing and connecting, open access publishing, research collaboration, open access repository, peer review process, preprint, ethics and integrity and reproducibility. The identified transparency and openness indicators are a valuable foundation for developing a framework that promotes responsible and reproducible research through the adoption of transparent research practices among social science researchers in the country. This is particularly significant as research and scholarly practices are increasingly embracing transparency and openness, as evidenced by the national initiative, the Malaysia Open Science Platform (MOSP). Incorporating these indicators into research practices can enhance the trustworthiness of research outcome while advancing the overall goal of open science.

Keywords: Transparency; Openness; Open Science; Scholarly Publishing; Social Sciences

INTRODUCTION

Scholarly publication plays a crucial role in advancing university careers, as it is an essential avenue for sharing research findings. Typically, academic researchers aspire to publish their research in reputable scholarly journals. Because scholarly journals are intended to provide a comprehensive and permanent record of research, the work must be conducted and published in an honest, objective, and fair manner, and the target journal must be carefully selected (Abrizah, Shah, and Nicholas 2019). Currently, the scholarly publication landscape is becoming more accessible and transparent. This was made possible by open science practices, which increase the transparency and openness of research.

In this research context, transparency is defined as openness, communication, and responsibility (About Transparency - Assignment Point 2021). Transparency, or the degree of openness in disclosing information, is a mechanism communicating the trustworthiness of the actor in negotiations (Ball 2009). Transparency encompasses various aspects, including an individual's to care, be vulnerable, be brutally honest, have uncomfortable conversations, keep commitments, and deliver bad news effectively (Studer 2014). It can be observed that transparency is readily apparent, not only in terms of openness and accountability, but also in terms of communication, whether it be positive or negative in nature. Openness is defined as a lack of secrecy or concealment, frankness, and dealing with transparency (Oxford Lexico 2022). Openness may also be described as the capacity to consider, accept, or listen to other people's or ideas, as well as the ability to not be limited or covered (Oxford Learner's Dictionaries 2022).

In Malaysia, a country experiencing growth and development in research, the significance of open access, open data, and open science is a subject of extensive discussions at both the national and international arenas. However, Malaysian researchers currently place considerable emphasis on publishing their research outcomes in high-impact journals to enhance their productivity and performance. Consequently, the question arises as to how academics from developing countries can effectively practice transparency and openness in their research endeavors? To what extent do Malaysian researchers provide open and transparent research output that allows for systematic replications, is understandable, and allows for formal criticism?

Furthermore, in Malaysia, the open scholarly platform or movement through the Malaysian Open Science Platform (MOSP) reflects the drive for transparency and openness in sharing of research output. Furthermore, with the evolving social science scholarly publishing landscape new criteria for credibility and rigor in research are emerging, emphasizing the importance of transparency in addition to existing ethical standards. Despite this, no comprehensive study has been conducted to date to examine the attitudes and practices of social science researchers in Malaysia, a large and strategically important research community, regarding transparency and openness in scholarly publishing. There are very serious reasons for filling this research gap because there are several conditions which may lead to significant consequences, which include scholarly digital transformation, the open access and open

science movement, and of course generational change. This paper is a part of a larger study that seeks to provide an understanding and assessment on the transparency and openness of scientific publishing among Malaysian social science, arts, and humanities researchers[1]. Specifically, this paper seeks to contextualize the study by contrasting social science researchers with their compatriots in the sciences, in terms of transparency and openness in publishing, and to report on the early insights to what the authors found as indicators of openness and transparency in scholarly publishing as a heads-up to the detailed analysis of the data. This study addresses the following research questions: (a) What is the interpretation of "transparency and openness in scholarly publishing" from the perspective of social science researchers? (b) What indicators of "transparency and openness in scholarly publishing" adopted by social science researchers have been identified through early insights?

LITERATURE REVIEW

Over the last decade, the Open Science movement has gained support among publishers, funders, policy makers, universities, and, most importantly, the scientific community. Open science is generally understood as the sharing of resources and ideas with the objective of making them openly and freely available for future use. Despite the diversity of the Open Science movement, the scientific community share the core belief that promoting openness of multiple research output and for multiple groups of people at multiple levels and geographies will foster equality, broaden participation, and increase productivity and innovation in science (Willinsky 2005). Through the development of Open Science and Open Access policies and guidelines, governments and funding agencies all over the world have come to recognise openness as a crucial component of scholarly research (Levin et al. 2016).

When researchers fail to document their assumptions, decisions, and actions and are unwilling or unable to share this information with others, their statements become more difficult to comprehend. When such errors occur frequently in a community of researchers, the community's credibility and reputation are compromised. Questions of data sharing and scholarly transparency are being addressed with increased frequency and vigor in the sciences. In addition to exposing researchers to a broader array of knowledge claims, technological advancements in electronic communication give them reason to believe that data and inferential information will become more accessible (Lupia and Elman 2014).

Numerous academic journals have revised their policies, recognising the value of cumulative knowledge creation and laying a solid foundation for it by requiring enhanced evidence trails and data reanalysis. There are undeniable benefits to having open data access, but there are also legitimate ethical and legal concerns regarding data sharing. This is the reason why access to research data and transparency in the research process have been extensively discussed throughout the social sciences (Nosek et al. 2015).

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[1] Doctoral research by the first author, supervised by the second and third authors, proposed to the Universiti Malaya in 2022 entitled "Transparency and openness of scientific publishing among social science, arts and humanities researchers".

The literature has identified seven key elements that encompass researchers' understandings, experiences, and practises of scholarly openness. These themes include: timely donation and access to research components; standards for the format and quality of research components; metadata and annotation; freedom to choose venues and dissemination strategies; transparent peer review systems; and access to research components in non-Western and/or non-academic contexts (Levin et al. 2016).

Furthermore, the literature has identified nine factors that influence the implementation of openness in science. They are : (a) the availability of repositories and databases for data, materials, software, and models; (b) the competitiveness of academic fields; (c) the digital nature of research; (d) credit systems in academic research; (e) career structures in academic research; (f) collaborations with industrial partners and attempts at commercialization; (g) intellectual property models and standards; (h) governmental perspectives on the prestige and social role performed by universities; and (i) the existence of multiple, and at times competing, government policies on open science (Levin et al. 2016).

Dimensions/Indicators of Transparency and Openness
The Transparency and Openness Promotion Factor (TOP Factor) refers to the dimensions and indicators of transparency and openness in scientific publishing and contains metric that reports the steps that a journal is taking to implement open science practices, that are based on the core principles of the scientific community[2]. Spitschan, Schmidt, and Blume (2021) described TOP Factor as a numerical score that summarizes the presence, requirement, and enforcement of transparent and open research practices in journals. A total of 149 biomedical articles published between 2015 and 2017 determined the proportion of reporting sources based on six reproducibility and transparency indicators from open access data provided on PubMed, including funding, a statement of conflict, protocol availability, data availability, replication, and article citation (Wallach, Boyack, and Ioannidis 2018). Fifteen key markers for transparency and best practises in open scholarship also had been identified to improve transparency and credibility of open access open scholarship (Bjornshauge 2015), including: Peer review process; Governing Body; Editorial team/contact; author fees; copyright; identification and handling of allegations of research misconduct; ownership and management; web site; journal name; conflicts of interest; access; revenue sources; advertising; publishing schedule; and archiving

Aside from that, Data Access, and Research Transparency (DA-RT) is one of several projects in the social sciences that work to make things more open. In social science, research transparency is the idea that researchers have a moral duty to make their evidence-based knowledge claims easy to evaluate by making their evidence, analysis, and study design public (Lupia and Elman 2014). Additionally, alternative literature has observed notable progress in promoting research transparency within the social sciences. These scholars advocate for the establishment of standards and practices that align scholarly incentives with scholarly values. They contend that while medical trials serve as partially applicable models, the social sciences

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[2] See https://www.cos.io/initiatives/top-guidelines.

require distinct approaches. To this end, social science initiatives are seeking to develop standards that go beyond what is required in medical trials. Bottom-up developments in the social sciences are ongoing, with a general consensus emerging around three principles: open data and resources, transparency, registration, and pre-analysis procedures (Lupia and Elman 2014).

Transparency and Openness Promotion (TOP) Guidelines

Transparency, openness, and reproducibility are widely acknowledged as important characteristics of science. The literature recommended eight criteria to help translate Open Science concepts into actual and tangible actions (Center of Open Science 2016). The TOP Guidelines specify escalating levels of adherence to 8 modular transparency dimensions in Table 1[3].

Table 1: The TOP Guidelines describe Increasing Levels of Adherence to Eight Modular Transparency Dimensions, Covering Citations, Availability of Data, Code, Materials and Design, Preregistration of Study Procedures and Analysis Plans, and Replication (Reproduce With Permission)

	Not implemented	Level 1	Level 2	Level 3
Citation standards	Journal encourages citation of data, code, and materials, or says nothing.	Journal describes appropriate citation for data and materials used consistent with journal's author guidelines.	Article provides appropriate citation for data and materials used consistent with journal's author guidelines.	Article is not published until providing appropriate citation for data and materials following journal's author guidelines.
Data Transparency	Journal encourages data sharing or says nothing.	Articles state whether data is available, and, if so, where to access it.	Data must be posted to a trusted repository. Exceptions must be identified at article submission.	Data must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.

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[3] https://www.cos.io/initiatives/top-guidelines (Reproduced with permission)

Analytic Method (Code) Transparency	Journal encourages code sharing or says nothing.	Articles state whether code is available, and, if so, where to access it.	Code must be posted to a trusted repository. Exceptions must be identified at article submission.	Code must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.
Research Materials Transparency	Journal encourages materials sharing or says nothing.	Articles state whether materials are available, and, if so, where to access it.	Materials must be posted to a trusted repository. Exceptions must be identified at article submission.	Materials must be posted to a trusted repository, and reported analyses will be reproduced independently prior to publication.
Design and Analysis Transparency	Journal encourages design and analysis transparency or say nothing	Journal articulates design transparency standards.	Journal requires adherence to design transparency standards for review and publication.	Journal requires and enforces adherence to design transparency standards for review and publication.
Study Preregistration	Journal says nothing.	Article states whether preregistration of study exists, and, if so, where to access it.	Article states whether preregistration of study exists, and, if so, allows journal access during peer review for verification.	Journal requires preregistration of studies and provides links and badges in articles to meet requirements.
Analysis Plan Preregistration	Journal says nothing.	Article states whether preregistration of the analysis plan exists, and, if so, where to access it.	Article states whether preregistration of the analysis plan exists, and, if so, allows journal access	Journal requires preregistration of analysis plan and provides link and badges in article to

			during peer review for verification.	meeting requirements.
Replication	Journal discourages submission or replication studies or says nothing.	Journal encourages submission or replication studies.	Journal encourages submission or replication studies and conduct results blind review	Journal uses Registered Reports as a submission option for replication studies with peer review prior to observing the study outcomes.

TOP Factor was discovered in the literature as a statistic for describing the extent to which publication policies have implemented the TOP Guidelines. To determine the TOP Factor, systematic techniques and evaluation instruments are required. Furthermore, the execution of these open scholarly principles is dependent on journal procedures and practises, for which there are no standards or rating instruments provided by TOP. The TOP Factor was developed to evaluate journal policies, methods, and practices in accordance with the TOP Guidelines, as part of the TRUST (Transparency of Research Underpinning Social Intervention Tiers) Initiative, which aims to advance open science in the social intervention research ecosystem. The calculation of a journal's TOP Factor score, the determination of journal ratings dependability, and the examination of coherence among a journal's policies, processes, and practices are also explained. It may be regarded as a protocol for evaluating around 345 significant journals that have published research used to inform evidence-based policy as an example of this process (Mayo-Wilson et al. 2021). It was proposed to assess journals and publications based on the Transparency and Openness Promotion (TOP) norms and associated criteria, using the recent debate over global tree 'restoration' potential as an example. A high-TOP score indicates that readers have enough information to evaluate the objectivity and credibility of scholarly publications and their authors (Slingsby 2020).

METHODOLOGY

The study used qualitative methodology, employing interviews as the data collection technique. A total of 100 most productive social science researchers in Malaysia based on the Web of Science Social Science Citation Index (SSCI) data were invited to participate via e-mail personally sent out to each. After two weeks six researchers agreed to be interviewed. The details of the participants are given in Table 2.

Table 2: Demographic details of research participants

Participants	Positions	Research Field	Gender	No of papers (last 5 years)
P001	Associate Professor	Humanities	Female	16
P002	Professor	Education	Male	39
P003	Professor	Business economics	Female	48
P004	Associate Professor	Economics	Male	74
P005	Associate Professor	Information science	Female	41
P006	Associate Professor	Business economics	Male	32

Interviews were conducted either in-person or remotely over Google Meet according to participants' preferences. The interviews were conducted in English, considering that English is widely utilized in Malaysia. The interviews, typically 45-60 minutes in duration, were recorded, with the transcripts returned to the participants to ensure accuracy/agreement and to obtain further clarity. All the interview transcripts (translated where necessary) were transferred to a 'coding sheet', which closely matched the questions of the original 'interview schedule', but left room for information derived from additional enquiries or clarifications during the interview process. The indicators found in Transparency and Openness Promotion (TOP) guidelines were used as it provides a valuable template as the basis for comparison on the indicators that emerged during the interviews. ATLAS.ti version 23 was used for coding the interview transcripts to generate thematic analysis for the findings. Each verbatim statement is accompanied by the participant code, date, line number and page number of the transcript. The study has obtained ethical clearance from Universiti Malaya research ethics committee.

RESULTS

Interpretation of "transparency and openness in scholarly publishing". Based on the interviews, five themes have been Identified to represent "transparency and openness in scholarly publishing"

(a) A thorough and detailed explanation of the methodology section
Findings addressed transparency and openness, implying a greater emphasis on the methodology section. In this aspect, participants believe that the methodology section of a paper should be presented in a comprehensive manner, ensuring openness and transparency to the greatest extent possible. If the method information is sufficiently documented, others will be able to replicate the research.

"It focuses on the methodological phase; it means that in that case the methodology should be retained in such a way that it will be as transparent and open as possible." (1:10 193 in P004; 13th Apr. 2023)
"It is based on methodology and the results. All that transparency involves the methods that have been used. So, when we write a paper, our method should be detailed enough, so that when other people want to copy it, they can. It is methodologically robust. That's why I said

earlier, if the paper is rejected because of the methodology, [it is] because there are no details." (2:63 777 in P001; 23rd Feb. 2023)

(b) Detailed description of the data utilized
Social science researchers in this study provide alternative definitions of transparency and openness in scholarly publishing that specifically pertain to the detailed provision of data for secondary use.

"What do we mean when we say open and transparent as possible, particularly in relation to the data utilized." (1:11 193 in P004; 13th Apr. 2023)
"When it comes to data, declaring statement [the availability] of data is a practice essential if you intend to publish it " (5:6 187 in P005; 14th Apr. 2023)
"Open and transparent means my data is available for secondary use" (6:24 539 in P006; 18th Apr. 2023)

(c) Data archived or stored in a research repository
Another aspect of transparency and openness in scholarly publishing involves the storage of data in research repository, as indicated in the following verbatim statements:

"All authors should be transparent in the sense they should, it is compulsory for all authors to provide data for the journal. So that the data will be stored in repository or databank, so that probably if I publish now, I want to check my result or the open of my result, then just go to databank, collect the data, used similar method that used, and you should be able to generate the same result." (1:91 205 in P004; 13th Apr. 2023)
If the data belongs to you and it's not confidential, then you're supposed to put it in data repository" (5:6 187 in P005; 14th Apr. 2023)

(d) Ensuring transparency in the reviewing process
Another perspective of transparency and openness in scholarly publishing is related to peer reviewing and should be as transparent as possible.

"Review process should be as transparent as possible, and you should also be open as possible. In that case, it is now under publisher. The publisher should ensure that the review process is structured in such a way that if the comment is given by the reviewers align with the content that they have reviewed." (1:9 163 in P004; 13th Apr. 2023)

(e) Willingness to share research output
Another definition of transparency and openness of scholarly publishing, as stated by one social scientist, encompasses the willingness to share research output at every stage of the research process.

" Transparency is open to sharing. That means open for everyone to see, get to know whatever information and processes allowing others to become familiar with things that we had done during the research." (2:31 633 in P001; 23rd Feb. 2023)

Hence, Fig. 1 depicts the understanding of social science researchers regarding the meaning of transparency and openness with reference to scholarly publishing across five thematic areas:
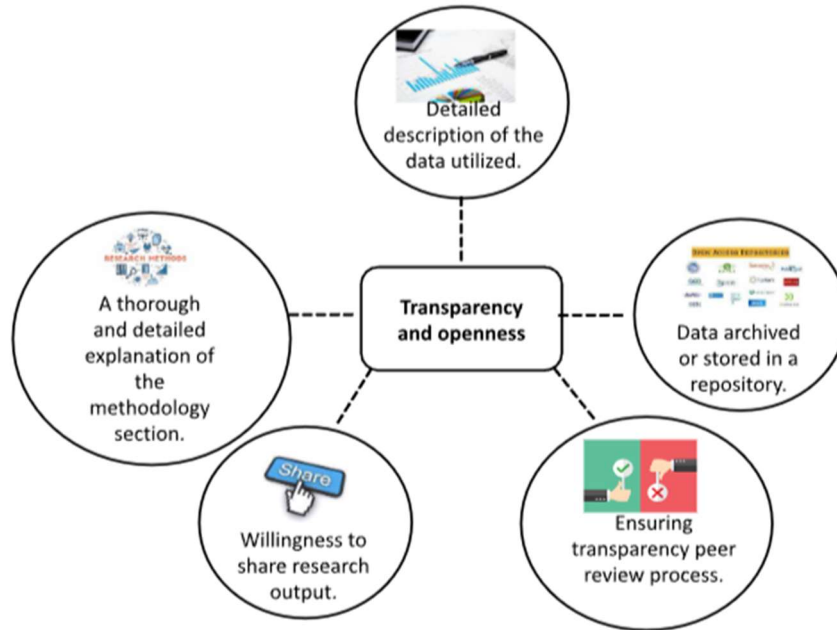
Fig. 1: The meaning of transparency and openness in relation to scholarly publishing by social science researchers

Indicators of "transparency and openness in scholarly publishing"
Preliminary analysis has identified the following eight themes as indicators of openness and transparency in scholarly publishing.

(a) Sharing and connecting
Early insights show that social science researchers primarily disseminate their research findings through publications in scholarly journals.

"Because at the moment I believe if people really are into their knowledge process, if the people really know what exactly the research is going on, obviously they know they should be knowing the best platform of the journal." (4:18 ¶ 367 in P002; 2nd Mar. 2023)
"In most cases the journals and the publishers usually impose restrictions on citations or sharing of your published papers. But there has been recent development in collaboration between Springer and ResearchGate, where it allows for the sharing of papers published in Springer journals." (1:18 ¶ 259 in P004; 13th Apr. 2023)
"Yes, I prefer that I go to a journal because [attending] conferences requires money. (6:19 ¶ 278 in P006; 18th Apr. 2023)

Social science researchers in this study have opted against attending conferences to present their research outcomes due to the inefficiency, cost and diminishing effectiveness associated with such events. One perceived conference as being beneficial for younger researchers.

"*Even though I do not attend conferences anymore. For me, the conference has changed in many ways. The conference has no longer become as effective as it is.* " (4:17 343 in P002; 2nd Mar. 2023)

"*My level [as Professor] are not anymore conference*" (3:9 275 in P003; 10th Mar. 2023)

"*I focus on journal papers because conferences sometimes waste time.*" (1:43 440 in P004; 13th Apr. 2023)

"*…. [attending] conference requires money. Not cheap nowadays. Conference [fees] at least RM1000 plus.*" (6:19 278 in P006; 18th Apr. 2023)

Social science researchers refrained from publishing their research output on social media for the following reasons: they did not have social media accounts, they were not very active on social media, and a few only used it as passive observers without actively contributing or sharing their own work.

" *I really haven't posted much on social media for the past few years, I'm just a reader.*" (2:36 537 in P001; 23rd Feb. 2023)

"*I am not a social media guy. No Facebook; No Twitter. I don't have Instagram. So, I do not have any social media in my life. So, I never use it.*" (4:15 325 in P002; 2nd Mar. 2023)

"*I don't have one. I will not go for that.*" (3:20 490 in P003; 10th Mar. 2023)

"*I'm not active on social media*" (5:9 209 in P005; 14th Apr. 2023)

(b) Open access publishing
The study findings revealed that social science researchers showed a reluctance to publish their scholarly works on open access platforms. Several reasons were identified for their lack of belief in open access publishing, including concerns about the quality and credibility of open access journals, the perceived impact on traditional publishing models, and the rapid and excessive publication of articles potentially compromising the quality of research output.

"*Not intentionally go for open access but choose to fit into particular traditional journal in the field*" (2:2 81 in P001; 23rd Feb. 2023)

"*I don't publish in Open Access, because of that, even in my research grants, I also do not have any allocation for publication. Furthermore, I do not believe in Open Access. I really do not believe in that way*" (4:31 391 in P002; 2nd Mar. 2023)

"*I'm not comfortable going for open access journals these days, particularly there are a lot of journals that're quite devious. They just publish so many articles at a very fast rate. Something seems to be off. So not comfortable. I have a recent bad experience. I think maybe you are also aware. Some of WoS journals have been kicked out from WoS and all of these are open access journals. I have two papers that were affected because of this. So, this is the main reason why I don't like to go for open access but if you don't go look into whether the journal is authentic or not, if fee is not an issue.*" (5:5 163 in P005; 14th Apr. 2023)

(c) Research collaboration and gender openness
Gender does not pose any issues in terms of research collaboration and publishing. Social science researchers prioritize merit and compatibility over gender.

"Whether someone is male or female, it doesn't matter to me. What matters is the ability to work together effectively and achieve our goals" (2:28 549 in P001; 23rd Feb. 2023)
"For me I really do not mind if there is a male or female. If the research is aligned with that, I am okay with that. So, gender participation is not something that I always look into in a very detailed manner, but I look into a detailed manner of competency and the interest that the people have in you. So my research team includes both genders" (4:57 475 in P002; 2nd Mar. 2023)
"I don't have preference as long as they're capable of doing what I want them to do. There's a specific project then of course you bring a team member who has the expertise you need. Who you bring in of course has to contribute to the success." (5:30 514 in P005; 14th Apr. 2023)

Nevertheless, certain social science researchers expressed a preference to collaborate with individuals of the same gender. They find it more comfortable and, in some cases, necessary to fulfill specific requirements set by the funder.

"Sometimes gender is an issue to get funding. The funds asked for female participation." (4:56 475 in P002; 2nd Mar. 2023)
"Mostly I worked with males, mainly because they've been my friends and acquaintances" (1:65 687 in P004; 13th Apr. 2023; 2nd Mar. 2023)

Findings regarding research collaboration revealed that almost all social science researchers engaged in collaborations with international researchers. One of the reasons for international collaboration is that the collaborator brings more experience to the table which allows for the exchange of ideas and enhances the quality of the research output.

"I go for international collaboration." (3:21 502 in P003; 10th Mar. 2023
"From the UK, from Italy, yes, also from Nigeria. This is part of what my important co-authors are." (4:45 409 in P002; 2nd Mar. 2023)
"So now how do I form a relationship with a researcher in the US that will probably improve my own research. Is it for me to form a research collaboration with a person who I believe is better than me because if I form a research collaboration with someone who is better than me then I need to improve myself but if I form with someone with lesser expertise? Maybe below my standard then I will not improve myself" (1:67 709 in P004; 13th Apr. 2023)

(d) Open access repository
The findings indicated that social science researchers did not maintain and deposit their research data in an open access repository. One primary reason cited for not depositing their research output in an open access repository was the perceived overwhelming number of platforms available for data deposition. There was this belief that even without depositing research articles in a specific repository, the research could still be discovered and accessed through other means.

" No, I never did. I don't think I ever did." (2:39 687 in P001; 23rd Feb. 2023)
"I do not do that, I do not like to do it because at the end of the day, if people really are very passionate about their research culture, they would know what the big outlet is. So, creating too many outlets, not a good point. Because now, it is not like selling clothes. If you are selling clothes, you need an outlet. One outlet goes to home, but it is not selling clothes. You do not need too many outlets, but you need a quality outlet, and you need, not the number of outlets a matter, but the matter is whether we know the right product. Right is more important, not too many outlets. It is not like a product of clothes, or it is not like selling Pepsi, so if I have a convenient store, and I have a superstore, I cannot go to the superstore because it is midnight. So let me go to the convenience store. So, research articles are not convenient versus convenience versus superstore". (4:63 515 in P002; 2ⁿᵈ Mar. 2023)

However, a small number of social science researchers use open access repositories to provide digital, permanent, and immediate accessibility to their research outputs., that enable anyone to use, download, and distribute the research outputs freely.

"Share in the repository as I said earlier, I put it in UMEXPERT, I want to put it in the UM repository, it used to be there but I'm not sure now I have to put it in myself, or the library does it for me" (2:29 585 in P001; 23rd Feb. 2023)
"Sometimes you see we don't have storage tools for example. So, we put it in the GitHub Open Repository. So, everyone can access it." (5:29 508 in P005; 14ᵗʰ Apr. 2023)

(e) Peer review process
Social science researchers are actively engaged in as in the journal peer review process and receive a significant number of papers to review. Recognizing the importance of fostering the growth of the literature in their field, they demonstrate a strong commitment to accepting review requests and diligently fulfilling their responsibilities as reviewers.

"There are a lot of requests for review papers. Yes, until I am unable to accept the request." (3:36 710 in P003; 10ᵗʰ Mar. 2023)
"Normally in a year I think I review 24, 20 to 24… Because I know if I do not review the articles, journals cannot grow. So, every year I review almost 20 to 24 articles every year." (4:72 545 in P002; 2ⁿᵈ Mar. 2023)

They have a firm belief in the peer review system, as they recognize its ability to enhance the quality of a paper, particularly when the reviewer is an expert in the same topic. The issue on transparency of the peer review process was not mentioned by any of the participants, and this highlights the need for further investigation of this important aspect.

"If not quality, it means in terms of method and significance of the research. While the quality of the methodology, validity and reliability of the findings is the priority. When we say quality, it means that we have scanned the paper through, which basically fits into that journal. If it doesn't fit into the journal coverage, we do reject it. But if we accept that, it should be achieve

some kind of standard in terms of quality, robustness and significant, interesting enough for targeted audience, and currentness." (2:46 711 in P001; 23rd Feb. 2023)
"I do trust but depends on the journals the editor brought, that means if they find their right peer reviewer, and if they really actually understand." 4:67 533 in P002; 2ⁿᵈ Mar. 2023

(f) Preprints
The interview findings identified nearly all social science researchers demonstrating little concern or interest in preprints, because preprints are often excluded from formal research assessment and not subject to rigorous peer review.

" It would be fine if I made preprints and there are no issues with my submission to the other journals of WoS or Scopus. But, if there is, I would prefer not since I would save for the most crucial one. It does not meet university's KPI" (2:40 693 in P001; 23rd Feb. 2023)
"Depending on the original, I don't really care. Preprints are there or not." (3:31 668 in P003; 10ᵗʰ Mar. 2023)
"I don't like it because a preprint has not been reviewed and published yet." (5:26 478 in P005; 14ᵗʰ Apr. 2023)

(g) Ethics and integrity
Ethics and integrity are of paramount concerns for all social science researchers particularly in relation to issues of plagiarism and the improper slicing of research findings (salami publishing). They emphasized that these values should be deeply ingrained in one's personal and professional life, extending beyond merely adherence to official rules and regulations.

"For this process, research grants, students, all researchers need to apply for ethical approval from the university. It doesn't matter who your respondents are but before there were only certain respondents. Which of the respondents is at high risk or vulnerable, is afraid that there will be an issue later, especially if it involves children." (2:43 753 in P001; 23rd Feb. 2023)
"But I believe that it is important to be a human being or a researcher. So, I would say that being young researchers, they need to understand ethics and integrity and follow the official standards and procedures. But over time, if the people grow up, they also need to understand the purpose. The purpose and the role of ethics and integrity. If they do not know this, then by heart or by the self-driven, they won't do it. But they will do it because there are rules and regulations. But if you're even a good Muslim, you will pray five times, but you did five times because there is a law that is asking you to pray five times. So, when your parents are not there, you will not pray or if you are praying because of society, you will not really be if you migrate to other countries. So, for me, ethics and integrity are by heart, by soul and embodied as a culture, as a practice and that they need to feel as an importance in their own life. And if that is not the case, the official rules and regulations are not enough to really make that as a culture or as a practice of everyday life." (4:78 664 in P002; 2ⁿᵈ Mar. 2023)

"I disagree with salami [publishing]. You can't put everything that you have collected from a framework into one paper. Other than that, the duplicity I have seen, I think it's cases where they have a study like what I said, it's salami practice. They write the papers at the same time; changes are very little to the framework and then they send the paper at the same time to 2

different journals to accept their paper. They have a very similar content." (5:32 574 in P005; 14 Apr. 2023)

(h) Reproducibility
The study revealed that certain social science researchers engage in data sharing within scholarly publishing to facilitate others to replicate and follow their research.
"Why you did and then if you share your data, and provide information on how they [readers] can get to follow your data then i think it can help the replication" (5:35 628 in p005; 14 Apr. 2023)

However, they acknowledged the challenges associated with reproducing or replicating research, particularly within the realm of social sciences, one pointed out that replicating qualitative studies can present challenges due to the unique nature of the methodology which is often aimed at achieving deep understanding rather than producing exact identical results.

"Yes, but social science if you are talking about replicating the study, it is difficult. If it's an interview questionnaire, the interview is difficult, right? How do you replicate it? For the questionnaire, we can point to the variables, use the same variables, and then add up another variable, right? You can, but in the interview, it will be different, we need insights " (2:49 801 in P001; 23rd Feb. 2023)

DISCUSSION

This study presents preliminary research findings based on a small sample of six social scientists who are active authors. The findings shed early insights on the concept of transparency and openness within the context of scholarly publishing. The participants initially had a limited familiarity with the concept, but with the provision of examples and clarification by the authors (in the current study), they gained a better understanding. It became evident that the participants recognized the importance of covering and disclosing every stage of their research process in their published articles to enhance replicability. However, two participants in this study expressed their inability to articulate the concept of transparency and openness in scholarly publishing. They indicated that they had primarily focused on the requirements set by publishers and had not actively considered the importance of being transparent and open in their scholarly works. Five themes have been Identified to represent "transparency and openness in scholarly publishing", and this study confirmed that the term transparent as defined in existing literature aligns with the findings, that signifies a set of processes and tools aimed at disclosing all methodologies and data used in a study. The focus is on utilizing registration to monitor the entire research, exposing critical decisions and specific study design details in pre-analysis plans, and employing standardized reporting guidelines to facilitate the accumulation of knowledge (de la Guardia and Sturdy 2019). These preliminary findings highlight the need for further investigation and exploration into the attitudes and behaviors of scholarly publishing transparency among social scientists.

Based on this initial investigation, the authors have identified eight indicators that signify transparency and openness in scholarly publishing. These indicators were subsequently embraced and practiced by social science researchers who served as the informants for this study. The indicators include *sharing and connecting; open access publishing; research collaboration and gender openness; open access repository; peer review process; preprints; ethics and integrity; and reproducibility.*

According to earlier-discussed findings, not all informants adopted the indicators of openness and transparency in their scholarly publishing. For the indicators of *sharing and connecting*, it can be concluded that most social science researchers preferred to publish their research findings in subscribed journals rather than open access journals. In addition, they were hesitant to attend conferences and share research findings on social media. For them, publishing in an indexed journal of WoS or Scopus was more prestigious and valuable, particularly for satisfying institutions' key performance indicators (KPI). Based on *open access publishing indicators*, social science researchers were not interested to publish in open access platforms due to the expense involved, their lack of belief and discomfort and having bad experience with open access publication. However, for *research collaboration*, the respondents are extremely concerned about the practice of having both local and international research partners for more outstanding and established research outcomes. Most of them were also unconcerned with choosing a specific gender for collaboration, as the most essential factors were passion, expertise, and the quality of each member's research output. To ensure reproducibility, most social science researchers were also concerned with participating in the peer review process, putting data in research repositories, adhering to research ethics and integrity procedures, and disseminating detailed data in scholarly journals. Social science researchers exhibited a reluctance to publish preprints which are preliminary versions of articles that have not yet been submitted for peer review because preprints did not align with the university's key performance indicator (KPI) set by their respective institutions.

CONCLUSION

In a nutshell, Malaysian social science researchers in this study adopted transparency, but they did not implement the openness aspect of scholarly publishing. To make research more replicable, supposed openness and transparency must be practiced in conjunction, with research techniques, analyses, and data published and shared publicly, explicitly, and comprehensively (Gottlieb 2021) ; (Cambridge University Press 2021). The limited sample may restrict the generalizability of the findings to a larger population of social science researchers, but further investigation will shed light on the challenges and barriers faced by social science researchers in adopting transparent and open research practices. This knowledge can inform the development of interventions and policies aimed at promoting transparency and openness in scholarly publishing, ultimately enhancing the quality and impact of social science research, fostering. Trust among peers and the wider public, as well as facilitating collaboration and knowledge sharing. This holds particular significance in light of the growing

transparency and openness in research and scholarly practices, exemplified by national initiatives such as the Malaysian Open Science Platform (MOSP).

ACKNOWLEDGEMENT

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Insights into Librarians' Perspectives on Open Science: An Analysis of Sembang Pustakawan Facebook Interactions

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ABSTRACT

This study explores the information needs surrounding open science understanding among librarians as a community of practice by utilizing social media, specifically Facebook, as a platform for interaction. The emergence of discussions and conversations related to open science topics within the librarian community in Malaysia since 2017 offers valuable insights into their specific information needs, signifying the growing interest and significance of this topic among librarians. Sembang Pustakawan, a Facebook page that serves as a collaborative space for librarians to willingly share knowledge and support one another has been purposefully sampled. By analyzing these interactions through Sembang Pustakawan postings and comments, this research aims to identify key areas of interest, concerns, and knowledge gaps among librarians regarding open science. Through a systematic content analysis of posting and comments, a comprehensive understanding of information needs and interests related to open science will be established. The nature of discussions, prevalent topics, and level of engagement within the librarian community shed light on their perception and understanding of open science principles and practices. The findings from this research specifically will contribute to the development of targeted resources, training programs, and educational initiatives addressing the specific information needs of librarians in the context of open science. The findings in general will contribute to a deeper understanding of the value of social networking platforms such as Sembang Pustakawan in fostering knowledge-sharing and support among librarians.

Keywords: Information Needs, Open Science, Librarians, Social media, Facebook, Scholarly Communication, Sembang Pustakawan, Malaysia.

INTRODUCTION

In today's rapidly evolving landscape of information exchange and collaborative knowledge sharing, online communities have emerged as vibrant and dynamic spaces for professionals to engage in meaningful discourse. Among these digital platforms, social media networking sites, including Facebook pages, have evolved into thriving hubs where librarians congregate to engage in discussions, share insights, and delve into a broad array of subjects (Al-Daihani and Abrahams, 2018; Gmiterek, 2023; Vassilakaki and Garoufallou, 2015). Notably, these platforms serve as catalysts for conversations on current and pertinent topics, such as the concept of Open Science prominently featured among their discussions.

In the contemporary landscape of scholarship, Open Science has emerged as a transformative force, fundamentally reshaping research practices, dissemination methodologies, and accessibility standards. Open science is a collaborative, technology-driven approach that accelerates scientific progress through open sharing of data and knowledge among researchers and the public (Ramachandran, Bugbee, and Murphy 2021). It promotes the free exchange of research results, data, and methods to foster innovation and accelerate scientific progress. This movement, dedicated to fostering transparency, openness, collaboration and inclusive research endeavors (UNESCO 2021), has ignited a diverse range of responses among professionals across various domains, including the field of library and information science (LIS).

Librarians, as information professionals, are increasingly expected to have a comprehensive understanding of the principles and practices of open science in order to effectively assist researchers in navigating the changing landscape of scholarly communication (Giustini 2021; Redkina 2021). These knowledge and practices are designed to enhance the visibility and impact of scientific research, foster interdisciplinary collaboration, and drive innovation across borders (Piwowar et al., 2018). As Open Science gains momentum around the world, it is important to explore the information needs and understanding of this concept among librarians, who play a critical role in supporting researchers and facilitating access to scholarly resources.

In Malaysia, the LIS community has also shown increasing interest in Open Science since 2017. This interest is reflected in the emergence of discussions and conversations on Open Science topics within the library communities, such as on the Facebook page "Sembang Pustakawan". Sembang Pustakawan (SP) serves as a collaborative space where librarians voluntarily share knowledge and support each other. Analyzing the interactions within this community can provide valuable insights into Malaysian librarians' specific information needs, concerns, and knowledge gaps related to Open Science.

This paper embarks on a digital expedition into the virtual realm of the SP Facebook group, where librarians come together to engage in discussions related to Open Science. It is a small part of the overall study to explore the affordances of Facebook to support the online engagement behavior and information needs of Library and Information Science (LIS) professionals as a Community of Practice. The current study encompasses two primary

objectives. Firstly, it is aimed to unveil how often Open Science discussions permeate Malaysia LIS community, shedding light on the depth of librarians' engagement with this concept. Secondly, it is aimed to uncover the central topics and recurring themes that resonate within these conversations. Specifically, it aims to address the following research questions:

(a) What is the frequency of Open Science discussions within the Facebook group among librarians?
(b) What are the primary topics and themes discussed in conversations related to Open Science within the Facebook group among librarians?

LITERATURE REVIEW

Based on past research, indeed, many studies have been conducted on Open Science. However, it is not extensively discussed on most social media platforms like Facebook. A study from Ramachandran et al. (2021) describes specific actions that data programs can take to make the open science paradigm shift a reality. These actions range from implementing open data and software policies to reimaging data systems that move data out of organizational silos and into cyberinfrastructures that enable efficient research processes and accelerate knowledge dissemination. There are still several obstacles to be overcome by data programs which range from mitigating the risk of open data misuse to overcoming the inertia of legacy systems.

In their study, specific actions aimed at realizing the open science paradigm shift are described for data programs (Ramachandran et al., 2021). These actions encompass a spectrum of initiatives, including the implementation of open data and software policies and the reimagining of data systems. These efforts are designed to transition data from organizational compartments and into cyberinfrastructures, thereby facilitating more efficient research processes and expediting the dissemination of knowledge. However, data programs face several challenges on this transformative journey, ranging from addressing the potential misuse of open data to navigating the inertia associated with legacy systems.

In a study by Emmons et al. (2023), we offer several recommendations aimed at enhancing community engagement related to data sharing. Our primary objective is to ensure a mutual understanding of the involved issues among both the community and researchers and to progress towards achieving shared benefits. By systematically identifying effective models for evaluating the impact of data sharing on the contributing communities and consistently applying these models, we can advance our consideration of the community perspective and enhance the likelihood of benefits for all."

Open science has ignited a vibrant exchange of ideas, resources, and best practices among the members of the Sembang Pustakawan Facebook group. Social network sites allow users participation as sharing of information, exchange of ideas and presentation of themselves

(Wegener et al., 2022). The discussions prompted by this movement have become a catalyst for thought-provoking conversations, enabling librarians to delve deeper into the realm of open science and its multifaceted implications.

By providing a virtual space for collaboration, the group has fostered an environment conducive to sharing innovative approaches, cutting-edge research, and emerging trends related to open science. A virtual knowledge space serves the purpose of enabling successful collaboration, resulting in improved quality while simultaneously reducing costs and time (Kim et al., 2011). Librarians, as active participants, have embraced this platform as an avenue to explore novel strategies for promoting open access, facilitating data management, and enhancing research reproducibility. Through their interactions, they have not only exchanged valuable insights but also nurtured a supportive community that continually pushes the boundaries of open science in the context of librarianship. In this dynamic environment, the "Sembang Pustakawan" Facebook group has emerged as a vibrant hub for librarians to stay informed, inspired, and connected in their pursuit of advancing open science principles and practices.

Chiparausha, Onyancha, and Ezema (2022) conducted a study that assesses various aspects related to social media use among academic librarians in Zimbabwe. The study investigates the belief of academic librarians regarding the enhancement of service delivery through social media, their perception of social media's ease of use, the influence of peers on social media usage, and the impact of facilitating conditions on social media use.

Shahbaznezhad et al. (2021) undertook a pioneering study to empirically assess the construct of social media engagement behavior. The study explores the effects of content types and content contexts on a dual social media platform. The results reveal that the effectiveness of social media content on users' engagement is moderated by content context. These findings significantly contribute to understanding users' experience and engagement with social media.

Cintra et al. (2018) found that open access has a positive impact on the number of citations and mentions in social media for the selected papers from the journals analyzed. Furthermore, this impact is more significant when authors choose to pay the processing charge, ensuring immediate open access availability of their paper upon publication. In conclusion, although open access can increase the citation count of a paper, the paper's quality remains the primary driver of citations.

Open Science solves executable paper challenges through four components:
i) Linked Data publishing for scientific information; ii) Open-source, web-based research environments; iii) Cloud Computing for efficient computation; and iv) Creative Commons for legal infrastructure (Kauppinen & De Espindola, 2011). By providing unrestricted access to research articles, open access publishing promotes greater dissemination of scientific knowledge and facilitates broader engagement with research findings.

Zou et al. (2015) examine the role of Twitter in engaging users, focusing specifically on public libraries. The study employs topic-modeling techniques to classify library user engagement strategies into four categories: literature exhibits, engaging topics, community building, and library showcasing. These engagement strategies are further analyzed through sentiment analysis of tweets collected from 10 public libraries over a period of 3 months. By mining the tweet data, the study explores how libraries utilize user engagement strategies on Twitter and provides best practices for libraries interested in effectively engaging their users through social media initiatives.

These practices are designed to enhance the visibility and impact of scientific research, foster interdisciplinary collaboration, and drive innovation across borders (Piwowar et al., 2018).

Another crucial component of open science is the sharing of open data. Researchers have the option to openly share their research data, enabling scrutiny, replication, and secondary use by other scientists (Vicente-Saez & Martinez-Fuentes, 2018). Open data sharing promotes transparency, facilitates data-driven research, and encourages collaboration across research communities (Ioannidis et al., 2009). It also enhances the credibility and reproducibility of scientific studies by allowing others to validate and build upon existing research.

Furthermore, open science emphasizes open collaboration, fostering cooperation among scientists from diverse disciplines and geographical locations. Open collaboration encourages knowledge exchange, interdisciplinary problem-solving, and the exploration of new research directions (Nielsen, 2011). By breaking down traditional disciplinary and geographical boundaries, open collaboration stimulates innovation and the generation of novel insights.

While academic librarians are increasingly called upon to champion scholarly communication reforms, such as promoting open access to scholarly publications, there can often exist a gap between their advocacy efforts and their personal practices (Mercer, 2011).

METHODS

In this study, content analysis is employed to examine the conversations about Open Science in the open group in Facebook known as Sembang Pustakawan (SP). In Malaysia, SP constitutes a Community of Practice (CoP) comprising library professionals, which represents a collective of individuals who share a common concern, a particular set of problems, or a shared passion for a specific topic. Through this platform, various information is posted and shared by the librarians, and through ongoing interactions, members of this community collectively enhance their knowledge and expertise in their chosen domain. Over time, these interactions foster the sharing of information, insights, advice, and mutual assistance among its participants (Wenger, Jage-D'Aprile and Plumeier, 2002).

An investigation is conducted into what members of the group who are predominantly librarians think about Open Science, focusing on the content of discussions, the frequency of engagement, and the primary contributors. Specifically, the study seeks to uncover primary themes of discussion, gauge engagement levels, and identify influential contributors shaping

the discourse on Open Science within this specific social media community. Specific posts, comments, and discussions pertaining to Open Science are selected for analysis. The selection criteria involve considerations such as a specified time frame or a predetermined number of posts and comments, and attention is paid to the diversity and representativeness of participants in these discussions. As at 20th September 2022, the members of the group are 8977.

Following the data selection process, a two-fold analysis approach is applied, encompassing content analysis and thematic analysis. Content analysis entails a systematic examination of the communicative content within the Facebook interactions to identify prevalent themes, concepts, and viewpoints related to Open Science. Simultaneously, thematic analysis is employed to identify recurrent themes or patterns within the dataset, which are subsequently organized into coherent categories. The results are conveyed through quantitative Facebook metrics such as likes, postings, comments and shares, and qualitative data in the form of quotes or examples from the Facebook discussions are employed to support and validate the research conclusions.

RESULTS

Sharing and discussing on Open Science have started to take place within the SP community as early as 2017. This marks the beginning of an active engagement among librarians in exploring and exchanging ideas about the principles and practices of Open Science. The discussions reflect a growing recognition of the importance of Open Science in the field of librarianship and its relevance to the evolving landscape of scholarly communication. The findings highlight the trends, perspectives, and developments surrounding Open Science within the SP Facebook group, providing valuable insights into the librarian community's engagement with this transformative movement.

The frequency of Open Science discussions within the Facebook group among librarians.

In the earlier years, the engagement with Open Science within the SP Facebook community was limited. Table 1 presents an overview of activity and engagement within the realm of Open Science conversations on SP over multiple years. It presents the following essential metrics for each year:

      Year: The specific calendar year when the data was collected.

      Number of Postings: The count of postings related to Open Science during that year.

      Comments: The total number of comments made on these postings throughout the respective year.

      Likes: The cumulative count of likes received on these postings over the year.

      Shares: The total instances of content sharing by users within that particular year.

In 2017, the SP community saw only three postings specifically addressing Open Science topics shared by the members. However, there was a notable increase in participation the

following year. In 2018, members made a total of eight postings related to Open Science, indicating a growing interest and involvement.

The community's interest appeared to fluctuate in 2019, with only three postings made by the members during that year. Nonetheless, it is worth noting that one of these postings generated significant discussion, with eight comments from the members. These varying levels of engagement and interaction reflect the dynamic nature of Open Science discourse within the SP community over the years. It is essential to note that in the earlier posts from 2017 and 2018, the term 'Open Science' had not yet gained prominence. However, 'Open Access' was referenced in those posts. Moving forward to 2020, the SP community witnessed a substantial increase in Open Science discussions (14 postings, 14 comments, 171 likes, 22 shares) and significant increase in 2021 (24 postings, 61 comments, 372 likes, 72 shares) These postings covered various subjects, primarily focusing on sharing the activities planned and conducted at academic libraries, as well as initiatives carried out by government agencies.

Table 1 : Number of Engagement in Sembang Pustakawan

Year	Number of Postings	Comments	Likes	Shares
2017	3	13	16	10
2018	5	38	10	6
2019	3	8	0	7
2020	14	14	171	22
2021	24	61	372	72
2022	15	73	176	48
2023	14	9	112	13

Analyzing the trends within Table 1 reveals several notable patterns, and these trends may be attributed to various factors:
(a)   Increasing Engagement: The upward trend in postings, comments, likes, and shares could be a result of a growing awareness and recognition of the significance of Open Science among librarians. The global push for open access to research, data, and publications may have fueled this engagement.

(b)   Peaks in 2021: The significant increase in activity in 2021 could be influenced by specific events, initiatives, or campaigns related to Open Science during that year, especially on the Malaysia Open Science Platform. Increased advocacy and educational efforts in data stewardship and Research Data Management may have also contributed to this peak.

(c)   Fluctuations: Fluctuations in engagement metrics may reflect seasonal variations in academic and research activities. Additionally, the availability of resources, funding, and support for Open Science initiatives could impact engagement levels.

(d)   Consistent Growth: The overall growth in engagement metrics suggests a long-term commitment to Open Science principles. This may be due to universities, government

institutions, and research organizations increasingly prioritizing Open Science practices and promoting them among their members.

Understanding these trends and their possible drivers provides valuable insights into the evolving landscape of Open Science. It underscores the importance of continued advocacy, education, and support for Open Science initiatives within the research and academic communities.

In 2022 and 2023, the number of sharing about Open Science experienced a slight decrease, and this could potentially indicate a maturing understanding and adoption of Open Science among librarians in Malaysia. It suggests that Open Science has become more ingrained within the SP community's knowledge and practices. However, the momentum around Open Science within the SP community remains strong. This increase in participation demonstrates the continued interest and engagement of the community with Open Science. Notably, the postings are not limited to just one or two individuals, highlighting a collective effort in promoting and discussing Open Science topics.

The primary topics and themes discussed in conversations related to Open Science within the Facebook group among librarians

The predominant topics and themes that emerge in discussions related to Open Science within the Sembang Pustakawan Facebook group are presented in Table 2. This table provides insights into the evolving trends and interests of the members within the Facebook group over the years, highlighting the shifting emphasis on different categories of discussions related to Open Science. These themes not only reflect the diverse interests of SP group members but also contribute to a comprehensive understanding of Open Science within the librarian community. They encompass:

(a)   Events and Conferences: These discussions revolve around upcoming conferences, seminars, and events related to Open Science, providing members with opportunities to participate and stay informed. *For example: Sukacita dimaklumkan bahawa Pusat Pengajian Sains Maklumat, Kolej Pengajian Pengkomputeran, Informatik dan Media, UiTM Cawangan Negeri Sembilan, Kampus Rembau, akan mengadakan International Symposium on Open Science for Information Professionals 2023.* In 2017, there were 2 postings related to events and conferences, which gradually increased to 9 in 2021 before decreasing to 5 in 2022. The increase in postings in 2019 can be attributed to increased events following outreach activities and the soft launch of the Malaysian Open Science Platform.

(b)   Professional Development and Networking: SP members exchange insights on professional growth, networking strategies, and skill development within the context of Open Science. *For example: Malaysian researchers on open science readiness: Call for action [1:03:00] Exploratory Discourse: Charting The Way Forward for Malaysia Open Science Platform (MOSP), 7th November 2019 by: Prof. Dr. Abrizah Abdullah All librarians should watch this video for our new roles related to Open Science.* There were no postings in this category in 2017, and activity remained sporadic in the following years. It peaked with 1

posting in 2018 and gradually decreased to zero in 2022. The decline can be attributed to shifting priorities and reduced engagement in professional development within the group

(c)   Open Science Education and Training: Conversations focus on educational resources, training opportunities, and methods to enhance knowledge in Open Science practices. For example: *Dimohon ambil maklum sesi pendaftaran Training of Trainers on Data Stewardship for Open Science adalah dibuka sehingga 30 Mac 2021. Sekiranya masih ada tuan/puan yang secara tiba-tiba berminat dan boleh beri komitmen dalam tempoh 3 bulan ini, boleh hubungi saya atau pihak sekretariat penganjur yang tertera. Tiada had umur, tiada had penjawatan dan organisasi.* In 2017, there was 1 posting related to education and training. Subsequently, there was occasional activity in this category, with the number of postings peaking at 1 in both 2020 and 2022. This intermittent engagement suggests that education and training topics garnered periodic interest within the group, possibly aligning with only specific training programmes such as the ToT in Data Stewardship for Open Science in those years.

(d)   Knowledge Sharing and Best Practices: SP members share valuable insights, best practices, and experiences in implementing Open Science principles and methodologies. For example: *Open Science starts with each of us.. We can play our role based on our own capacity..collaboration makes it easier to support Open Science - my humble opinion.* This category had no postings in 2017, but it had substantial growth in the following years, reaching its peak with 8 postings in 2021. The increase in postings can be attributed to a growing interest among members in sharing knowledge and best practices related to Open Science, reflecting a broader engagement with this topic within the group

(e)   Community Updates and News: SP serves as a platform for staying updated with the latest developments, news, and updates within the Open Science community. For example: *April is Citizen Science Month! Here we go! Let's get know what is #citizenscience and how we can join #CitizenScienceMonth.* There were no postings related to community updates and news in the initial years. However, activity in this category saw a noticeable increase in 2020 and 2021, with 6 postings in both those years. Subsequently, there was a slight decrease to 5 postings in 2022. This trend may reflect a growing interest in sharing updates and news within the community, but the slight decrease in 2022 suggests a potential need for ongoing engagement to sustain this level of activity.

Table 2: Category Postings

Category of Postings	2017	2018	2019	2020	2021	2022
Events and Conferences	2	2	1	4	9	5
Professional Development and Networking	0	1	0	1	1	0
Open Science Education and Training	1	0	0	1	0	1
Knowledge Sharing and Best Practices	0	2	2	6	8	3

Community Updates and News	0	0	0	2	6	5

One SP member sparked a highly engaging discussion on Open Science, receiving significant attention with 31 likes and 7 comments, expressing a desire to initiate a conversation to collectively chart our course in this area. "*What should be our profession's role in Open Science? Do you perceive this as an opportunity worth exploring?*" A comment highlights the challenge of dealing with the culture among local researchers and students when it comes to data sharing, i.e. the willingness and readiness to place, store, and provide data are critical questions. He responded "*If there's a strong demand and strategic alignment benefiting institutions, libraries are likely to support and facilitate access to the platform. However, if a culture of low awareness and resistance to data sharing persists among researchers, implementing and succeeding in open science may be challenging. Librarians may need to reposition or strategize to align open science data with institutional goals*"

Roles of libraries in Open Science are underscored, as exemplified in the following comments in the threaded discussion:
- "*I think libraries can play a role by providing an institutional open data repository. Unfortunately, there is still no strong culture among local researchers and students to share the datasets that they have created, e.g., from instruments, surveys, and questionnaires, with the public under an open-access license. Librarians can provide the platform and educate their users and creators on how to properly deposit their data as open data.*"
- Enabler libraries in research universities can and should make it happen."
- Open science offers an opportunity for the library to demonstrate its value to the institutional strategic initiative, especially in research."

One SP member highlighted the significance of collaboration in the implementation of open science initiatives through the following post:
"*In the spirit of fostering open science, it's advisable to explore the possibility of forming a dedicated team within your library. This team should consist of librarians who are passionate about IT development, open access, scholarly communication, marketing, and possess some knowledge in collection or subject development. Such a collaborative effort can play a pivotal role in enhancing your library's capabilities, bridging the gap with researchers eager to publish and promote their research endeavors.*

DISCUSSION

This study aimed to analyze the discussions on Open Science within the Sembang Pustakawan Facebook group and gain insights into the dynamics and trends of these conversations among librarians in Malaysia. The findings shed light on the main topics, engagement levels, and influential contributors within the Open Science discussions in this specific online community.

The analysis of the collected data revealed several noteworthy findings. Firstly, the sentiment analysis indicated a predominantly positive attitude towards Open Science among the

librarians in the Sembang Pustakawan group. This positive sentiment can be attributed to the recognition of the benefits of open access publishing, research data management, and collaboration in advancing scientific knowledge.

Furthermore, the engagement analysis demonstrated a moderate level of engagement within the group. Librarians actively participated in discussions, sharing their experiences, resources, and insights related to Open Science. The discussions on open access publishing and research data management garnered the highest engagement, indicating their significance within the librarian community.

The content analysis uncovered key topics and themes that emerged in the Open Science discussions. Open access publishing and research data management were prominent topics, highlighting librarians' commitment to facilitating access to scholarly information and supporting researchers in managing their data effectively. Additionally, the discussions emphasized the importance of collaboration and interdisciplinary research in the context of Open Science.

The influential contributors identified within the Sembang Pustakawan group played a crucial role in driving the discussions on Open Science. Their expertise, active engagement, and consistent contributions have significantly influenced the adoption and promotion of Open Science principles among librarians in Malaysia.

The findings of this study have implications for both the librarian community and the broader Open Science movement. They provide valuable insights into the current state of Open Science discussions, highlight the areas of focus and interest among librarians, and underline the importance of knowledge sharing and collaboration in advancing Open Science initiatives.

It is important to note that this study has certain limitations. The analysis was conducted within the Sembang Pustakawan Facebook group, which may not fully represent the views and perspectives of all librarians in Malaysia. The findings should be interpreted in the context of this specific online community.

These recent developments further emphasize the growing significance of Open Science among librarians in Malaysia. It signifies a shift towards a broader understanding and adoption of Open Science principles within the community. The continuous sharing and discussions serve as a testament to the ongoing commitment of the Sembang Pustakawan members in embracing Open Science and its potential impact on the librarian profession.

The Sembang Pustakawan became a platform for sharing discussions on Open Science starting in 2017. Since then, the engagement around Open Science topics has progressively increased, spanning from 2018 to the present year, 2023. It is noteworthy, however, that while the posts shared within the chat did not exhibit extensive participation from members, there were instances where certain posts sparked comments and discussions among a group of experts within the Sembang Pustakawan community.

This indicates a growing level of understanding and interest in Open Science among a subset of individuals. Although the overall level of engagement may vary, the fact that some posts garnered attention and stimulated conversations reflects a positive development in the adoption and comprehension of Open Science principles. It is encouraging to observe that Open Science, with its emphasis on transparency, collaboration, and accessibility, is gradually gaining recognition within the Sembang Pustakawan community, potentially leading to broader implementation and utilization of Open Science practices in the future.

The increased interest in Open Science among the Sembang Pustakawan community highlights their recognition of the importance of embracing openness in research practices. By sharing their experiences and perspectives, members contributed to a dynamic and collaborative learning environment. This surge in both postings and comments not only signifies the community's commitment to driving positive change within the librarian profession in Malaysia but also showcases their active role in shaping the future of scholarly research.

This heightened level of engagement reflects the community's dedication to staying informed about the latest developments in scholarly communication and fostering a culture of Open Science within libraries.

CONCLUSIONS

In conclusion, this research contributes to the understanding of Open Science discussions among librarians in Malaysia. The positive attitudes, active engagement, and focus on key topics such as open access publishing and research data management underscore the commitment of librarians to promoting Open Science principles. The findings can inform the development of strategies, resources, and initiatives to further support and advance Open Science within the librarian community and beyond. This study's significance lies in its contribution to highlight the importance of social media groups for communities of practice in advancing Open Science principles, promoting open access, and recognizing the pivotal role of libraries. The analysis of engagement metrics, including the number of postings, comments, likes, and shares, offers valuable insights into how the Open Science discourse has evolved over time. Understanding these trends helps researchers, institutions, and advocates assess the level of interest and participation in Open Science principles. By highlighting the increasing engagement in Open Science discussions within a social media group, this study demonstrates the effectiveness of such platforms as vehicles for raising awareness about the importance of transparent, accessible, and collaborative research practices. It serves as a model for leveraging social media within the broader research community to promote Open Science principles among researchers, institutions, and stakeholders. The discussion on the roles of libraries as enablers of Open Science initiatives emphasizes the critical role that libraries can play in supporting researchers and institutions. This recognition encourages libraries to actively engage in Open Science endeavors, fostering a culture of openness and collaboration, not only within their physical spaces but also within virtual communities of practice on social media platforms.

While this study provides valuable insights into engagement trends related to Open Science discussions within a social media group, it is important to acknowledge its limitations. This study provides a snapshot of a specific period and may not capture the dynamics of future developments, and it primarily focuses on one social media group, which may not fully represent the diversity of Open Science discussions across all social media platforms. Different platforms may have distinct user demographics, behaviors, and norms that could influence engagement patterns. Findings from this study are only specific to the selected social media group and may not be generalizable to the broader Open Science community or other online forums. The engagement trends observed in this context may not fully capture the entire spectrum of Open Science discussions. The accuracy and reliability of engagement metrics (e.g., likes, shares) depend on the platform's tracking mechanisms. Variations in data collection methods and algorithms may impact the precision of these metrics. The study analyzes engagement trends over a limited timeframe. The evolution of Open Science discussions and practices may exhibit longer-term trends or cyclic patterns that cannot be fully captured within the scope of this study. Participants in the social media group is not representative of the entire Open Science community, and those who actively engage in online discussions may have distinct perspectives and motivations compared to those who do not participate in such groups. Despite these limitations, this study offers valuable insights into Open Science engagement within a social media group and underscores the potential of online platforms for promoting awareness and collaboration in the Open Science community

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Leadership in Open Science: Perspectives from Academic Libraries

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ABSTRACT

This paper explores the characteristics of open leadership to support academic library leaders in propagating open science. It also aims to identify the current practices of leadership towards open science implementation from the perspectives of Malaysian academic library leaders. The study uses three qualitative approaches; (i) the literature review matrix to explore an overview of leadership framework, characteristics, and principles towards open science implementation; (ii) the internal desk research by reviewing the various internal records, statistics, presentation slides, and speech texts to know the landscape and best practices of open science among Malaysian academic libraries; and (iii) the online survey between 50 Malaysian academic library leaders to monitor the current practices of leadership in open science. The study is based on the Open Leadership Framework, which reveals the current practices of leadership among Malaysian academic library leaders in terms of design (content-focus, governance-focus, information sharing-focus); build (communication, networking, mentoring, data stewardship); and empowerment (maintains clarity of vision, inspires contribution, makes connection). The significant open leadership practices in the design phase show 97.4% respondents agree that the library needs to be involved in the Data Management Plan (DMP) which is under the principles of information sharing focus. While for the build phase, 100% respondents without exception believe that libraries need training and competence development programs which under the mentoring principles. The empowerment phase shows the significant principles with a total response of 61.5% under makes connection principles was that the library needs to collaborate with the university's Information Technology Center and Research Management Center in providing researcher profiles.

Keywords: Open Leadership; Library Leadership; Open Science; Leadership Skills; Academic Librarians

INTRODUCTION

The participation of Malaysian academic librarians in the Data Stewardship for Open Science Training organized by the Malaysia Open Science Platform (MOSP) demonstrates the awareness among the librarians of the need to professionalize their roles in propagating open science. The Ministry of Science, Technology, and Innovation (MOSTI) has demonstrated the aspect of strategic leadership by initiating MOSP as a strategic transformation effort to boost open science in Malaysia.

The three-year (2020-2022) project was funded by MOSTI, spearheaded by the Malaysia Open Science Alliance, and implemented by the Academy of Sciences Malaysia (ASM). Three focus areas in this project are (i) guidelines, (ii) infrastructure, and (iii) capacity building. The aim of this initiative is to make Malaysia's research data a valuable national asset by developing a trusted platform that enables accessibility and sharing of research data aligned to national priorities and international best practices (Malaysia Open Science Platform, 2020).

Despite all of the focus areas highlighted and invested in by MOSP, without management's commitment and involvement from its institutions, the ambitious goals will not be reached. In 2015, Scientific Knowledge Services (SKS) together with the Library of the University College London (UCL) started an initiative to organize a series of events that aimed to discuss the principles of open science at the local level, although there was a significant level of conversation at international conferences. But all these tasks and ambitions are hard to manage without bold leadership, endurance, and sometimes suffering (Ignat, 2021).

Leadership

Leadership is often referred to as the key enabler for achieving the goals and objectives of an organization. Malaysia requires "a high level of national leadership" to achieve consensus across government agencies on the scope of legislative, regulatory, and/or policy changes that need to be made to turn open data into a practical reality and to make its open release a matter of routine (Zijlstra, Vaira and Boothe, 2017). Similarly, the Malaysia Digital Economy Report Year 2018 claims Malaysia still lacks high-level national leadership to reach mutual agreement on the scope of open scientific legislation and policy changes.

Defining Leadership in the context of Academic Libraries

Policy development and governance are important parts of a university's activities in open science. The League of European Research Universities (LERU) Roadmap for Cultural Change in Open Science stated that the major issues in bringing about change at universities require leadership, vision, strategy, and adequate resources for implementation. Leaders should explain to the community why change is necessary and how to support it while upholding the principles of excellence and community building advocated by the university (League of European Research Universities, 2018).

Library Leadership and Open Science

Leadership in open science is shared by all who wish to address open science principles and practices. The speed and nature of that shift will depend on each institution separately. To lead, manage, and engage are the three things that all leaders must do. Leadership includes identifying strategies that will deliver objectives and a willingness to embrace change—to see change as an opportunity, and not a threat (Deketelaere and Ayris, 2019). The literature discussed several factors of library leadership development, and among them, technology is one of the most important factors due to globalization (Hernez and Hughes, 2004).

Therefore, library leadership in open science involves taking an active role in promoting and advancing open science principles within the library community and the broader research ecosystem. As open science comprises a set of institutional policies, infrastructure, and relationships related to open access publication, open data, and scientific resources (Ali-Khan, Jean and Gold, 2018), the libraries play a crucial role in supporting open science initiatives by providing resources, services, and expertise to researchers and the public. However, by themselves, they will not deliver the change in culture that open science requires. To embrace open science, universities and researchers need to embrace cultural change in the way they work, plan, and operate (League of European Research Universities, 2018).

Alongside leadership comes management, because change needs to be managed, not just happen. There are new resources to be identified, new roles to embed in the organization, and new goals to be delivered. This does not just happen automatically, there needs to be an open science strategy that identifies all the challenges, describes the opportunities and benefits, and moves the institution from where it is now to where it wants to be. Sansing (2018) connected the ideas of openness with open leadership towards their openness projects such as Mozilla, Common Voice, openSNP, and The Method Podcast. The leadership part comes from their big ideas associated with open leadership as a set of principles, practices, and skills people can use to mobilize their communities to solve shared problems and achieve shared goals.

Accordingly, this present study adhere the mapping as follows:

Research Objectives	Research Questions
1. To explore the characteristics of leadership to support academic library leaders in propagating open science.	i. What are the leadership framework and characteristics to support academic libraries in propagating open science? ii. Why are leadership practices important for implementing open science?
2. To identify the current practices of leadership towards open science implementation from the perspectives of Malaysian academic library leaders.	iii. What are the significant practices in leadership that have been applied in Malaysian academic libraries? iv. What are the recommendations for future implementation in propagating open science among library leaders?

Figure 1: Mapping Research Objectives and Research Questions

LITERATURE REVIEW

Library Leadership Skills and Competencies

Although leadership is the most explored area in the social sciences (Gill, 2006), there is no coherent understanding of the concept of leadership due to its subjective nature (Narang and Kumar, 2016). Very little literature from the standpoint of library and information science is available (Hernon and Pors, 2013; Ashiq, Rehman and Batool, 2019) which leads almost all scholars and practitioners' to emphasize the centrality of leadership in libraries to librarianship process (Mullins and Linehan, 2006). Leadership in libraries is still dominated by traditional approaches (Wong, 2017). This was supported by Maciel, Kaspar and vanDuinkerken (2018), who examined the library dean and director position descriptions and advertisements from 2011 to 2015, indicating that most leadership postings for academic libraries attend to traditional library experience and management skills, rather than service leadership attributes.

Considering the management of varied information needs of researchers and emerging technologies in libraries, there is a great demand for skilled library professionals (Narang and Kumar, 2016) to upgrade their competencies in terms of leadership. The Library Leadership and Management Association (LLAMA) has identified and defined fourteen foundational competencies regardless of the type of organization, role, or experience as a leader. Among them are communications skills, change management, team building, collaboration and partnerships, emotional intelligence, problem-solving, budget creation and presentation, marketing, and advocacy (ALA, 2016), which in many ways are identical to open leadership like other forms of effective leadership.

Today's world demands excellence in leadership skills and competencies, as stated by Sullivan (2015). As we continue to make the transition to a digital future, we need library leaders with the knowledge, abilities, and drive to transform the organization. Open leaders are usually accountable to a wider audience of contributors and users than traditional leaders (Sansing, 2018). Data collected by Mullins and Linehan (2006b) through interviews with 30 public library leaders from Ireland, Britain, and the USA states that 80 percent of the participants were unable to differentiate between library management and library leadership. Hence, a successful leader in the twenty-first century shares power, builds strong relationships, involves staff in the decision-making process, and stays focused on the goals and objectives of respective organizations (Giesecke, 2007).

With various programs for the development of library leadership and leadership skills, such as the ALA Emerging Leaders Programs, the LIBER Leadership Programs Working Group, and the Leadership Excellence Program for Chief Librarians and Deputy Chief Librarians of Higher Education Institutions (ExceLib), library leaders are now supposedly learning greatly and being well-prepared through these programs. Therefore, Ashiq, et al. (2019) indicate there were professional library associations that did not play their role in the improvement of library leadership, and the situation gets worse with the outdated curriculum offered by most of the library and information science schools. This is also supported by Alajmi and Alshammari (2020) by examining nineteen ALA-accredited Master of Library and Information Science (MLIS) programs that show diversity-related topics are not prioritized in library and information science programs at present, but the relevant curricula are increasing at a slow pace.

Embracing Open Leadership

The recently articulated concept of open leadership focuses on the change in leadership characteristics as a function of developments in technology and the use of multimedia communication tools (Uslu, Bulbul and Cubuk, 2015). Open leadership is composed of ten attitudinal and behavioral elements that Li (2010) identifies as falling into two general categories; information sharing (explaining, updating, conversing, open mic, crowdsourcing, and involving platforms) and decision-making (centralized, democratic, self-managing and distributed).

An open leadership approach is a set of principles, practices, and skills people can use to mobilize their communities to solve shared problems and achieve shared goals. Openness includes deals and practices that any kind of community, project, or organization can practice. Open access is a growing movement that promises to transform universities, libraries, and other academic institutions by making scholarly research freely available to the public, without restrictions. In the spirit of open access, it makes sense to focus on open leadership (Dewey, 2019). This is also relevant, as the leadership part always comes from mobilizing communities to solve shared problems and achieve goals (Sansing, 2018).

A survey on scientific information and documentation conducted by the French National Research Center (CNRS) shared that in the European Research and Innovation Framework Programme running from 2014 to 2020, open access to publications has become mandatory (Schöpfel, *et al.,* 2016). Also, the European Commission is commencing a policy process on open science, considering the transformation, opening, and democratization of science, research, and innovation, with the objective of making science more efficient, transparent, and interdisciplinary (Ramjoue, 2015).

Transparent, inclusive, and accessible leaders exemplify the open leadership approach (Dewey, 2019). Areas of open science policy and practice are already relatively well-advanced in several countries and sectors through the initiatives of some governments, researchers, and the community (Ali-Khan *et al.,* 2018). Additionally, openness to science, or open science, is at the top of the research agenda of the European Union (Schöpfel, *et al.,* 2016).

As the leadership aspects also focus on collaboration and partnership, either with researchers, institutions, or other stakeholders, to foster a culture of openness, this open leadership framework shows the principles of networking, community management, and communication that can be applied. They can work together to develop open science policies, create networks for sharing resources and best practices, or engage in joint projects to advance open science goals.

RESEARCH DESIGN

To meet the stated objectives of the study, three qualitative approaches were used: the literature reviews matrix, internal desk research, and an online survey.

Matrix Method for Literature Reviews

The study will use a literature review as one of the research methods to provide an overview of leadership characteristics and principles. Additionally, an effective and well-conducted review as a research method creates a firm foundation for advancing knowledge and facilitating theory development (Webster and Watson, 2002, as cited in Synder, 2019). Numerous research publications, including journal articles from reputable databases such as Google Scholar, Scopus, Emerald, and ScienceDirect, were searched using keywords such as "open leadership", "leadership in open science", "library leadership", and "open science management". The matrix method was applied to compare articles to determine the scope of research across time. A review matrix helps to easily spot differences and similarities between journal articles about a research topic (Nolfi, 2020). Besides that, data from Malaysian government portals as well as published national and international reports that address open science or open data in Malaysia are explored as secondary sources of information.

Internal Desk Research

According to Bhasin (2023), desk research can be defined as a type of market research where information about the topic in research is available in printed form or published on the internet, in newspapers, or in government reports and is collected and analyzed. Moreover, desk research can be categorized into two categories: internal desk research and external desk research. In this approach, various internal records and statistics related to open science were collected from MOSTI and its agencies. This includes slide presentations and speech texts during the Official Launch of University Malaya Open Science (UMOS) on June 6th, 2023, workshops, and case study reports during the ExceLib program, which was held from February 27th to July 5th, 2023. The reviewed and collected data will help to establish an understanding of the landscape of open science in Malaysia, which can be connected to the current practices of leadership in open science.

Online Survey

A survey instrument presents a set of questions that can be used to monitor the leadership aspect among academic library leaders in implementing open science. The questions are based on the Open Leadership Framework, and the Likert Scale from 1 (strongly agree) to 4 (strongly disagree) is used to allow an individual to express how much they agree or disagree with a particular statement. The study took fifty Malaysian public and private academic libraries, consisting of chief librarians, deputy chief librarians, and senior librarians, as the survey population. At the end of the approach, all the information gathered will be used to

explore the current practices of leadership styles and aspects among Malaysian academic library leaders in propagating open science.

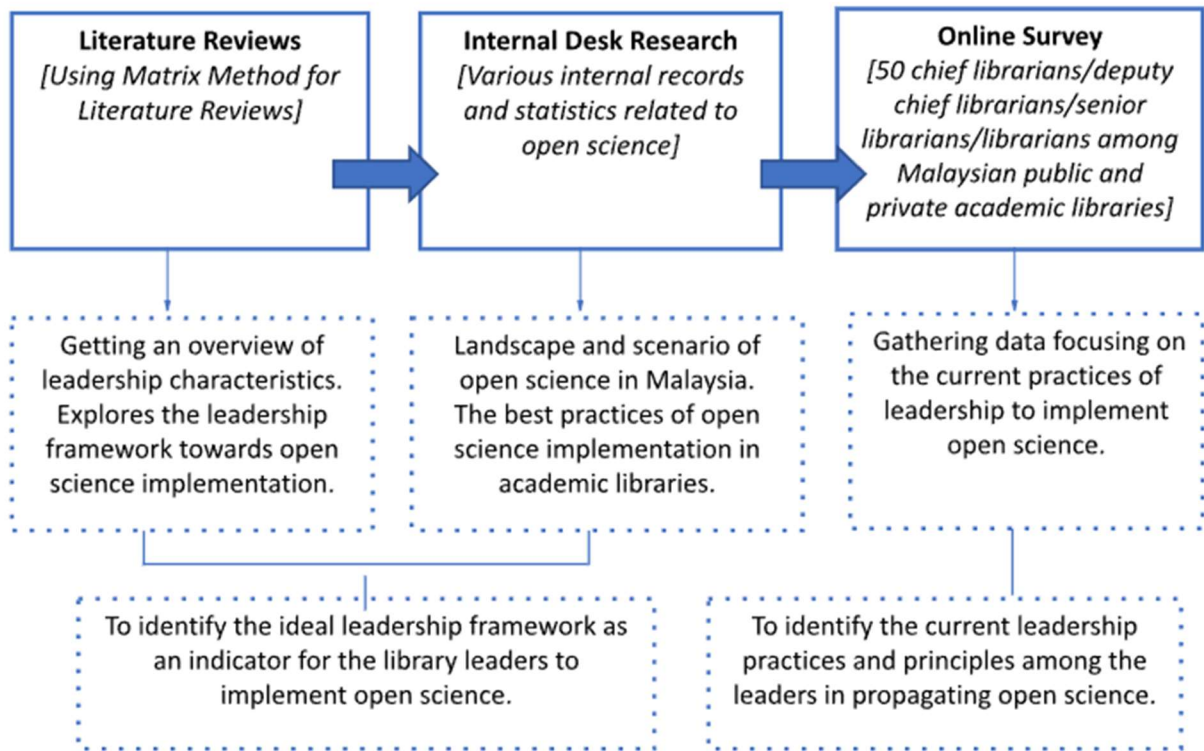Figure 2 indicates the planning steps for the research design of the study.

Figure 2: Planning of Research Design for the Study

RESULTS

For the data gathering on the online survey, the responses are viewed and analyzed using Microsoft Excel. The online survey was conducted among twenty Malaysian public universities and ten selected private academic libraries through email invitations and sharing links using messaging applications. 34 (87.2%) responses were received from public universities; five (12.8%) responses are coming from private academic libraries (as per data retrieved on July 13th, 2023). Consequently, 39 questionnaires were completed and used for analysis, resulting in a 78% response rate, which represents their academic libraries. Figure 3 shows the percentage of institutional positions held by seven respondents (18%) among chief librarian/director, 22 respondents (56%) among senior deputy chief librarians/deputy chief librarians, and 10 respondents (26%) among senior librarians/librarians.
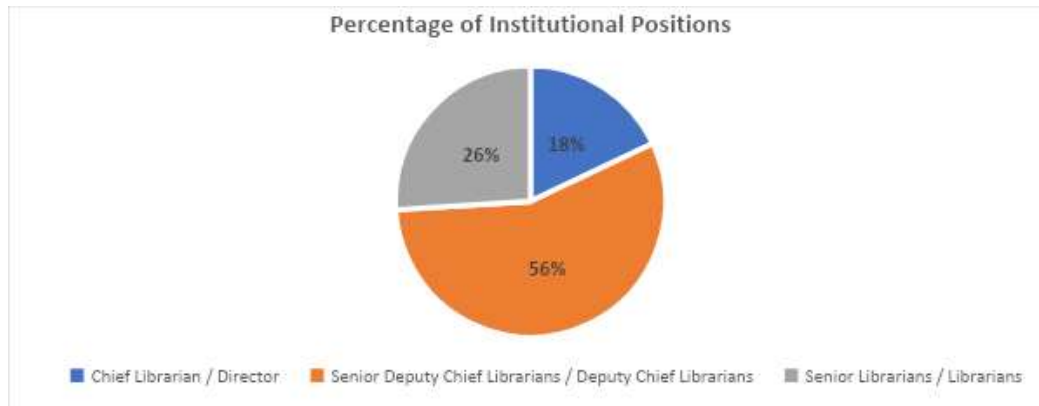
Figure 3: Percentage of Institutional Positions among the Respondents

The Open Leadership Framework

Based on a literature search, a research model known as the Open Leadership Framework (Sansing, 2018) was applied. Open leaders are guided by open principles, which strive for understanding; sharing; participation, and inclusion. From the study, to apply these principles, library open leaders in Malaysian academic libraries take these practices – design; build; empower.

- Design: Open leaders make contextual, deliberate decisions about how and when to be open.
- Build: Open leaders create structures and systems that ensure clarity and process-based management.
- Empower: Open leader's model personal leadership skills that sustain them and their contributors.

In the study, a quantitative approach was adopted, and the framework is presented in Figure 4.

	Understanding	**Sharing**	**Participation and Inclusion**

Design for…	▪ Content focus
	 ▪ Community interactions
	   - Learning through use
	 ▪ Storytelling
		▪ Information-sharing focus
		 ▪ Community interactions
		   - Gifting
		   - Enhancing value exchange
		   - Networking common interests
			▪ Governance focus
			 ▪ Community interactions
			   - Creating together
			   - Soliciting ideas
			   Project identity

Build for…	▪ Communication ▪ Design ▪ Facilitation ▪ Maintenance ▪ Project management	Commons-based production Data stewardship Documentation Licensing Networking	▪ Decision-making ▪ Delegation ▪ Event planning ▪ Community management ▪ Mentoring
Empower for…	▪ Maintains clarity of vision & purpose ▪ Maintain authenticity & integrity ▪ Stays curious	Makes connections Resilience Self-care	▪ Embraces failure ▪ Ensures safety ▪ Inspires contribution

Figure 4: Open Leadership Framework (Sansing, 2018)

The Characteristics of Open Leadership Practices

(a) Design Practices

For the design practices, the study initiates the content focus (understanding); information-sharing focus and gifting (sharing); and governance focus (participation and inclusion) as the open principles that can be implemented among library leaders. These aspects focus on the advocacy programs that focus on open science principles and policies at institutional, regional, and national levels (Ogungbeni, *et al.,* 2018). As the landscape of open science in Malaysian academic libraries is based on unclear information and the absence of development plans or policies (Amanullah and Abrizah, 2023), it is suggested the roadmap for cultural change toward open science by establishing advocacy programs to identify the benefits of open science approaches, whilst being realistic about the challenges (League of European Research Universities, 2018). This is associated with policy development aspects where library leaders can provide input on policies related to open access publishing, research

data management (RDM), copyright, incentives, and licensing to ensure these policies align with open science principles and benefit the research community.

(b) Build Practices

As for the build, the study analyzed how leaders can take these practices in terms of communication, facilitation, and maintenance (understanding); commons-based production, data stewardship, and networking (sharing); and mentoring (participation and inclusion) among the open principles towards open science implementation. These include the infrastructure and services to support open science activities, which involve establishing institutional repositories for open access publications and research data, providing guidance on data management plan (DMP) and sharing plans, and offering tools and platforms for collaborative research. This possibly echoed the findings of Higman and Pinfield (2015), who revealed the cause of slow implementation is not rooted in the lack of leadership by the libraries but in the institutional guidance in the areas of research governance. In fact, the National Open Science Platform launched by MOSTI in 2018 aims to facilitate the sharing of research outputs, including publications, data sets, and software.

(c) Empower Practices

While for the empowerment practices, the study found that the library should be leading in terms of maintaining clarity of vision and purpose (understanding); making connections (sharing); and ensuring safety and inspiring contribution (participation and inclusion). These can be implemented by taking the lead in designing and delivering education and training for an open science program in the outreach and community engagement aspect by hosting events, workshops, and participating in conferences and seminars. The Focus on Open Science in Hungary reported that open science practice is best established at the university level, where there are training programs to support it. Significant practice across Europe shows that such activities are successfully led by university libraries, which are well-placed to offer leadership (Ignat, 2021).

The Current Practices of Open Leadership

From the design section, analysis of the study demonstrates the current leadership practices among the Malaysian academic library leaders in terms of governance focus, with 94.8% accepting that the governance of open science programs in universities should be carried out on a top-down approach rather than bottom-up (Q2). Whereas only 5.2% of respondents disagree with the statement. Matthews (2015) quoted Professor Atalar as saying, "The top-down approach is more successful provided that the right person is the leader. [But] poor leaders in a top-down approach may lead to a disaster." Moreover, gaining support from the top management of the institutions will attract human talent and expertise and secure development funds to exceed the project cycles (Ignat, 2021).

Table 1 also shows that most of the respondents (97.4%) agree that the library needs to be involved in DMP, which is under the information sharing focus (Q3). The results show there are no respondents strongly disagreeing while only 2.6% of respondents disagree with the statement. DMP support refers to any elements, standards, tools, policies, or plans for the details of data management throughout open science or research management services. The libraries can take the lead by up-skilling their professionals and introducing research data management (RDM) services, including consultancy in DMP, data processing and its analysis, data description guidance, and preservation of data (Sheikh, Malik and Adnan, 2023).

The results found that 71.8% of respondents strongly agreed that the significance of collaboration between institutions (internal/external) helps make the open science agenda a success (Q5). Universities may be able to save money by collaborating on shared infrastructure and services. Managing costs is a key part of the leadership role that all universities need to adopt. Malaysia has been actively promoting open science initiatives to foster collaboration, transparency, and knowledge sharing within the scientific community. One of the most significant challenges in introducing open science practices is managing the costs of the transition (Deketelaere and Ayris, 2019).

For the question on the aspect of library management that should lead to the development of an open science policy at the university, the study perceived that 66.6% of respondents agreed and 33.4% disagreed with the statement (Q1). Therefore, categorizing the findings into chief librarians and directors shows that 85.7% accepted that library management should lead policy development, whereas only 14.3% disagreed with the statement. It shows that the library's top management believed this open leadership practice was significant for open science implementation.

Table 1: Findings on the Design Leadership Practices

Open Leadership Practice	Question	Principles	Strongly Agree	Agree	Disagree	Strongly Disagree
Design for…	Q1: Library management should lead the development of an open science policy at your university	Content-focus	35.8%	30.8%	30.8%	2.6%
	Q2: The governance of open science programs is more suitable to be implemented top-down rather than bottom-up.	Governance focus	79.4%	15.4%	2.6%	2.6%
	Q3: The library needs to be involved in your university's Data Management Plan (DMP).	Information sharing focus	64.1%	33.3%	2.6%	0%
	Q4: Libraries need to propose of incentives to academics and researchers to encourage the production of open access output.	Community interactions - Gifting	35.9%	41.0%	20.5%	2.6%
	Q5: It is important for your library to collaborate with institutions (internal / external) to make the open science agenda a success.	Community interactions – Learning through use	71.8%	0%	0%	28.2%

The study also reveals that the libraries need to propose incentives and recognitions to academics and researchers to encourage the production of open access output, where 76.9% accepted the statement, and the others denied it (Q4). It is in contrast with the survey result by PLOS 2023, which found that less than 20% of respondents will work on the adoption of professional incentives for academics who employ open science-based outputs. Abd Rahman (2023) stated that researchers 'buy-in' and sustainability are among six major issues and challenges to implementing open science in Malaysia. It is important to develop incentives for researchers to overcome those barriers. Joseph (2021) reported that the NASEM Board on Research Data and Information agreed on the development of a new national-level initiative that aligns incentives to support open science.

Figure 5 demonstrates the current practices of open leadership that have been carried out among Malaysian academic library leaders.
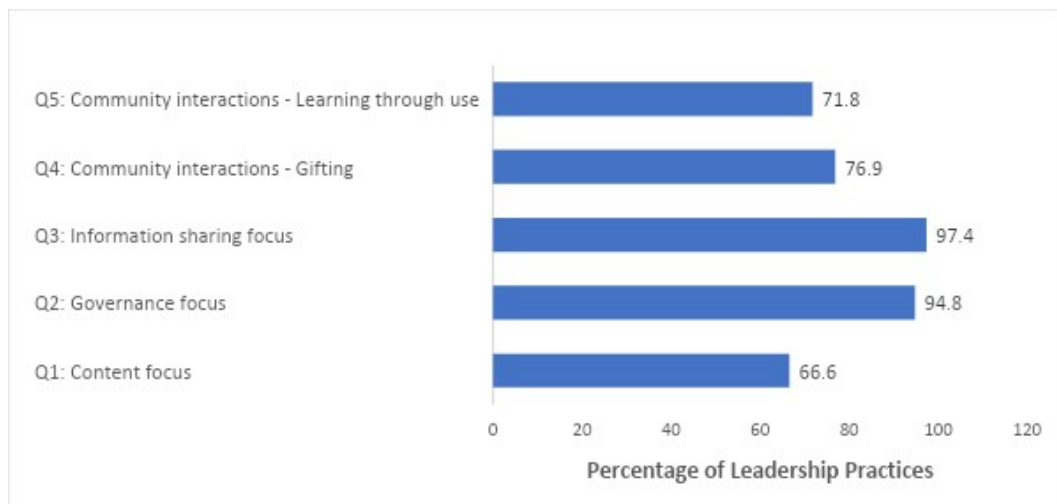
Figure 5: Open Leadership Practices for the Design Principles

While for the build practices, Table 2 exposes 100% of respondents without exception believing the libraries need training and competence development programs that are specific to open science (Q10). The mentorship agenda matches specific advice to the librarians' needs for growth and helps with professional growth. A leader needs to master the necessary practical skills, such as managing projects and organizing digital collections (Tzanova, 2020).

Therefore, only 35.8% of the respondents agree with the statement that the library has provisions for successful training programs related to open science (Q12), which shows the limited allocation received for almost all academic libraries. Although this facilitation principle is significant for learning needs, it is still a challenging issue to be addressed. Leaders should learn the needed approaches to understand constraints on their ability to engage in open science practices (Castille, *et al.,* 2022).

The statement on the Data Stewardship Program (Q11) shows 64.1% of respondents acknowledge their librarians have already followed the program offered by the Malaysian Academy of Science and MOSTI. During the UMOS program, it was presented that the MOSP focus areas include national guidelines, awareness and capacity; and infrastructure. Among the targets was to train 200 data stewards, which was achieved by July 2022, when almost 240 data stewards had been trained in the Malaysian research landscape (MOSP, 2023).

Most of the respondents, 94.9%, recognize that library management should encourage publication in open access journals (Q8) as well as the library's role in determining the university's open data platform (Q9). For both statements, only 5.1% disagree, which indicates that common-based production and project management principles are significant for open science implementation. This focuses on the project content, framework, milestones, and documentation, besides leading the evaluation, accessibility, and adaptability of the project (Sansing, 2018).

Table 2: Findings on the Build Leadership Practices

Open Leadership Practice	Question	Principles	Strongly Agree	Agree	Disagree	Strongly Disagree
Build for…	Q6: The open science agenda has been clearly communicated at your university.	Communication	5.1%	30.8%	61.5%	2.6%
	Q7: Libraries need to lead collaborative activities in universities to increase awareness of open science.	Networking	33.3%	53.8%	10.3%	2.6%
	Q8: Library management should encourage publication in open access journals as one of the strategies for selecting journals in universities.	Common-based production	28.2%	66.7%	5.1%	0%
	Q9: Libraries have an important role in determining your university's open data	Project management	59%	35.9%	5.1%	0%

	platform (repository).				
	Q10: Libraries need to have training and competence development programs that are specific to open science.	Mentoring	59%	41%	0%	0%
	Q11: Librarians from your university have followed the Data Stewardship Program offered by the Malaysian Academy of Sciences and MOSTI.	Data stewardship	51.3%	12.8%	23.1%	12.8%
	Q12: Your library has provisions for successful training programs related to open science.	Facilitation	17.9%	17.9%	46.3%	17.9%
	Q13: Your library has specific provisions for developing and maintaining an open data platform (repository).	Maintenance	17.9%	23.1%	41.1%	17.9%

Hence, in terms of the library having specific provisions for developing and maintaining an open data platform, 41% of respondents agree with the statement (Q13). Still, the budgeting issues occurred in terms of facilitation and maintenance, which always need to be planned for the long-term for the sustainability of the project or programs. The presentation slides on Open Science to Jumpstart Open Innovation at the UMOS clearly stated that in open science management, minimizing the costs of unnecessary duplication of research is important, along with better planning in research management and funding (Akademi Sains Malaysia, 2023). Moreover, among the barriers to implementing open science are a lack of knowledge, time, and costs associated with the implementation (El Amin, *et al.,* 2023).

It also states that 87.1% of respondents accepted that libraries need to lead collaborative activities in universities to increase awareness of open science (Q7). Creating partnerships with allied organizations makes it easy for libraries to rally around shared issues and values.

Collaboration and partnership can also be implemented by encouraging collaboration with external partners, other research organizations, and funding agencies to promote open science (Abrizah, 2023). As open science promotes transparent and accessible knowledge that is shared and developed through collaboration for the benefit of all (Peeters, 2021), leaders do not need to worry about starting with small partnerships because working together on small projects can lead to big opportunities for bigger collaborations (Carpino, Mentkowski and Nejdl, 2020).

The analysis also shows that only 35.9% of respondents agree that the open science agenda has been communicated at their universities. It shows that the communication within the community regarding open science is still not completely comprehensive. Since open science practices shift from closed to more transparent positions (Bowman and Keene, 2018), leaders should produce clearer communication of what is required for organizational success (Johnson and Sobczak, 2021).

Figure 6 illustrates the percentage of current practices of open leadership under the build element.
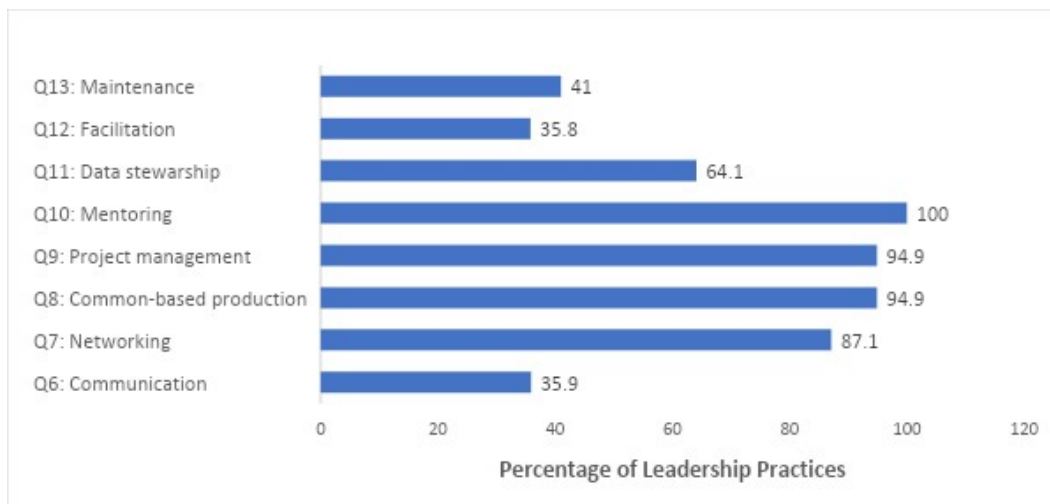
Figure 6: Open Leadership Practices for the Build Principles

For the results on empowered leadership practices, Table 3 displays the significant principles in terms of maintaining clarity of vision and purpose, inspiring contribution, and making connections. This illustrates a set of leadership principles that are currently practiced among Malaysian academic library leaders, who strongly agree on the statement under these practices.

The most strongly agreed statement, with a total response of 61.5%, was that the library needs to collaborate with the university's Information Technology Center and Research Management Center in providing researcher profiles based on open access platforms (Q16).

The respondents also highly accepted that the library management needs to include the open science agenda as the main core of the library's strategic plan, which indicates 46.2% strongly agree and 53.8% agree (Q14). The experience from the National Institutes of Health Malaysia in implementing open science shares that the management or organization can support the movement of open science through appropriate data or strategy plan establishment (Muhd Zulfadli, 2023).

Table 3: Findings on the Empower Leadership Practices

Open Leadership Practice	Question	Principles	Strongly Agree	Agree	Disagree	Strongly Disagree
Empower for…	Q14: Library management needs to include the open science agenda as the main core in the library's strategic plan.	Maintains clarity of vision & purpose	46.2%	53.8%	0%	0%
	Q15: Libraries need to encourage faculties / institutes / centers in universities to develop, implement open science and open evaluation in the academic publishing process.	Inspires contribution	38.5%	61.5%	0%	0%
	Q16: The library needs to collaborate with the university's Information Technology Center and Research Management Center at the university to provide researcher profiles based on open access platforms.	Makes connections	61.5%	38.5%	0%	0%

While for the statement that libraries need to encourage faculties/institutes/centers in universities to develop, implement open science and open evaluation in the academic publishing process (Q15), 61.5% of respondents agree, and the others strongly agree. This inspiring contribution encourages and promotes research integrity, transparency, and reproducibility through clear guidelines and expectations.

The Significant Practices and Recommendations in Open Leadership

This section summarized the significant practices in open leadership that have been applied in Malaysian academic libraries based on the online survey analysis. Figure 7 illustrates the

most exceptional practices in terms of design, build and empowerment principles in open leadership besides the recommendations for the future towards open science implementation.
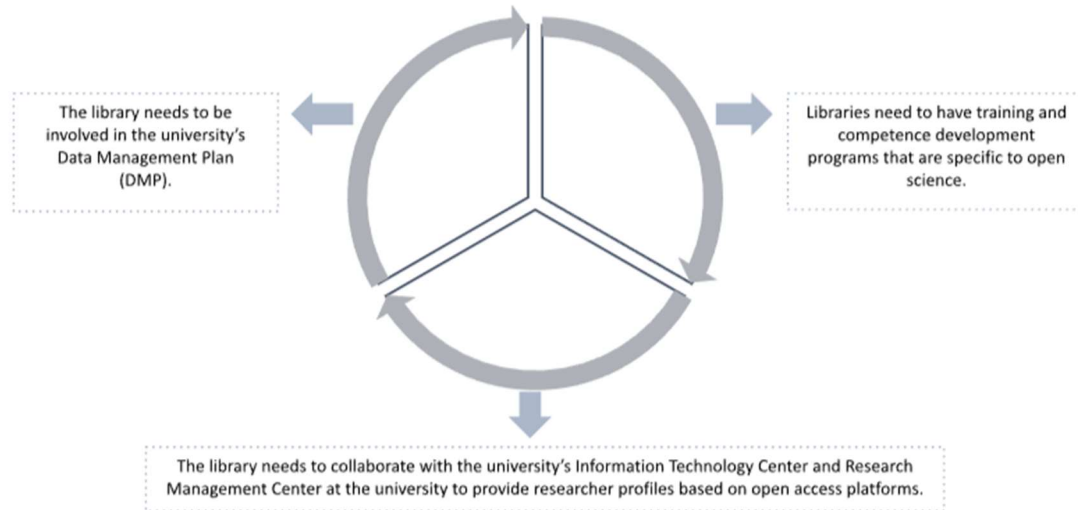

Figure 7: The Significant Practices Open Leadership among Malaysian Academic Libraries

CONCLUSION

It is apparent that open leadership is an approach that supports the implementation of open science, yet it is not so frequently observed in Malaysia, compared to other leadership styles. The results show that several leadership practices are put forward to support academic library leaders in propagating open science, therefore requiring a comprehensive understanding of the principles and values that encourage the academic library leaders to act and promote these practices within the scientific community and beyond. In summary, open leadership in open science among Malaysian academic libraries focus on policy advocacy in terms of DMP or policy changes at the institutional, national, and international levels besides working with government and funding agencies to shape supportive policies and legislation.

While there may be challenges and concerns to address complex global challenges, mentoring principles in terms of education and training programs for researchers, students, and institutions are essential to raise awareness about open science practices besides to encourage the integration of open science topics and to foster collaboration, transparency, and inclusivity. By embracing open leadership principles such as making connections through collaboration and networking, being able to establish online communities and networks to share the best practices and discuss the challenges in implementing open science. In the spirit of open leadership, fostering a culture of openness, collaboration, and inclusivity in scientific research can unlock the full potential of open science to address the challenges and build a brighter and more equitable future for all.

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Malaysian University Librarians' Inclination towards Citizen Science

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ABSTRACT

Libraries have been at the forefront of Open Science, of which Citizen Science is a one of the pillars for success. However, the literature reveals that the uptake of Citizen Science projects by university librarians in the South East Asian countries is lacking. This study aims to ascertain Malaysian university librarians' inclination towards citizen science projects at their campus. The study takes a quantitative approach using the survey method. Data is collected in two instances. (i) the current engagement level determined at multiple dimensions of cognitive, affective, social, behavioral and personal motivates; (ii) the possible roles and responsibilities in a citizen science project as librarians envisage. The population under study are librarians at all public universities in Malaysia. 321 responses were received through a survey conducted in April 2023. The findings reveal that only a small number of librarians are actively involved in citizen science projects at their respective universities, mainly as project managers or data stewards. As for possible roles in the future, it was hopeful of revealing that the majority of the librarians were very positive towards their ability to contribute on all cognitive, social, behavioral and personal levels to seek opportunities for future involvement in citizen' science to promote active citizenship among university campus society.

Keywords: Citizen Science; Open Science; Librarians; Academic Library; Malaysia

INTRODUCTION

The scientific community increasingly embraces the objectives of open science and citizen science, two related research and public outreach programmes. An important component of open science is the participation of social actors and knowledge-producing organizations in scientific research and decision-making processes. On the other hand, citizen science refers to amateur scientists participating openly and regularly under supervision in scientific research projects (Eitzel et al. 2017). The terms "open science" and "citizen science" are sometimes used interchangeably, but the two ideas have different goals and characteristics.

Libraries have been at the forefront of Open Science, which includes citizen science as a strong pillar for success. Libraries have the opportunity to present the infrastructure, information literacy skills, including research skills, data management, and most importantly,

develop resilient societies that are knowledgeable and able to actively contribute to scientific research. Furthermore, a research guide on open science and citizen science emphasizes the integrated model of public knowledge production and engagement with science(Knack 2017). Another study explored the role of citizens in open science and their research contributions, emphasizing the importance of openness, transparency, and access to knowledge (Roche et al. 2020). However, the literature reveals that the uptake of Citizen Science projects by university librarians in the South East Asian countries is lacking (Kaarsted et al. 2023). Though, certain programmes and suggestions point to the possibility of the emergence of such networks or organizations.

For instance, academic libraries can support citizen science efforts by providing tools and resources to advance scientific and information literacy (Cohen et al. 2015). Additionally, libraries are encouraged to play a part in fostering citizen science and providing assistance and direction to librarians who are enthusiastic in taking part in citizen scientific programmes (CEPAL 2023). Even while these projects and suggestions do not expressly identify any current networks or organizations, they do suggest that librarians who are interested in citizen science need more assistance and resources. As interest in citizen science among Southeast Asian librarians increases, it is feasible that similar networks or organizations will form in the future. We intend to add to the body of knowledge by conducting this study on Malaysian university librarians' propensity for citizen science initiatives and to offer insights that can guide strategies to encourage librarians' active participation in such projects. Recognizing areas for improvement and facilitating the creation of efficient support systems within academic libraries to encourage citizen scientific participation will be made possible by understanding librarians' levels of engagement and their anticipated roles.

LITERATURE REVIEW

CITIZEN SCIENCE

According to the Oxford English Dictionary (2014), the first recorded use of the word"citizen science" in its current form dates back three decades (Oxford English Dictionary 2014). Citizen science was added to the Oxford English Dictionary in 2014, and it is defined as scientific work carried out by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions (Oxford English Dictionary 2016). The term first appears in the January 1989 issue of the MIT Technology Review. The article 'Lab for the Environment' discusses three examples: community-based laboratories that investigate environmental risks, Greenpeace's laboratory work, and Audubon's recruitment of volunteers for a 'citizen science' program (Haklay et al. 2021). Moreover, citizen science, in its broadest sense, refers to the active participation of the general population in scientific research projects. Citizen science is a rising discipline in which scientists and citizens work together to create new scientific and societal knowledge (Vohland et al. 2021).

According to the definition developed by the Open Science Policy Platform (OSPP), broadly defined, citizen science is scientific work undertaken by members of the public, often in

collaboration with or under the direction of professional scientists and scientific institutions. Citizen science is an already very diverse practice, encompassing various forms, depths, and aims of collaboration between academic and citizen researchers and a broad range of scientific disciplines. Civic participation in research can range from short-term data collection to intensive involvement in the research process, from technical contribution to genuine research, and collaboration to co-creation of knowledge. For this study, the definition by OSPP is the most accurate and related to the research objective.

A citizen science project can involve a single person or millions of individuals working together to achieve a common goal. Generally, public participation occurs through data collection, analysis, or reporting (SciStarter 2020). There are four common features of citizen science practice: (a) anyone can participate, (b) participants use the same protocol so data can be combined and be high quality, (c) data can help real scientists come to real conclusions, and (d) a wide community of scientists and volunteers work together and share data to which the public, as well as scientists, have access (Flagg 2016). While all these definitions have some aspects in common – most notably the concept of a public that participates in an activity known as scientific inquiry - the majority of them are vague and susceptible to interpretation (Haklay et al., 2021). As a conclusion to the concept of citizen science, the most popular terms that are associated with it are "community science," "amateur science," "crowdsourced science," "volunteer monitoring," and "public participation in scientific study."A growing global movement, citizen science welcomes participation from individuals, groups of friends and family, community organizations, and anyone else. In addition to developing research questions, producing and sharing observations, and interpreting and disseminating project outcomes, this crowdsourced, collaborative project may also involve obtaining, analyzing, and analyzing data (Scistarter, 2020).

CITIZEN SCIENCE AND LIBRARIES

Citizen science is now recognised as a transformational strategy that engages communities in sociopolitical processes, empowers individuals, and advances scientific research (von Gönner et al. 2023) Public libraries have embraced citizen science programmes as community centers to rethink their place in society (Cigarini et al. 2021). However, the literature demonstrates both benefits and drawbacks of citizen science incorporation in library contexts. The potential of citizen science to reinvent public libraries as community-driven organizations is highlighted in a research that examines the benefits and drawbacks of citizen science in public libraries (Cigarini et al. 2021). The study ses the value of citizen science in encouraging neighborhood engagement and improving library patrons' scientific literacy. It also points out difficulties including resource shortages and the requirement for training and assistance for library employees to successfully undertake citizen science programmes.

Academic libraries are becoming increasingly aware of the opportunities for citizen science participation. By involving stakeholders and legitimizing their participation in the design and collection of research data, citizen science projects, according to studies, can enhance the quality of decision-making processes (von Gönner et al. 2023). This shows how academic

libraries have the opportunity to help citizen science projects that encourage the use of evidence when making decisions.

Furthermore, studies have explored the potential for academic libraries to incorporate citizen science into their instructional practices. Collaborating with faculty, libraries can provide workshops and consultations to support research assignments and guide students in incorporating citizen science methodologies (Halpern 2020). This demonstrates the potential for libraries to integrate citizen science into their educational initiatives and enhance information literacy skills among students. Another study that identifies citizen science prospects for academic libraries emphasizes the need for training and educational programmes to assist librarians in integrating citizen science into their library services. This emphasizes how crucial it is to give librarians the knowledge and abilities they need to participate in citizen science initiatives and assist users and researchers in this field (Cohen et al. 2015; Kaarsted et al. 2023)

Another study highlights the potential of citizen science to open up new avenues for research and knowledge creation by positioning it as a top research field in information quality (Lukyanenko, Wiggins, and Rosser 2020). It emphasizes how crucial it is to value citizen science as a source of knowledge and the role libraries play in ensuring the reliability and correctness of citizen science data.

In general, the literature demonstrates that citizen science offers libraries—academic and public—the opportunity to engage communities, improve scientific literacy, and support evidence-based decision-making. However, problems including a lack of resources and the need for staff assistance and training must be addressed. By embracing citizen science and implementing it into their services and teaching practices, libraries may play a significant role in encouraging citizen involvement, advancing scientific research, and helping to build resilient communities.

RESEARCH DESIGN

(a) Study design and sampling
From February 2023 to April 2023, a cross-sectional was conducted among librarians who were working at Malaysia public universities. Malaysia has 20 public universities with a population of 642 librarians. All librarians from Gred S41- S54 and Jusa C were invited to participate in this study through an e-mail. Participants can be librarians who have previously participated in CS projects, as well as those who have not yet been involved but are interested in doing so if provided with the chance. They were asked to complete a Google Forms survey. Follow-up survey invitations were sent twice to increase participation.

(b) Ethical consideration
This study was approved by the University of Malaya Research Ethics Committee (UM.TNC2/UMREC_2399). Participants were informed that their participation was voluntary.

Participants had to click "Yes, I consented to engage in this study" in order to give their permission to participate.

(c) Instrument

The study used the Dimensions of Engagement framework by Phillips et al. 2019 to measure the engagement of Malaysian librarians in citizen science. The instrument consisted of demographic information sections and 37 items to represent the five dimensions of engagement; 1) Behavioural, 2) Motivation, 3) Affection, 4) Social Connections and 5) Cognitive The participants were first asked if they had been involved in any citizen science project at their respective campus. Those who answered YES were then directed to questions about their active involvement, while those who answered NO were directed to questions on their perception of engagement.

i) Behavioral

The participant's current engagement level and possible involvement in a project in terms of what they did or would do were assessed using 13 items for each domain. The response options for the current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total behavioral score ranged from 0 to 13, with higher scores representing higher levels of tasks they did or would do in a CS project.

ii) Motivation

In this section, the participant's current engagement level and possible involvement in a CS project in terms of what motivated/ would motivate them to be involved were assessed using 6 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. Item 6 "I did it because my job demanded it" / "I would do it if my job demanded it" was reverse coded. The possible total motivation score ranged from 0 to 6, with higher scores representing higher motivation they had or they would have to do a CS project.

iii) Affection

The participant's current engagement level and possible involvement in a project in terms of their feelings about a CS project were assessed using 5 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total affection score ranged from 0 to 5, with higher scores representing positive feelings about a CS project.

iv) Social Connections

The participant's current engagement level and possible involvement in a project in terms of their interaction with others were assessed using 5 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options

for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total social connections score ranged from 0 to 5, with higher scores representing positive interaction with others in a CS project.

v) Cognitive

The participant's current engagement level and possible involvement in a project in terms of their learning were assessed using 8 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total affection score ranged from 0 to 8, with higher scores representing positive learning in a CS project.

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences, version 26.0 (IBM Corp., Armonk, NY, USA). A p-value of less than 0.05 was considered statistically significant. The scales' reliability was evaluated by assessing the internal consistency of the items representing the scores. The behavioral, motivation, affection, social connections and cognitive items had a reliability (Cronbach's α) of 0.902, 0.801, 0.705, 0.744, and 0.841. The high Cronbach's α value indicates all domains have satisfactory level of internal consistency. Descriptive statistics were computed on the dependent and independent variables. Frequency tables, charts, and proportions were used for data summarisation. The score distributions were checked for underlying assumptions of normality using the Kolmogorov-Smirnov test and Shapiro-Wilk test; as all the score distributions were not normally distributed, non-parametric tests were used. The Mann-Whitney U test and the Kruskal-Wallis test were used to compare medians. Spearman's correlation coefficient was used for correlation analyses.

RESULTS

A total of 318 complete responses were received. The participant characteristics are shown in Table 1. Less than 5% (n=14) of the study participants have been involved in a CS project.

Table 1: Participants' characteristics

	Overall (N=318)	Involved in CS project (n=14)	Not involved in CS project (n=304)
Duration of experience (years)			
<1	15 (4.7)	2 (14.3)	13 (4.3)
1-5	29 (9.1)	0 (0.0)	29 (9.5)
6-10	43 (13.5)	1 (7.1)	42 (13.8)
>10	231 (72.6)	11 (78.6)	220 (72.4)
Position Grade			

S41	80 (25.2)	3 (21.4)	77 (25.3)
S44	170 (53.5)	7 (50.0)	163 (53.6)
S48	45 (14.2)	3 (21.4)	42 (13.8)
S52 and above	23 (7.2)	1 (7.1)	22 (7.2)
Highest education level			
Undergraduate	130 (40.9)	4 (28.6)	126 (41.4)
Postgraduate	188 (59.1)	10 (71.4)	178 (58.6)

Figure 1 shows the distribution of roles of study participants in the previous CS project. Most of those involved in a CS project held a project manager post (26.7%, n=4). Most of the CS projects they had conducted were astronomy and spaced-themed projects (19.2%, n=5).

(A)   Roles in the previous CS
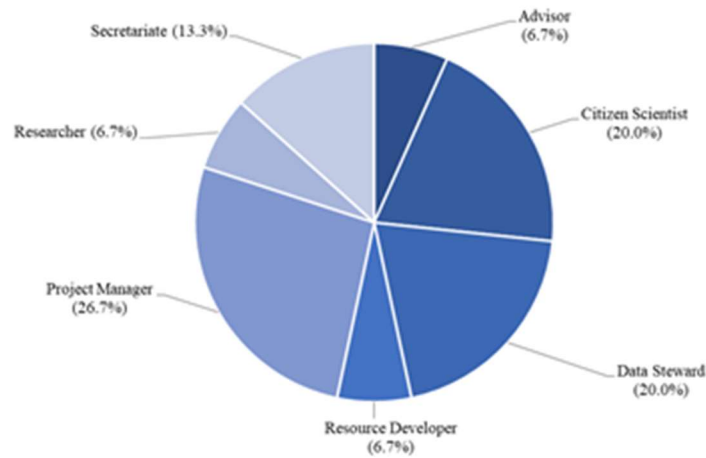
(B)   CS project themes

Figure 1: Distribution of Roles & Theme of Study Participants in the Previous CS Project

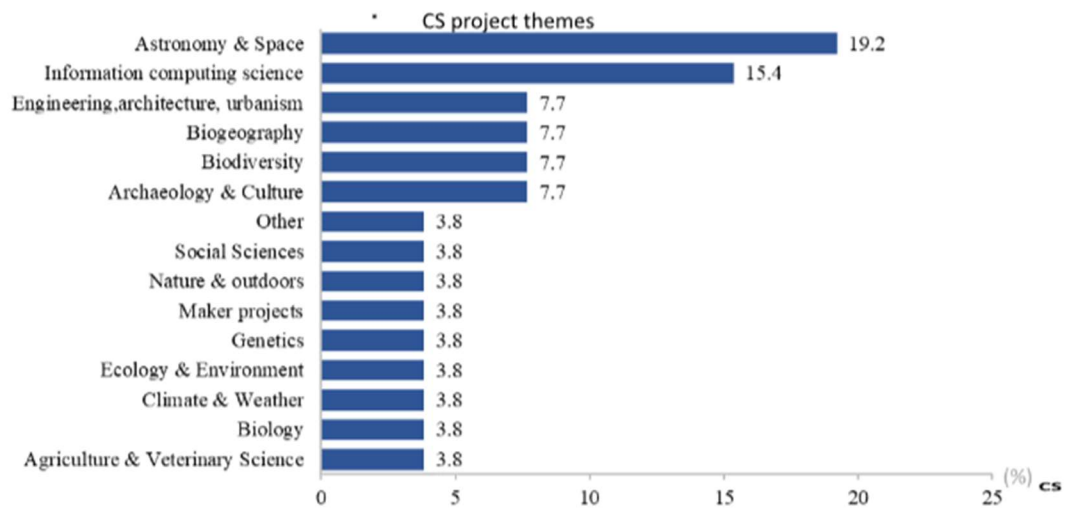Figure 2 shows the distribution of "yes" responses for behavioral, motivation, affective, social connections and cognitive items among study participants who had been involved in a CS project. Almost two-thirds reported that they had attended meetings related to the project and communicated the general information about the project to others. All study participants (100%) reported that they were willing to contribute to science or education or community and collaborate or interact socially with others. Additionally, every study participant engaged in new behaviors and activities as a result of their engagement, learned new tool use via practise, and expanded their knowledge through interactions with others. A total of 85.7 percent said they had participated in the CS project due to their concern for the data quality, particularly accuracy in data collecting.

Figure 3 shows the distribution of "yes" responses for behavioural, motivation, affective, social connections and cognitive items among study participants who were not involved in a CS project. Almost 80% of the study participants reported that they would be attending meetings related to the project, finding supporting information to defend the evidence found and collecting data. The majority (92%) of the study participants are willing to contribute to science, education, or community. A total of 85% reported that they would get involved in a CS project if their job demands it. More than 80% reported that they would get involved in a CS project because of their dedication to the idea, the project, the environment, or the science behind the project and their concern for data quality, especially accuracy in data collection. Slightly more than 90% of the study participants would get involved in a CS project because of their willingness to collaborate or interact with others. 95% of the study participants believed they could learn from direct observation or hands-on experience with the project and increase their knowledge through interactions with others.

Figure 2: Distribution of "Yes" Responses for Behavioural, Motivation, Affective, Social Connections and Cognitive Items among Study Participants Who Had Involved in a Cs Project (N=14)
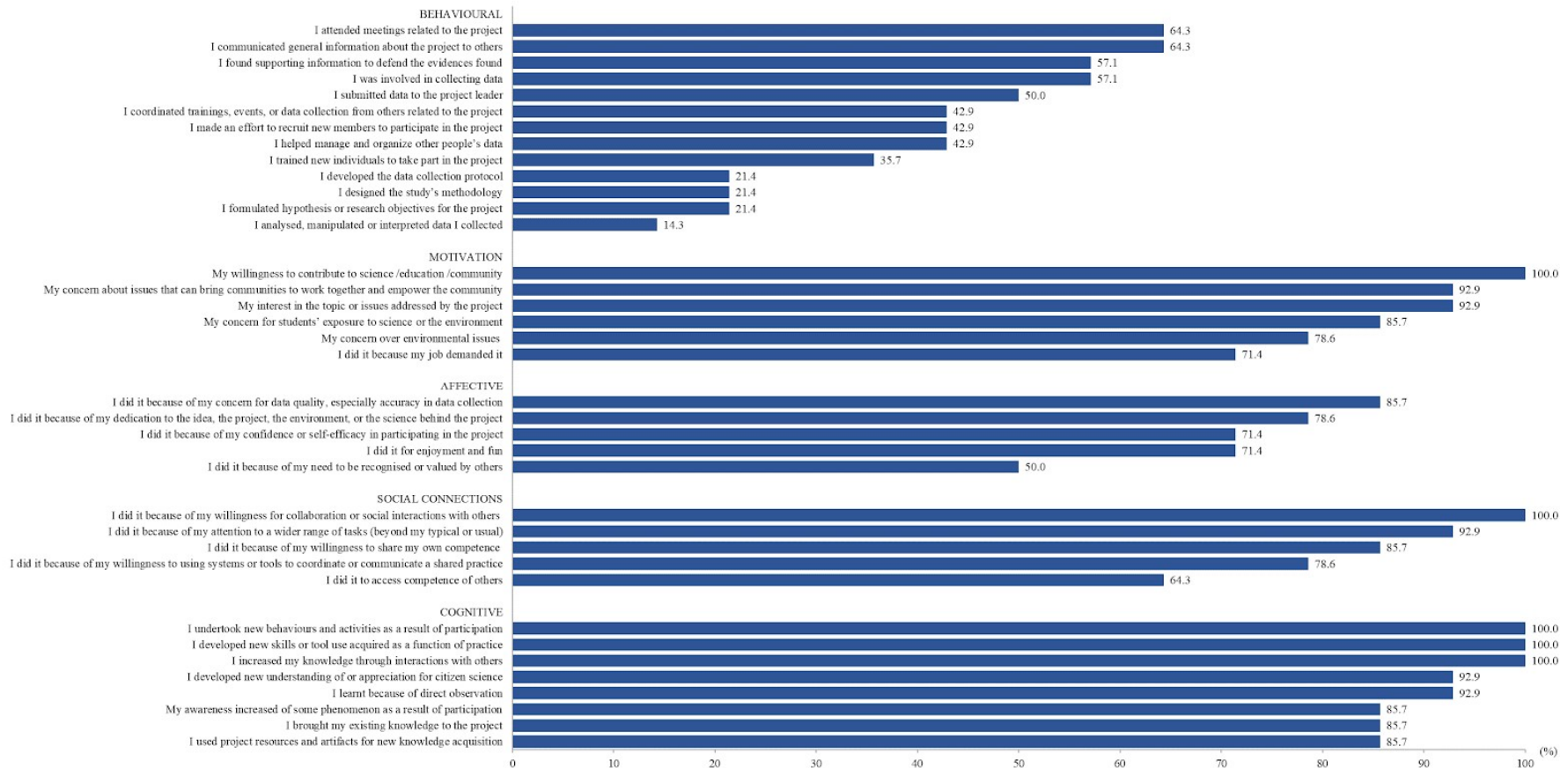
Figure 3: Distribution of "Yes" Responses for Behavioural, Motivation, Affective, Social Connections and Cognitive Items among Study Participants Who Have Not Involved in a CS Project (N=304)

Table 2 compares the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics. Overall median score for behavioral, motivation, affective, social connections and cognitive was 4.0 [interquartile range (IQR) 2.8-8.5], 5.0 [4.0-5.3], 4.0 [2.5-5.0], 4.5 [4.0-5.0] and 8.0 [6.8-8.0], respectively. There was no significant difference found between median scores by participants' characteristics in all domains.

Table 2: Comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics

		Current Engagement Level in a previous CS project				
		Total Behavioral Score Median (IQR)	Total Motivation Score Median (IQR)	Total Affective Score Median (IQR)	Total Social Connections Score Median (IQR)	Total Cognitive Score Median (IQR)
Overall		4.0 (2.8, 8.5)	5.0 (4.0, 5.3)	4.0 (2.5, 5.0)	4.5 (4.0, 5.0)	8.0 (6.8, 8.0)
Participants' characteristics Duration of experience (years)						
<1	2 (14.3)	9.0 (8.0, 10.0)	5.0 (5.0,5.0)	4.5 (4.0, 5.0)	4.0 (4.0, 4.0)	7.0 (6.0, 8.0)
1-5	0 (0.0)	-	-	-	-	-
6-10	1 (7.1)	-	-	-	-	-
>10	11 (78.6)	3.0 (2.5, 5.5)	5.0 (4.5, 5.5)	4.0 (2.0, 5.0)	5.0 (4.0, 5.0)	8.0 (7.5, 8.0)
p-value		0.073	1.000	0.411	0.391	0.397
Position Grade						
S41	3 (21.4)	10.0 (9.0, 10.5)	5.0 (4.5, 5.0)	4.0 (4.0, 4.5)	4.0 (4.0, 4.5)	6.0 (6.0, 7.0)
S44	7 (50.0)	3.0 (2.5, 4.0)	5.0 (4.5, 5.0)	3.0 (1.0, 3.5)	4.0 (3.0, 4.5)	8.0 (7.5, 8.0)
S48	3 (21.4)	7.0 (4.0, 9.0)	5.0 (4.0, 5.5)	5.0 (5.0, 5.0)	5.0 (5.0, 5.0)	8.0 (7.5, 8.0)
S52 and above	1 (7.1)	-	-	-	-	-
p-value		0.124	0.520	0.071	0.175	0.444
Highest education level						
Undergraduate	4 (28.6)	6.5 (2.0, 10.5)	5.0 (4.5, 5.5)	4.5 (4.0, 5.0)	5.0 (4.5, 5.0)	8.0 (7.0, 8.0)
Postgraduate	10 (71.4)	4.0 (3.0, 7.0)	5.0 (4.0, 5.0)	3.5 (1.0, 5.0)	4.0 (4.0, 5.0)	8.0 (7.0, 8.0)
p-value		0.775	0.704	0.185	0.215	0.740

Table 3 shows the comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics. Overall median

score for behavioral, motivation, affective, social connections and cognitive was 9.0 [interquartile range (IQR) 6.0-13.0], 5.0 [4.0-5.0], 4.0 [3.0-5.0], 5.0 [3.0-5.0] and 8.0 [7.0-8.0], respectively. Similarly, there was no significant difference found between median scores by participants' characteristics in all domains.

Table 3: Comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics

		Possible involvements in a CS project				
		Total Behavioral Score Median (IQR)	Total Motivation Score Median (IQR)	Total Affective Score Median (IQR)	Total Social Connections Score Median (IQR)	Total Cognitive Score Median (IQR)
Overall		9.0 (6.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
Participants' characteristics Duration of experience (years)						
<1	13 (4.3)	8.0 (5.0, 13.0)	5.0 (4.0, 5.0)	5.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
1-5	29 (9.5)	9.0 (7.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
6-10	42 (13.8)	8.0 (6.0, 13.0)	5.0 (5.0, 5.0)	5.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
>10	220 (72.4)	9.0 (5.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
p-value		0.801	0.599	0.335	0.795	0.809
Position Grade						
S41	77 (25.3)	9.0 (6.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
S44	163 (53.6)	9.0 (5.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
S48	42 (13.8)	9.0 (6.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (7.0, 8.0)
S52 and above	22 (7.2)	7.5 (4.0, 11.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
p-value		0.629	0.738	0.707	0.839	0.498
Highest education level						
Undergraduate	126 (41.4)	8.5 (5.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
Postgraduate	178 (58.6)	9.0 (6.0, 13.0)	5.0 (4.0. 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
p-value		0.775	0.704	0.185	0.215	0.740

Among the study participants who had been involved in a CS project, Spearman rank order correlations showed that motivation scores were positively related to cognitive scores (r = 0.590, n = 14, p < 0.05). Affective score is also positively related to social connections scores (r = 0.735, n = 14, p < 0.01). Among those who have not been involved in a CS project, all domains are positively correlated with each other.

Table 4: Spearman rank order correlations

	Current Engagement Level in a previous CS project (N=14)				
	Behavioral	Motivation	Affective	Social Connections	Cognitive
Behavioral	-				
Motivation	0.039	-			
Affective	0.385	0.185	-		
Social Connections	0.266	0.297	0.735**	-	
Cognitive	-0.349	0.590*	0.085	0.037	-
	Possible involvements in a CS project (N=304)				
	Behavioral	Motivation	Affective	Social Connections	Cognitive
Behavioral	-				
Motivation	0.370**	-			
Affective	0.503**	0.463**	-		
Social Connections	0.514**	0.452**	0.630**	-	
Cognitive	0.409**	0.441**	0.464**	0.564**	-

DISCUSSION

The study found that Malaysian public university librarians were not actively participating in citizen science projects at their respective universities. According to the study, of those involved in a citizen science project, the majority held project manager post, and most of the citizen science projects they had conducted were astronomy and space-themed projects. A total of 85.7 percent said they participated in the CS project because they were worried about the data quality, particularly the accuracy of the data gathering.Citizen science initiatives may use quality assessment and quality control (QA/QC) procedures to overcome these issues and guarantee the accuracy of the data. These actions could involve participant education and assistance, standardized data collection techniques, and data validation and verification (Follett and Strezov 2015; Downs et al. 2021). By offering participants training and support, addressing legal and ethical concerns, and putting quality assessment and quality control methods in place, libraries and librarians can play a significant part in assuring data quality in citizen science projects. (Follett and Strezov 2015; Gabriele and Eva-Maria 2016; Downs et al. 2021). Maintaining the quality of the data is essential to citizen science initiatives. Citizen

science initiatives can provide more accurate and reliable data by enhancing data quality, resulting in better scientific findings and decision-making.

Several interesting findings were found among study participants who were never involved in CS projects. The study revealed that even though they never had experience in any CS project, they are receptive to future involvement in citizen science projects. They are confident in their ability to collect data, find research resources, and attend meetings related to the project. However, librarians have not yet fully realized their ability to advance beyond their usual job duties. The majority of librarians lack the confidence necessary to assume the role of a "researcher" who is capable of designing the study, developing hypotheses and research questions, and even assessing data.. Additionally, they did not consider themselves as project participants' recruiters or trainers. This can be as a result of their lack of self-perception as project managers or owners. However, research found that engaging in citizen science initiatives gave university libraries the chance to foster a positive attitude toward scientific inquiry (Cohen et al. 2015).

Libraries and librarians can play a crucial role in ensuring data quality in citizen science projects by providing participant training and support, identifying legal and ethical issues, and implementing quality assessment and quality control measures. The study suggests a need to enhance their confidence in research methodology-related roles.

The present study revealed that librarians were concerned with data quality and accuracy. Public university librarians are confident in being able to contribute to the citizen science project, but would not seek recognition for doing their task. As librarians are service-oriented, there is no inclination towards recognition of a task that is obvious to them as part of their service to the university community. Librarians play a crucial role in managing research data, which is a part of their role in supporting researchers. However, in citizen science projects, managing data is still a new area and requires specific training because data quality is one of the crucial issues in citizen science projects. Several studies have identified research data management challenges in citizen science projects and recommended that university libraries focus their services on identifying legal and ethical issues, adhering to the FAIR principles, and ensuring data quality (Gabriele and Eva-Maria 2016; Balázs et al. 2021; Hansen et al. 2021;). Increased data reliability and accuracy from citizen science initiatives can result in better scientific findings and decision-making (Cigarini and Bonhoure 2022).

The survey also discovered that librarians at public universities are driven to participate in citizen science initiatives because they want to help communities become more knowledgeable about and empowered by environmental issues. Surprisingly, a few librarians were unsure about the part they could play in exposing pupils to the environment, despite the fact that the majority would do it because their profession required it.

CONCLUSION

In conclusion, public university librarians are open to participating in citizen science initiatives because they think their present knowledge and abilities can help with information sharing and resource-based services. However, there are new roles that they may be willing to try, such as involvement in research design and methodology, project management, and increased social responsibility. To achieve this, librarians need to be motivated to be concerned about student learning and have increased feelings about the purpose of citizen science projects and go beyond their routine job tasks. The primary duties that librarians could do include activity promotion and participant recruiting. Although it may be difficult to provide research tools, particularly technical resources, librarians have the power to instruct in research skills. Academic libraries and university citizen science project managers that want the initiatives to flourish with more engagement from society members may find the study's conclusions helpful. The instrument used in the study offers university librarians a method to gauge their current level of engagement with citizen science projects and address the gaps to elevate their active involvement shortly. Future studies could compare the findings of this study with other countries in Southeast Asia to infer generalizations across institutions.

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The Perception of Foreign Speakers Toward Pusat Rujukan Persuratan Melayu (Prpm) in Improving the Learning of Malay Language

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ABSTRACT

The Malay language is among languages that are usually preferred by foreign speakers to be learned due to its potential as an international language. The Malay language is the medium of learning in the Malaysian national education system. This study is focusing on the perception of foreign speakers toward the usage of the open access PRPM Online dictionary https://prpm.dbp.gov.my/) in improving their learning of Malay language. Quantitative approach in data collection is based on the distributed questionnaires to Universiti Malaya foreign students. The outcomes of the study showed that the students perceived PRPM as a useful learning tool to improve Malay language competency. It helps in grammar understanding, guides pronunciation and spelling as well as improving vocabulary. They mainly use the PRPM online dictionary to find meaning and definition of words. The PRPM online dictionary is not used as the main reference due to available alternatives online. The study also discovered several limitations in PRPM, especially the thesaurus corpus and user instruction aspects. Besides those issues, the PRPM online dictionary is still used by those students to comprehend Malay language. The right and suitable language delivery digital platform could assist users in the learning process of Malay language.

Keywords: Malay Language, Second Language, Open Access Dictionary, Malay Lexicography,

INTRODUCTION

Pusat Persuratan Rujukan Melayu or PRPM (https://prpm.dbp.gov.my/) is a digital platform that provides an open access online dictionary of Malay language. It was developed by Dewan Bahasa dan Pustaka (DBP). The platform was launched in 2008.

The main objective of PRPM is to provide an online reference for Malay language users. Based on user keywords, PRPM search engine will fetch definitions of words from Malay and English dictionaries and terminologies from several fields, Pantun, proverbs, and other resources. The PRPM collects, arranges, and distributes Malay literature worldwide via the internet. The data center of PRPM database is situated at Dewan Bahasa and Pustaka (DBP) headquarter In Kuala

Lumpur. The website has reached 4 million search hits online. On average PRPM receives 49000 visits monthly (Dewan Bahasa Dan Pustaka [DBP], 2012).

The Malay language is a prerequisite for all foreign students who study in the Universiti Malaya (UM). The students are required to take one semester introductory courses in Malay language. These courses are provided by the Faculty of Language and Linguistics. The courses entitled TXGZ61202 Bahasa Malaysia Asas (For postgraduate) and GLT1017 Bahasa Melayu Asas (For undergraduate). This is to equip them with basic communication skills in the hope that they could further understand Malaysian culture during their stay in this country. However, those students might be exempted from taking the course if they passed an exemption assessment. As the online resource to learn Malay language, PRPM could be the most reliable platform in exploring Malay language due to its comprehensiveness. Hence those students' views and experience with PRPM can provide accountable information to understand its contribution in the learning process of the language.

PRPM and Universiti Malaya Library

Although PRPM is not part of subscribed UM Library online resources, it is still an essential tool for UM   students since Malay language is the official medium of learning and teaching in UM. There are several courses that use PRPM as the reference tool at the Academy of Malay Studies. For example, JIB 2017 Bahasa Melayu dalam Penyiaran dan Kewartawanan (Malay language in Broadcasting and Journalism) and JIB2015 Bahasa Melayu, Masyarakat dan Media Sosial (Malay Language and social media). These are among the mobility courses that joined by foreign students.

The PRPM is an initiative by the Dewan Bahasa dan Pustaka (DBP), a government body that is responsible for the Malay language planning and enforcement in Malaysia. DBP is empowered by a specific act known as Akta Dewan Bahasa (Pindaan Perluasan) 1995.This act has entrusted DBP to plan and enforce measures to uplift the Malay language as National language. Hence It is a national duty of Universiti Malaya Library to encourage the use of PRPM in order to encourage the proper use of Malay Language. The usage of the platform is promoted to students by the Malay Studies Library by using social media such as Facebook and during the library information skill session.

PRPM as an open access dictionary

The PRPM online dictionary is an open access resource that provides   a   spectrum of Malay words information. It does not only give definition of those words but beyond what a printed version commonly   offers. In a single web page a user is also able to know the proper spelling of the word in Romanised   letters and in Jawi script.

Furthermore, it provides a phonetic   guide to assist the word pronunciation. Information about the word class is given whenever relevant. The variation of the word meaning is included if any. In each of the meaning variations, usage examples within the context of given definition are supplemented. This information is mainly derived from the published DBP Malay dictionary entitled Kamus Dewan Edisi Keempat (Fourth edition of Kamus Dewan).

Besides typical dictionary information, other additional information such as synonyms for a word is available in the thesaurus section.

The PRPM dictionary also gives a reference of past DBP answered queries from the public regarding the usage of certain words. For example, there is a question about a proper usage of the word "Kalau" (if) that has been replied to by DBP. The record of the query will be displayed if a user is seeking the definition of the word "Kalau" in the PRPM dictionary. The record of the information is retrieved from the PRPM Khidmat Nasihat web service.

Moreover, the PRPM also provides a link to the "DBP Korpus". It contains a vast amount of Malay word corpus data. It provides a snippet of statement and source of a specific Malay word, for example: Statement: "Kalau ayah tak ada duit belilah basikal baru" ; Source: Mohd Fauzi Abdul . Kalopak Gugur. Keluarga, 2003. This data is freely available for anyone who wants to use it for research purposes.

OBJECTIVES

The objectives of this paper are:

1. to study the perception of foreign speakers of Malay language among Universiti Malaya (UM) students toward the Malay language online dictionary which is known as the Pusat Rujukan Persuratan Melayu (PRPM) in learning the language.

2. to study the usage purpose of PRPM Online dictionary by Universiti Malaya's foreign students.

PROBLEM STATEMENT

The PRPM online dictionary is developed by DBP as an open access digital platform to help the Malaysian public to understand the Malay language. How the UM foreign students perceive the PRPM as a learning tool of the Malay language is still unknown. The information is useful as an input for improvement and future research on the platform.

LITERATURE REVIEW

There have been numerous studies examining how users utilize different types of online dictionaries to learn languages. However, the focuses of these studies are often scattered that it is difficult to organize them into a coherent scheme. Considering the differences in the focus on each study the literatures are divided into the following subsections:

1. **Perception of word definition in online dictionary**

Wijaya (2022) conducted a study on millennials perception of references of "perempuan" or woman in in Kamus Besar Bahasa Indonesia (KBBI). The Online dictionary of Indonesian language is developed by Badan Bahasa. The study found the millennials still have the tendency of gender-based reference in the given definition in the KBBI. For instance, correlating matriarchal domestic responsibility of raising children in an event that view between man and woman. However, there is a growing neutrality over the previously male dominated terms, such as "hardworking" and "boss". However, the term perempuan is still associated with derogatory references such as "prostitute" and "slut". Millennials' perspective of the language differs from conservative views towards women to more progressive.

2. **Overview of online dictionary initiative in countries language planning.**

The book chapter by Kwary and Nor Hashimah (2015) discusses language planning. Of both Malay and Indonesian Languages which originated from the same language known as Melayu. The emphasis of the chapter is more towards sharing lexical activities in Malaysia and Indonesia When discussing the language planning, both authors highlighted several existing digital lexical initiatives in the countries. Kwary explained about Indonesia's initiatives of online lexicographical resources namely KBBI Kamus Besar Bahasa Indonesia and Glosarium which developed by Badan Bahasa. Meanwhile Pusat Rujukan Persuratan Melayu or PRPM which is developed by DBP is described by Nor Hashimah as a one stop center for online users to find all information about Malay language. With PRPM, the user is able to retrieve information from twelve dictionaries in just one query. Another initiative known as the Gerbang Kata is another online dictionary service by DBP that enables users to interact with lexicography units to discuss, exchange ideas and introduce new words.

3. **Online dictionary as a language learning tool.**

Kit and Berg (2014) emphasized online dictionaries are essential in the language learning process. Furthermore, online dictionaries have superior properties over printed dictionaries, it is able to deliver fast responses and has reversibility in giving lexical help. However, it is seen as volatile due to its dependency towards network stability. They suggested online dictionaries and their specifications should be studied and tested on a regular basis. They proposed that teachers who teach a language course should seek suitable online dictionaries before using them as course reference tools. Furthermore, they also iterated the improvement of online dictionary by innovation of cognitive ability association of online dictionary based on queries analysis as inferences to help language learners to get the best translation in the context of user works.

4. **Online dictionary in teaching linguistic**

Campoy- Cubillo and Esbri -Basco (2022) explored the potential of online dictionaries and the multimodal affordances they bring to the teaching of metaphors and idiom in the language

classroom. This study views online dictionaries and their multimodal affordances as a powerful learning tool to guide   EFL students to understand complex English metaphoric language.

5. Perception of usefulness of online dictionary in learning language

In this study Li and Xu (2015) investigated the use of an online dictionary by Chinese EFL learners in identifying the meanings of verb phrases. The results of the study showed that learners have improved in doing the task after consulting the online dictionary. However, training in using online dictionaries is necessary to lead students to make correct choices.

6. Retrieval system of online dictionary

Cunliang et. Al. (2022) introduced Lit Mind Dictionary It is an open-source online generative dictionary. The platform can retrieve a word and context containing the word as input and automatically generates a definition as output. It supports not only Chinese and English, but also Chinese-English cross-lingual queries. The dictionary gives flexibility to a user to develop a vocabulary.
The selected literature provided various information on the application of online dictionaries in language learning. Even though one of them is discussing users' perception, none of them is related to PRPM users' perception. Therefore, this study is important to provide information in the subject matter for future reference.

RESEARCH DESIGN

This study used a quantitative approach for data collection. A questionnaire with 18 sets of questions is the main tool to gain insight. The questionnaire is developed based on four (4) constructs such as demography, experience, language, and learning. Likert scale rating with 5 answer statements (Strongly Agree to strongly Disagree) are used to measure the respondents' perception.

The rationale of the selection of the four constructs is described as this:

1. Demography
 Will give a brief background information of the respondents who participated in this study such as country of origin, gender, faculties, and level of study. 2. Experience: This construct consists of questions to get the insight of the respondents' experience in using the PRPM online dictionary. For example, the purpose of using the dictionary is. For this question six multiple options are provided for them to choose from. Respondents also asked a general question whether they are using online dictionaries to learn a language, but not necessarily PRPM. Their preference over online or printed format dictionaries is also questioned. 3, Language: This construct tries to get respondents' perception of PRPM ability in helping them to improve their Malay language in these four aspects such as grammar, spelling, pronunciation, and vocabulary. 4. Learning: The purpose of the construct is to attain

respondents' insight on how they perceive PRPM as a Malay language learning tool. Is PRPM useful in their learning? Do the respondents gain learning autonomy by using the platform? and whether the resources available in PRPM such as thesaurus and Malay proverbs enhance their learning experience? are included in the questions. All These constructs which are underlining the questionnaire are believed to be able to give some relevant data for this research.

Google Form is used to design the question platform. The questionnaire was then distributed to 100 respondents among the international students of the Universiti Malaya. The distribution of the questionnaire is done online via email and WhatsApp since the form itself is web- based.

The application of the questionnaire in this research is due to its advantage in collecting data from large populations with far distance proximity but with less budget and time (Majid, 1990). Since the study does not require direct contact with respondents the selected method is considered suitable. Baxter et al. (1996) emphasize questionnaires enable researchers to formulate precise questions for interested groups whose opinions or experience is investigated.

In support of this, Monette et al. (1998) listed out four advantages of questionnaires as a research data collection tool. Firstly, questionnaires are inexpensive and provide quick information gathering if compared to an interview. The research tool only takes a month or 6 weeks to accumulate data.

Secondly, questionnaires can collect data from geographically dispersed respondents. Distance and geographical boundaries are not obstacles. Thirdly, a question with a personal or sensitive nature may provide an accurate answer than an interview. Respondents are likely to respond honestly to questions if asked not to face a person that is possibly making judgements about them; Finally, questionnaires may eliminate the interviewer bias. It occurs when interviewers influence interviewee response by answering the question in a particular direction.

Majid (1990) stated Likert scale measures attitude. The approach proposes a list of statements with positive and negative values about individual attitudes towards certain institutions or issues. The basis of the Likert scale is on the assumption that all feedback scores retrieved from the designated list of statements reflecting one attitude on the issues, it also provides reliable measurement of the attitude under study. Mcleod (2023) pointed out the Likert Scale extent of respondent feedback from a simple Yes or No answer to a degree of opinion which then enables the respondent's attitude to be measured.

According to Moura (2020), Likert Scale is a psychometric that is intensively used to measure attitude, perception, emotions, and intentions. The scale gives an opportunity to an individual to express himself in an objective manner. It measures abstract concepts which are tangible and seem impossible to measure before.

Hence in this research, a questionnaire with Likert Scale measurement schema was adopted as appropriate for data collection due to its ability to measure abstract concepts such as UM foreign students' perception towards the PRPM online dictionary.

RESULTS AND DISCUSSION

Overall, there were 58 respondents (R) who participated in this study. The respondents were foreign students of the Universiti Malaya who are currently enrolled in various academic courses. Below are the selected tables and data analysis from the collected questionnaire from the four constructs: Demography, Experience, Language and Learning.

Demography

Table 1: Country of origin of respondents

Country	Number of Respondent (R)	Percentage
China	13	22.40%
Other	10	17.20%
Indonesia	8	13.80%
Pakistan	7	12.10%
Bangladesh	3	5.20%
UAE	2	3.40%
Thailand	2	3.40%
Iran	2	3.40%
France	2	3.40%
Brunei	1	1.70%
Turkiye	1	1.70%
Korea	4	6.90%
Oman	1	1.70%
Nigeria	2	3.40%
Total	58	99.70%

The highest number of the respondents (13 R/22.4%) were coming from China. Most of the Chinese students are taking language courses at the Academy of Malay Studies (APM) and the Faculty of Language Linguistics (FBL). The respondents from APM (18 R) also contributed to the highest response in faculty demography in this survey. This is probably due to the academy's reputation in accepting students from several countries such as France, South Korea, China, Thailand, Singapore and Indonesia to enroll in undergraduate and postgraduate programmes in Malay Language and culture. Besides that, the flexible mode of studying in APM known as "Mobility" has attracted students to join courses on Malay language remotely from their own countries.

Experience

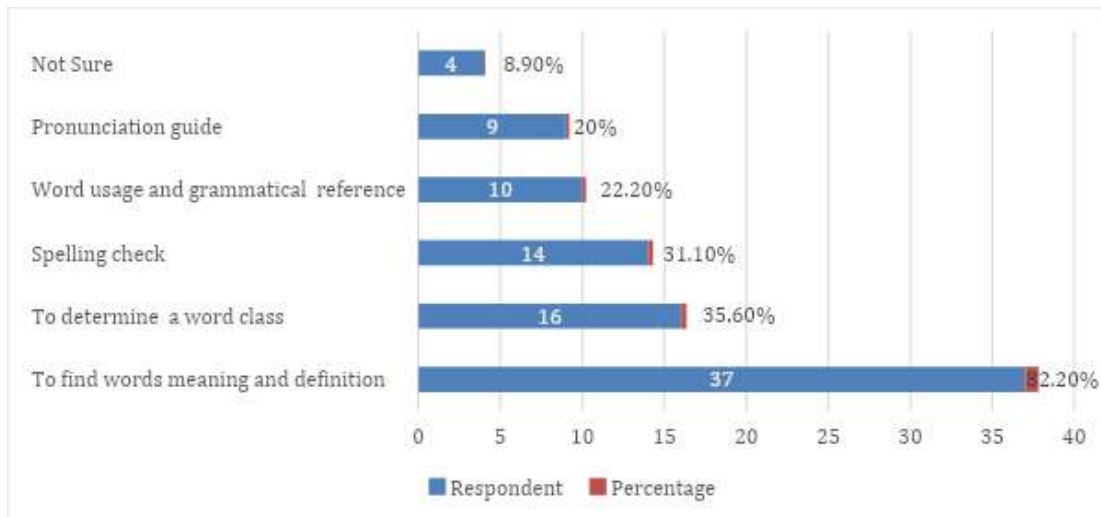Figure 1: The Usage Experience Of Prpm Online Dictionary

Figure 2: The Usage Purpose of PRPM Online Dictionary

77.6% (45 R) of the students were in favor of using online dictionaries to learn Malay language. This showed that the online tool has its own advantages. Especially in the aspect of its format flexibility. There is no longer a lump of dictionary to be carried everywhere, but a smartphone as a medium and internet connection. It is still believed that an online dictionary is a crucial supporting resource in learning a language. A formal learning session with a professional instructor is undeniably the best approach. However, the study showed that 20 students have never used the PRPM (Fig. 1). This is conceivable since there are several available webs- based and apps of Malay dictionaries instead of PRPM. For example, Carikata, Malaycube, Malay English Best Dictionary in Malaysia, English Malay Dictionary, to name a few. Although PRPM could offer better description of Malay words, it is subjected to users' preference of choice and convenience.

Even though PRPM is providing comprehensive information to its users, as reflected from the result (Figure 2), their main purpose of using PRPM is to find the meaning of words. In other words, they only utilize the basic function of the PRPM dictionary. This situation normally happens to a non-native speaker who wants to instantly acquire the meaning of the foreign words in their mother tongue in order to understand the whole context of a text or conversation. In any respect, this activity is a part of the language learning process.

Surprisingly, the study found 45 respondents still prefer to use printed dictionaries over the online format. What could be interpreted from this is, not all online dictionaries are able to provide comprehensive information as in printed. Users still need to go back to the original format for complete information. Secondly even if they did, they still lack the feel and touch as the physical format. Thirdly, using a digital device for a long screen time to access an online dictionary or any digital text may cause a health hazard such as eyes and musculoskeletal system stress (Moulick, 2023).

Hence considering these factors, an online dictionary is still necessary but may be used as a complimentary reference with a physical dictionary in learning Malay language.
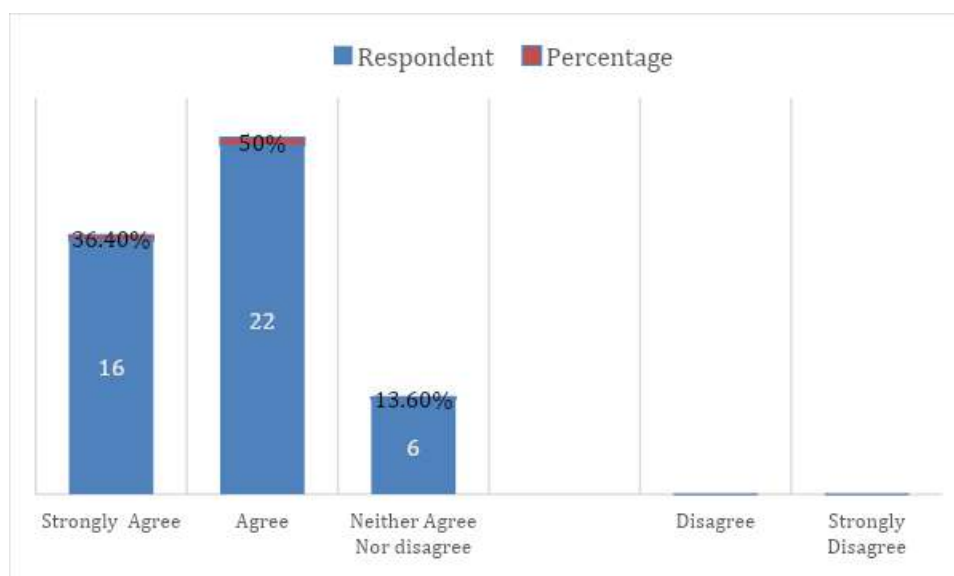
Language

Figure 3: The PRPM Online Dictionary Helps with Malay Language Grammar Understanding
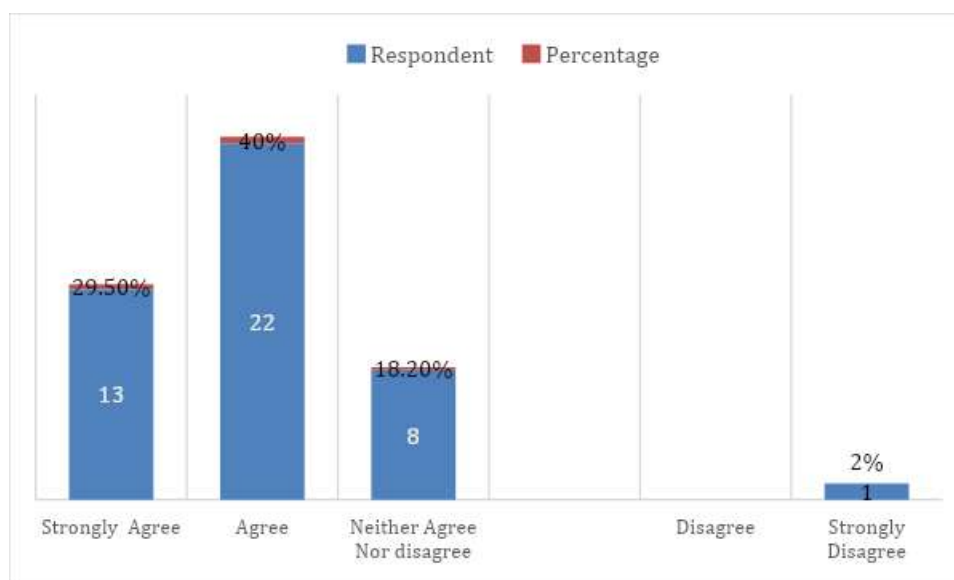
Figure 4: The PRPM Online dictionary helps Malay language pronunciation.
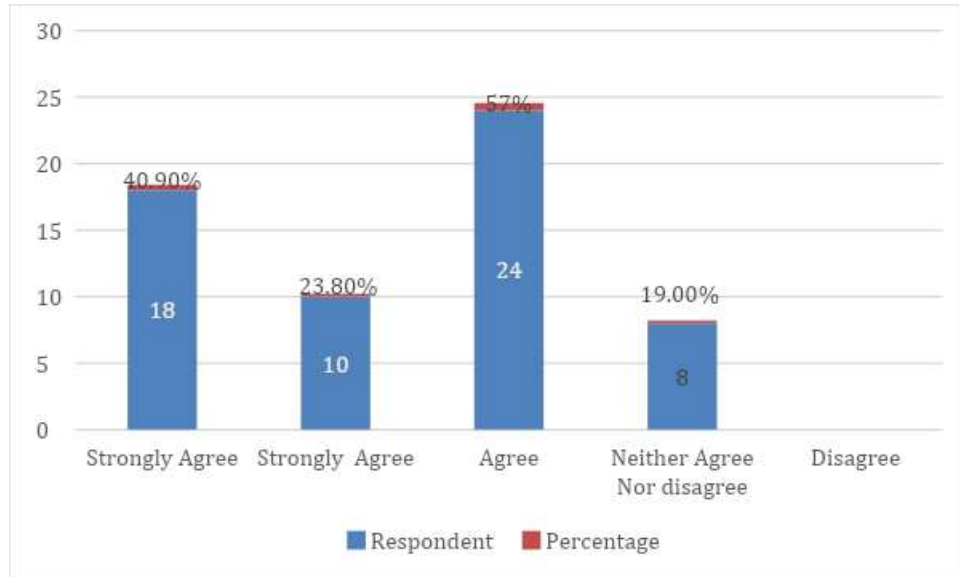
Figure 5: The PRPM Online dictionary guides Malay words' spelling.
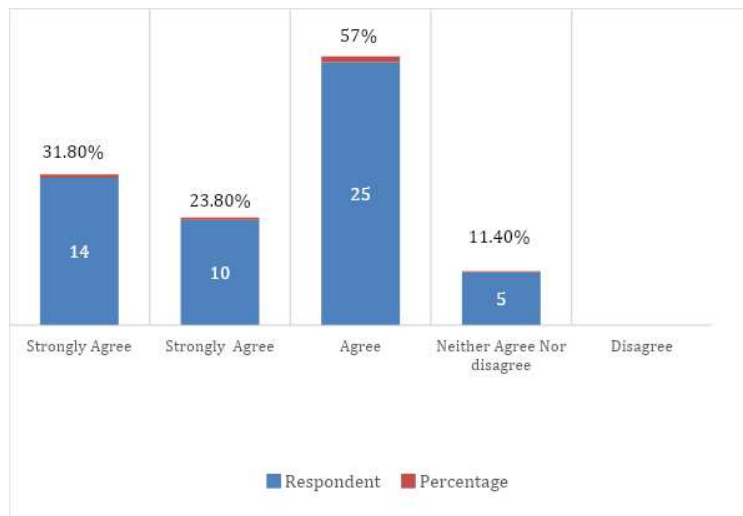
Figure 6: The PRPM Online dictionary improves Malay vocabulary.

Overall most of the students gave positive views (Strongly Agree and Agree) toward the potential of the PRPM online dictionary to help them in learning all aspects of Malay language such as grammar (38 R), pronunciation (43 R), spelling (52 R) and vocabulary (54 R) as in Figure 3 to 6. This is possible because PRPM is designed in such a way to be the one stop

center for its users to get all information about the Malay language. It is fully supported by the Malay language experts (DBP, 2015).

Learning

Figure 7: The PRPM Online Dictionary gives Learning Autonomy
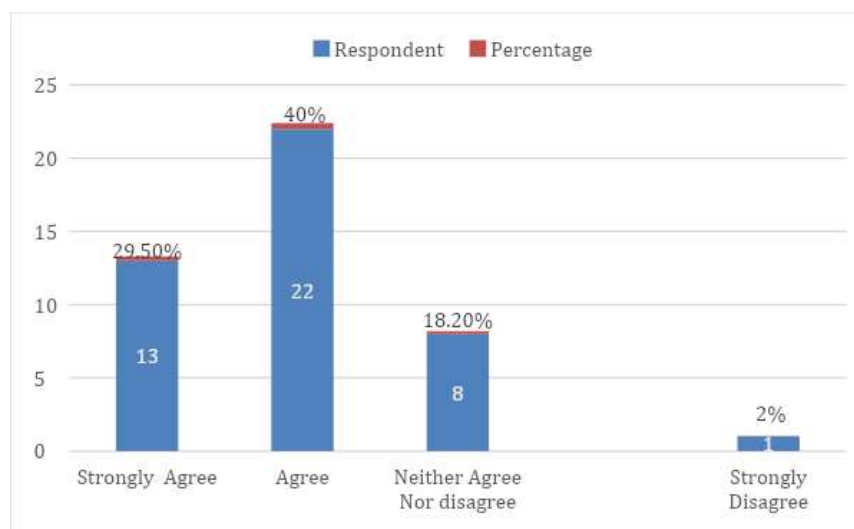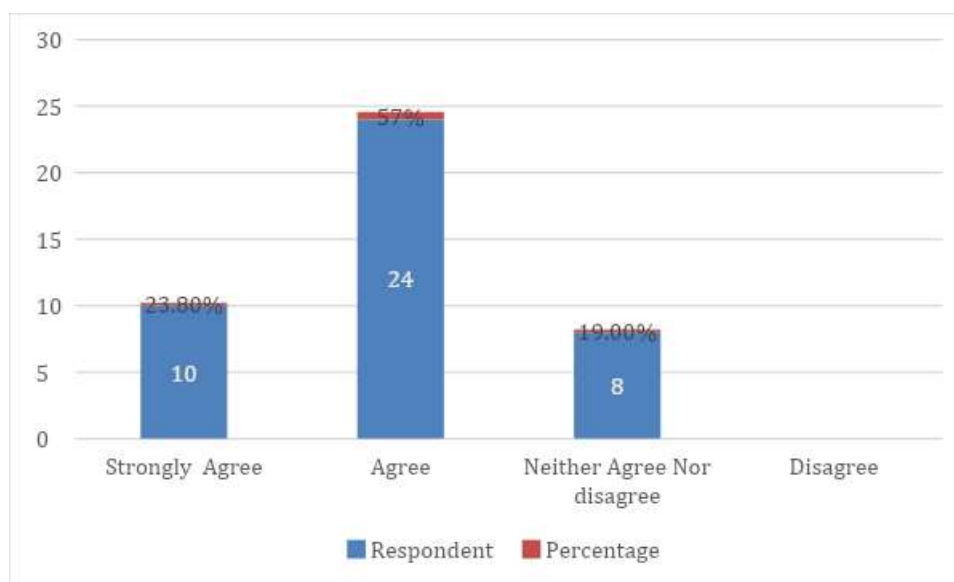

Figure 8: The PRPM Online Dictionary is Easily Accessible

35 respondents acknowledged that the PRPM has given them learning autonomy (Figure 7). This is the strength that most online applications could offer. This advantage   indirectly promotes the PRPM usage. They also perceived the PRPM to be easily accessible (34 R) that allows them to learn the Malay language with their own time and pace (Fig. 8).

31 students also agreed that (the additional features such as the Malay Pantun (Pantoum) and Peribahasa (Proverb) in PRPM have enhanced their Malay language learning process.

FINDINGS

The conducted research   highlighted several findings:

1. The students perceived the PRPM as a useful learning tool to improve Malay language competency. It helps in grammar understanding, guides pronunciation and spelling as well as improving vocabulary (Fig. 3 to 6).

2. The students mainly use the PRPM online dictionary to find meaning and definition of words.

3. The PRPM is not the main online dictionary referred to by those students. There are other alternatives.

Limitation of PRPM

Besides amicable analyses of PRPM, there are few noticeable limitations which are considering for rooms of improvement:

1. The thesaurus tool   contains less word corpus. For example, synonyms for common words such as "Angkat" (Lift), "Baca" (Read) and "Cari" (Find) are unavailable.

 2. Bilingual instruction such as the English language is not available. The PRPM is totally in Malay language. This option could facilitate foreign speakers in using the PRPM.

 3. Word phonetic guide is not accompanied with pronunciation sound samples. Therefore, users that understand phonetic symbols may have difficulty pronouncing the word correctly.

CONCLUSION

Based on the study, the PRPM online dictionary is practically useful for the foreign students to improve their Malay language competency. It provides a lot of information about the language at their fingertips. It is an excellent initiative by the Malaysian government to uplift the proper use of Malay language. However, some of the   foreign students are hindering it due to the availability of alternatives. Thus, it is the role of Lecturers and librarians to encourage its usage in the classes and libraries to promote the resource to its users.

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Trust Bridging Data Governance and Open Science Adoption in Higher Education Institution

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ABSTRACT

In the current advancement of technology and digitalization era, vast amounts of data has been produced every second, which not only advances scientific research but also plays an important role in facilitating socio-technical development and sustainable development agenda. The usage of open science has positive images and perceptions among students and scientists, which open science publications are more favorable than non-open science publications. Adoption of open science has been proposed as a strategy for universities in developing countries to land in higher rankings and provides opportunities for the public to voluntarily participate voluntarily in the research process. However, not all data is suitable to be shared publicly due to privacy, ownership, trust, and incentive, these concerns need to be solved in enticing higher adoption of open science. Adopting open data or open science is still a challenge especially in gaining trust, which is the prerequisite of open science. To address this shortcoming, in this perspective, we conceptualize the data governance components to gain trust in adopting open data among academicians in the context of higher education institutions. Drawing from data governance taxonomy, this paper posits that a) data quality, b) data security, c) data architecture, d) metadata, e) data lifecycle, f) data storage, and g) data pricing has significant influence towards trust and open science adoption. This paper also argues that trust mediates the relationships of a) data quality, b) data security, c) data architecture, d) metadata, e) data lifecycle, f) data storage, and g) data pricing on open science adoption. Such understanding of data governance and trust in adopting open science would enable a more effective strategy for a better adoption rate of open science in higher education institutions.

Keywords: Open Science, Data Governance, Trust, Higher Education Institution

INTRODUCTION

In the current world that has advanced technology in knowledge discoveries has resulted in tonnes of data to be generated every seconds, with the abundance of data and knowledge has helped us not just in shaping the world but also saving humankind such as during COVID19, where the open science has helped all scientist around the world to communicate and sharing data in finding the solutions to pandemic like COVID19 (Viseur, 2021). Open science is not just advancing scientific research but also plays an important role in facilitating socio-technical development and sustainable development agenda (Samuel & Lucivero, 2020). In the context of higher education institutions, the usage of open science is growing but still limited, nevertheless the perception of open science among higher education users is positive especially among the students and researchers, which open science publications are more favorable than non-open science publications (Schneider et al., 2022).

To understand the landscape of open science in higher education institutions is very important as higher education institutions are one of the organizations that are active in research. So, having more higher education institutions to participate in open gives higher data richness to the open science databases. The adoption of open science in higher education is getting the attention of scholars (Ivančević & Luković, 2018). In addition, the usage of open science has been identified as one of the key components and strategies in landing the university ranking to the higher rankings (Kurniasih et al., 2018). Open science provides opportunities and platforms for the public and researchers to voluntarily participate in the research process, which would benefit humankind (Abd. Rahman, 2019).

However, not all data is suitable to be shared publicly due to its nature including the privacy, ownership, trust, and incentive (Li et al., 2022). Adopting open data or open science is still a challenge especially in gaining trust of the users, which trust is one of the main prerequisite of open science to be adopted by researchers and change the research landscape (Clark, 2021). Hence, these concerns need to be understood and solved to have higher participation from higher education institution users in open science. The understanding of data governance in open science from the higher education institutions perspective is crucial to gain trust among researchers to adopt open science (Demchenko & Stoy, 2021).

To address this shortcoming, the main objective of this paper is to understand how data governance develops trust among higher education institution users to adopt open science. In order to understand the main objective, drawing from data governance taxonomy (Abraham et al., 2023), this paper posits that a) data quality, b) data security, c) data architecture, d) metadata, e) data lifecycle, f) data storage, and g) data pricing has significant influence towards trust and open science adoption. This paper also argues that trust mediates the relationships of a) data quality, b) data security, c) data architecture, d) metadata, e) data lifecycle, f) data storage, and g) data pricing on open science adoption. The understanding of data governance and trust in adopting open science would enable a more effective strategy for a better adoption rate of open science in higher education institutions.

LITERATURE REVIEW

Open Science

Over the past decades, the advancement of technology and the digital world has evolved the world of science towards transparency, reproducibility, and openness, which has resulted in a movement known as 'Open Science' (Armeni et al., 2021). The challenges of reliability and accountability of scientific works have gaining attention of scholars especially on the transparency of the research, in light of these issues, researchers and scholars are driven to increase the reliability and transparency in various aspects of the work beginning from the initial research until the finish products (Bezjak et al., 2018; Munafò et al., 2017; Nosek et al., 2015; Nosek et al., 2018; Stall et al., 2019).

The concern over accessibility and transparency of scientific research also gaining attention from journals, funders, and policy makers where they urge and having expectation to scholars to increase the accessibility and transparency of their search, finding, and also products (Aczel et al., 2020; Burgelman et al., 2019; Morey et al., 2016). So, by adopting openness in research, scholars would work in a less error environment (Hales et al., 2019), and have higher visibility to peers in the same research area and also to scientist from other discipline, which also resulted in higher citation rates (Colavizza et al., 2020). In addition, participating in open science practices would promote and facilitate the sharing and reuse of data, materials, and code in the scientific community (Allen & Mehler, 2019), which would increase scholars' outputs and literacy, besides it also increase the trust in the scholarly process (Tennant et al., 2016).

By promoting and adopting open science, it is not only giving tangible benefits to individual researchers, but also benefits the scientific community and the society at large (Armeni et al., 2021). But, in many open science occasions, most of the time it often attracts innovators and early adopters only, which creates so called 'open science bubbles'. (Armeni et al., 2021). While, it is good to have the early adopters of open science in doing their research workflows, but a critical number of adoptions are needed especially among mass scientist and scholars so that open science can move from open science advocacy to actual behavior, but this still remains challenging especially when open science is not widely and normatively accepted by the scientific communities yet (Armeni et al., 2021)

As part of transitioning towards open science, it has promoting the need for the research environment to adapt to new societal and technological advancement over the past years (Burgelman et al., 2019), such as the usage of web-based technologies and social media networks as regular tools for data collection, sharing, analysis, and collaboration (Voytek, 2017). So, the abundance of available data and its availability to open science has raised the concerns among scholars on how the data has been managed.

Data governance

Data governance refers to a framework that gives structure and formalization in terms of data management (Morabito, 2015). In order to have a good data governance, organizations need to specify what must be governed such as the scope of the data (Abraham et al., 2019), who

are responsible in governing the data, such as the roles and governance bodies (Otto, 2011), and what are the decisions must be made in data-related areas such as the data governance decision domains (Abraham et al., 2019; Lee et al., 2019). This study draws the last component. Based on Abraham et al. (2023), we describe the seven data governance decision domains: (a) data quality; (b) data security; (c) data architecture; (d) metadata; (e) data lifecycle; (f) data storage and infrastructure, and (g) data pricing towards trust in adopting open science among higher education institution users.

i) Data quality

Data quality is defined as the ability of data to fulfill the usage requirement in a specific context (Khatri & Brown, 2010). Data quality is evaluated based on quality dimensions of completeness, credibility, accuracy, timeliness, and consistency of data (Khatri & Brown, 2010). In the scientific literature, preventive and reactive measures are two proposed measures in managing data quality (Otto et al., 2012). In the context of open science, preventive measures would inhibit data providers from onboarding data products with insufficient quality. For example, data providers take additional steps in testing the quality for the data through automated test scripts before putting the data available for consumption (Smith et al., 2016). While, the main aim of reactive measures is to support the identification and reporting of data quality issues after the data has been made available for consumption. The example includes rating systems that allow consumers to rate and provide feedback on the data (Zuiderwijk et al., 2014) or data providers (Ramachandran et al., 2018). The data quality has been backed up by trust in adoption of data in the Internet of Thins (IoT) setting (Byabazaire et al., 2020).

Hence, in the context of open science in higher education settings, we posit that a high standard of data quality will gain the trust of higher education institution users in adopting open science. By having preventive and reactive measures in place for open science, it creates higher data quality, which helps in gaining trust among the users of higher education institutions to adopt open science as part of their research behavior.

Proposition 1: Data quality helps in gaining trust of higher education institution users in adopting open science

ii) Data security

Data security is defined as the preservation of security measurements including the accessibility, authenticity, availability, confidentiality, integrity, privacy, and reliability of data (Carretero et al., 2017). So in the context of data consumption publicly, the concerns of requirement are including the control of when, to whom, and to what extent data is being made available for consumption (Tzianos et al., 2019) and how and where the data being used (Otto & Jarke, 2019). Data security is always associated with trust in adopting any technology (Sun et al., 2013)

In order to establish data confidentiality, data providers use encryption techniques (Tzianos et al., 2019). In order to protect data sensitivity during usage, data providers are adopting

methods that fully restrict raw data access and only allow certain part of the data to be accessed, such as the identity data has been hidden using anonymization techniques (Ha et al., 2019). Homomorphic encryption is also being used in enabling mathematical operation on encrypted data (Roman & Stefano, 2016). Data usage terms have been adopted in controlling and protecting data ownership, where these terms will describe the appropriate data usage (Otto & Jarke, 2019; Tzianos et al., 2019). In addition, data terms and contracts help in negotiating and assuring the authorizations, obligations, and prohibitions on data covered by the contract (Allen et al., 2014). This would enable data providers to have a remedy against data consumers in case of contract infringements (Truong et al., 2012).

So, in the context of open science and higher education institutions, we posit that data security helps in gaining trust among higher education institution users to adopt open science in their work environment. This includes the specification of confidential data storage, data access control, confidential data usage, and data usage control. We argue that by having high control of these 4 aspects of data security, it leads to higher trust among higher education institutions to adopt open science in their research.

Proposition 2: High data security will gain trust of higher education institution users in adopting open science

iii) Data architecture

Data architecture is defined as a set of data specifications, which is used as guidelines for data requirements and data integration (Abraham et al., 2023), that consist of comprehensive data models on a conceptual, logical, and physical level (Watson et al., 2004). Data architecture is important in introducing transparent data for consumption (Luciano et al., 2017).

In the context of the data marketplace, data standards are often referred to as being important to supporting interoperability and data exchange between data providers and data consumers (Lis & Otto, 2020). In the data marketplace, data format ranging from standardized through proprietary to hybrid, where data marketplaces define standardized vocabularies and formats, which all participants in the marketplace must follow (Otto & Jarke, 2019), while proprietary approach allows data providers to offer their data products using their own proprietary data formats (Özyilmaz et al., 2018). But, the most convenient approach for both parties, which is data providers and consumers is a hybrid approach, where data providers can supply data in proprietary format, which later will be automatically normalized by the data platform using standardized data model (Nagorny et al., 2018).

So in the context of open science in higher education institutions, we argue that comprehensive data architecture through the right data format such as standardized data format, proprietary data format, or hybrid data format is able to promote data transparency that helps to build trust among higher education institution users in adopting open science.
Proposition 3: Comprehensive data architecture develops trust of higher education institution users in adopting open science

iv) Metadata

Metadata is defined as data about data (Abraham et al., 2023), where metadata is giving meaning and context to data by providing a structured description of the content, quality, and other characteristics of data (Khatri & Brown, 2010). In the data marketplaces context, rich information of metadata is crucial in supporting data consumers especially when finding data of interest (Tzianos et al., 2019), identifying the usefulness of the data (Ramachandran et al., 2018), and precisely interpreting and processing data (Zuiderwijk et al., 2014).

There are two approaches regarding the metadata vocabulary in the scientific literature, which are specific metadata vocabulary and standardized metadata vocabularies (Abraham et al., 2023). Specific metadata data vocabulary is used by data providers to describe and publish metadata, while data consumers use it to look up and retrieve metadata (Otto & Jarke, 2019). A few examples of standardized metadata vocabularies are CERIF and DCAT (Zuiderwijk et al., 2014). The well-established metadata standard would result in data authenticity.

So, in the context of open science of higher educational institutions, established metadata vocabulary (standardized vocabulary or marketplace-specific vocabulary) would enable data providers and users to search relevant and authentic data. The identification of the right and established data architecture helps researchers in searching for the right data which leads to gaining their trust in adopting open science.

Proposition 4: Established metadata vocabulary gains trust of higher education institution users in adopting open science

v) Data lifecycle

The data lifecycle is defined as the whole lifecycle of data starting from collecting, creating, using, maintaining, archiving, and until deleting the data (Khatri & Brown, 2010). For example, in the context of data marketplace, the main life cycles of the data phases are data onboarding, data discovery, data purchase, and data usage (Abraham et al., 2023). Where, during the data onboarding, the data providers would capture, create, and store the data, which later is made available for consumers' consumptions (Otto & Jarke, 2019). During the data discovery phase, the consumers will search the right data based on their goals and consumptions (Ramachandran et al., 2018). In the data purchase phase, consumers would pay in the exchange of the data, and the data providers will give access to the users to access the purchased data (Tzianos et al., 2019). In the final stage, which is data usage stage, the consumers will use the data in achieving their aims or goals such as by enriching and aggregating it (Otto & Jarke, 2019).

In the context of open science at higher education institutions, we posit that the understanding of a suitable data cycle develops trust to the higher education institution users to adopt open science. It is important to understand which data lifecycle is more appealing to researchers at higher education institutions (data trade focus vs data usage focus). The

understanding of the right data lifecycle helps in gaining trust among researchers, which leads to higher adoption of open science at higher education institutions.

Proposition 5: Suitable data lifecycle promotes trust of higher education institution users in adopting open science

vi) Data storage and infrastructure

Data storage and infrastructure is information technology (IT) artifacts that are responsible for effective data management (Tallon et al., 2013). How data must be stored is always a question in data management (Abraham et al., 2023). There are three main approaches in data storage which are the centralized, decentralized, and hybrid storage approaches (Spiekermann, 2019).

In centralized approach, data are provided by data provider via a central location such as cloud storage service, while in decentralized approach, data will be stored at data provider facilities, and the hybrid data storage approach is the combination of both the centralized and decentralized approaches (Abraham et al., 2023). The location and storage of data highly influence trust of the users (Dixit et al., 2021).

So, in the context of open science in higher education institutions, we posit that a secured data storage and infrastructure develop trust among the higher education institution users to adopt open science. The understanding of data storage and infrastructure from higher education institutions helps to gain their trust in adopting open science.

Proposition 6: Secured data storage and infrastructure develops trust of higher education institution users in adopting open science

vii) Data pricing

When the exchange of data involves various parties, the question that arises is how to price data relevantly (Abraham et al., 2023). In the data marketplace, there are main pricing models that have been used, which are pay-per-use and subscription-based pricing models based on their business models. Through a pay-per-use model, the data marketplace would charge consumers based on the data consumption (Spiekermann, 2019; Truong et al., 2012). While via subscription based pricing strategy, consumers will be granted access to data for a certain period of time. Other than these two pricing models, data can be provided free of charge whenever allowed by a data provider, which is normally done by public authorities and non-profit organizations (Spiekermann, 2019). There is also hybrid pricing strategy being used by data providers, where basic data is supplied free of charge but providers are charging premium prices for detailed data (Thomas & Leiponen, 2016). In addition, data pricing would enable the right price for data (Truong et al., 2012). In the data marketplace, other than fixed prices, they also adopting more dynamic pricing such as bidding (Parra-Arnau, 2018), progressive pricing (Spiekermann, 2019), the "pay what you want" approach (Zuiderwijk et al., 2014), and packaged pricing (Spiekermann, 2019).

So, in the context of open science in higher education institutions, we posit that reasonable and sustainable data pricing will give trust among higher education institutions to be the data provider and data user of open science. It is important to understand which data pricing strategy is more suitable for higher education institution strategy, as the right pricing strategy helps in developing trust in adopting open science.

Proposition 7: Suitable and sustainable pricing develops trust among higher education institution users in adopting open science

DISCUSSION

Higher education institutions are one of the parties that are actively involved in vast amounts of research that generates tonnes of data, which the data can be used and transformed to various outputs that can be beneficial to various parties such as researchers, scholars, businesses, policy makers and others. The movement of the scientific community towards transparent science such as open science is a noble movement in advancing the state of knowledge. But, the question of how this data is being governed is always a concern not just to the data users, but also the data providers.

Hence, this paper posits that data governance as the main factor to gain trust of higher education institution users in adopting open science. There are seven main components that would influence trust of higher education institution users to adopt open science, which are : (a) data quality; (b) data security; (c) data architecture; (d) metadata; (e) data lifecycle; (f) data storage and infrastructure, and (g) data pricing. Establishing good data governance in the context of open science will give more confidence among researchers and users in higher education institutions to adopt open science as part of their research cycle.

This paper also provides theoretical advancement for trust literature, which is by examining the data governance taxonomy towards open science via trust, it gives understanding on how data governance develops trust among higher education institution users to adopt open science. Gaining trust is one of the most challenging in adoption behavior, so the understanding of data governance influence will provide the fundamental understanding to the researchers.

CONCLUSION

The provided propositions help researchers to understand how data governance dimensions (a) data quality; (b) data security; (c) data architecture; (d) metadata; (e) data lifecycle; (f) data storage and infrastructure, and (g) data pricing influence trust among higher education institution users to adopt open science in their research cycle. The identification of how each dimension of data governance influences trust in adopting open science among higher education institutions will give insight to the data owners and data providers to facilitate the needs of higher education institution users in adopting open science. We conclude that high data governance practice by data owners and providers will gain trust among higher education institution users to adopt open science in their research.

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Uncovering the Publication Trends and Pattern of Responsible Open Science Research: A Bibliometric Review

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ABSTRACT

This research employs bibliometric analysis as a methodology to investigate the ethical ramifications associated with open access publications. The dataset employed in this study is sourced from the Scopus database, hence offering a comprehensive range for analysis. The primary aim of this research is to provide a thorough and comprehensive analysis of the complex ethical problems that are intertwined with the practice of open access publishing. To accomplish this task, a comprehensive literature and bibliometric analysis was conducted on a dataset including 210 documents. This study employs bibliometric techniques, such as bibliometric coupling, text mining, factorial analysis and thematic clustering to do a quantitative examination of various elements within the chosen materials. The aforementioned characteristics encompass authorship patterns, trends in citations, collaborations among co-authors, categorization of documents, and the creation of themed maps. The approach utilized in this study involves a comprehensive examination of bibliographic data, citation patterns, text mining, thematic mapping, cluster analysis, and co-authorship networks to elucidate the intricate network of ethical concerns linked to open access publications. This study seeks to utilize exploratory analysis and network visualization approaches to uncover emergent themes, ascertain key contributors, and assess the influence of research entities on the advancement of ethical discourse within this specific domain. The findings of this bibliometric analysis contribute to the scholarly understanding of ethical quandaries and discussions within the field of open access publication. The capacity to identify novel trends and established domains of emphasis enables scholars, professionals, and decision-makers to attain a holistic comprehension of the dynamic ethical landscape in the domain of open science. These observations hold relevance for enhancing ethical practices, fostering transparency, and cultivating responsible behavior within the broader framework of open access publication.

Keywords: Open Science; Ethics; Responsible Publishing; Bibliometric; Text Mining

INTRODUCTION

The concept of open science encompasses a movement that promotes the dissemination of scientific data, methodologies, and outcomes in an open and accessible manner (Amsen, 2015). In recent years, there has been an increasing recognition among researchers of the advantages associated with open science, including enhanced openness, reproducibility, and collaboration (Van Noorden, 2013). In the scientific community, the notion of "responsible open science research" is becoming more and more popular (Ramachandran et al., 2021). Although responsible or ethical open science research has many different definitions and interpretations, generally it refers to the concepts of promoting ethicality, transparency and collaboration in research along with providing open access to scientific knowledge (Ramachandran et al., 2021). Open access publishing, preregistration of studies, open data sharing, and the dissemination of research materials are all included in the concept of "responsible open science research" (Cook et al., 2021).

Open access publishing is widely regarded as a vital element of the open scientific paradigm. Open access publishing is a scientific publishing model that promotes unrestricted access to research articles, allowing users to freely read, download, and reuse them for diverse purposes. Tracz and Lawrence (2016) argue that this specific strategy has the potential to improve the availability of scientific knowledge to a wider audience, including researchers, policymakers, and the general public.

The incorporation of open science into responsible research and innovation has positioned it as a defining characteristic of ethical research across diverse settings, including higher education institutions and numerous governmental and non-governmental research groups. There is a noticeable trend among researchers, organizations, and professional bodies towards adopting the essential principles of this program. The core concepts of the program are being more widely acknowledged within the research community (Samuel & Lucivero, 2020).

Nevertheless, it is crucial to acknowledge that open access publication is not without its ethical considerations, as highlighted by Schöpfel et al. (2020). Certain researchers have expressed apprehensions on the possibility of predatory open access publishers exploiting scholars through exorbitant publication costs. Moreover, there was apprehension regarding the potential impact of open access publishing on the caliber of scientific research. In addition, an increasing number of research publications are embracing the Open Data policy, which involves the requirement or encouragement for researchers to share their data with the public. However, the dissemination of public data in the age of digital technology has the capacity to undermine the confidentiality of individuals, thereby discouraging them from voluntarily divulging information.

The present work utilizes bibliometric approaches, specifically bibliometric coupling, text mining, and factorial analysis, to conduct a quantitative analysis of different components within the selected materials. The elements comprise various aspects such as authorship patterns, citation trends, co-author collaborations, document classifications, and thematic

grouping and factorial analysis. The findings of this research provide valuable perspectives on the ethical implications linked to open access publishing. The data provided in this context has promise for its application in the development of policies and execution of protocols that promote the progression of accountable open science research.

Objectives of the Study

The main objective of this research is to provide a thorough and comprehensive analysis of the complex ethical problems that are closely linked to the practice of open access research. The present study will employ bibliometric analysis as a methodological approach to investigate the ethical considerations associated with open access articles. The dataset employed in this study is obtained from the Scopus database, offering a comprehensive range for analysis.

Research Questions

RQ1.How have Responsible Open Science Publication research trends evolved?
RQ2.What are the leading Journals, Publications, Countries and Authors in the field of Responsible Open Science research?
RQ3.What are the leading thematic research clusters and dimensions in the research domain?

METHODOLOGY

We have applied bibliometrics technique to improve our understanding of our topic. In academic disciplines with a large volume of scholarly publications, bibliometric analysis is better than qualitative analysis, especially when examining structural relationships in the relevant literature. Our bibliometric analysis relies on data retrieved from a reliable database i.e. Scopus (Al-Khoury et al., 2022; Julius, 2021).

Two popular software programs, Biblioshiny and VOS-viewer, helped us with the inquiry. These applications help us to perform bibliometric analysis on scholarly publications, authors, journals, and keywords. The platform displays citation networks, co-authorship networks, keyword co-occurrence networks, network visualization, factorial analysis, text mining and thematic mapping (Cobo et al., 2011; Zhu et al., 2019).

Search Strategy

For this study, we put together our datasets using a Scopus database. This research included the articles published in English, Chinese, Croatian, Spanish. The research objective was to classify publication on ethical concerns related to open science publishing. We initially began by searching for the pertinent article by using keywords such as "Open access Publishing" AND "Ethics* OR "responsible" AND "Open Science".

The process of gathering data to identify pertinent research papers associated with ethical/responsible open access publishing is shown in Figure 1
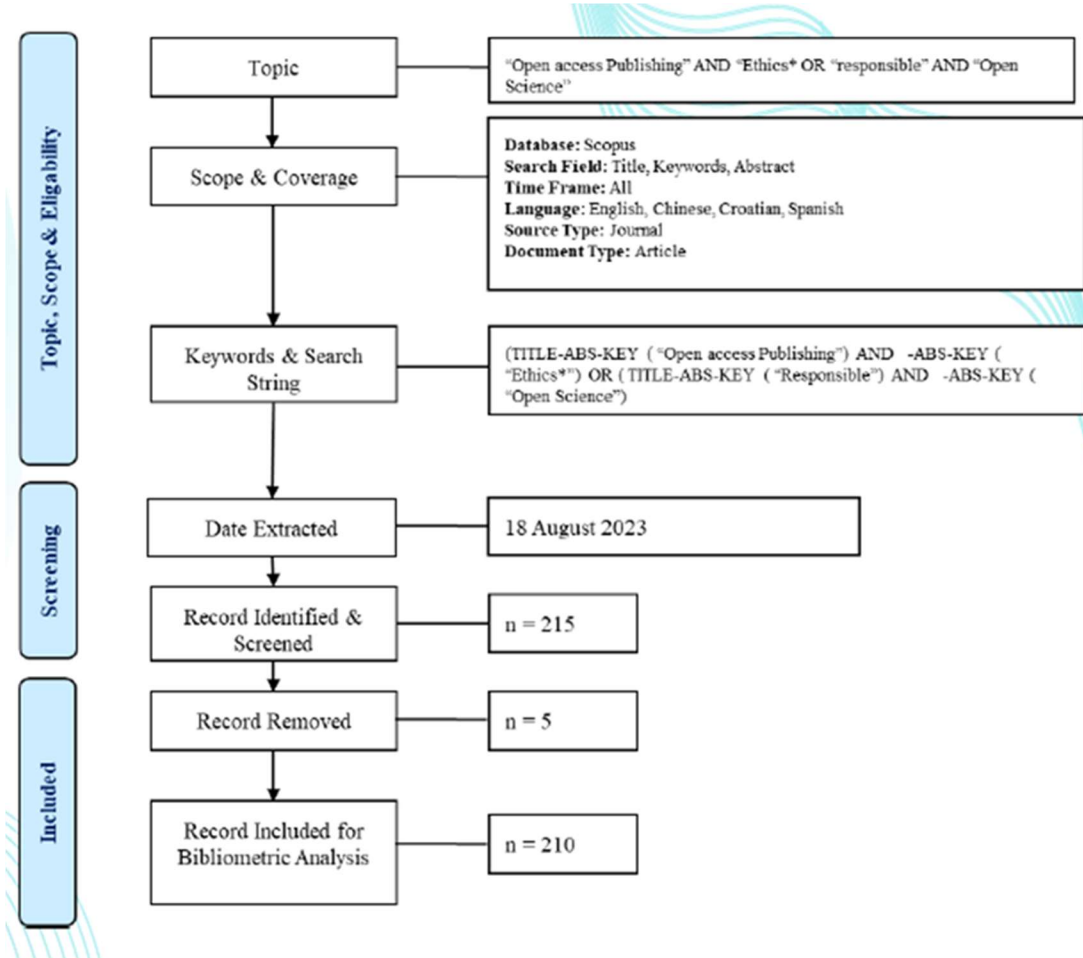
Figure 1: Search strategy

FINDINGS AND DISCUSSION

In order to address the RQ.1 we have used the Biblioshiney software and crafted the whole research canvas and publication trendline to uncover how the research has evolved in this field.

Figure 2: Research Canvas

Figure 2 visualizes the research done in the field of responsible open science publishing in Web of Science on a canvas. The research started in the field in 2004 and till now (2023) the trend still exists. There are a total of 157 journals that publish research on this topic. The annual growth is 14.45%, and average document age is 4.66 years and 11.33 citations. There are a total of 210 documents, and 748 authors contributed. 20% of the publications have international co-authorship, and there are 242 author's keywords.

Publication Trend
The Figure 3 presents the distribution of papers over different years, offering valuable insights into the evolving trajectory of research efforts within this topic.

Figure 3: Publication Trend

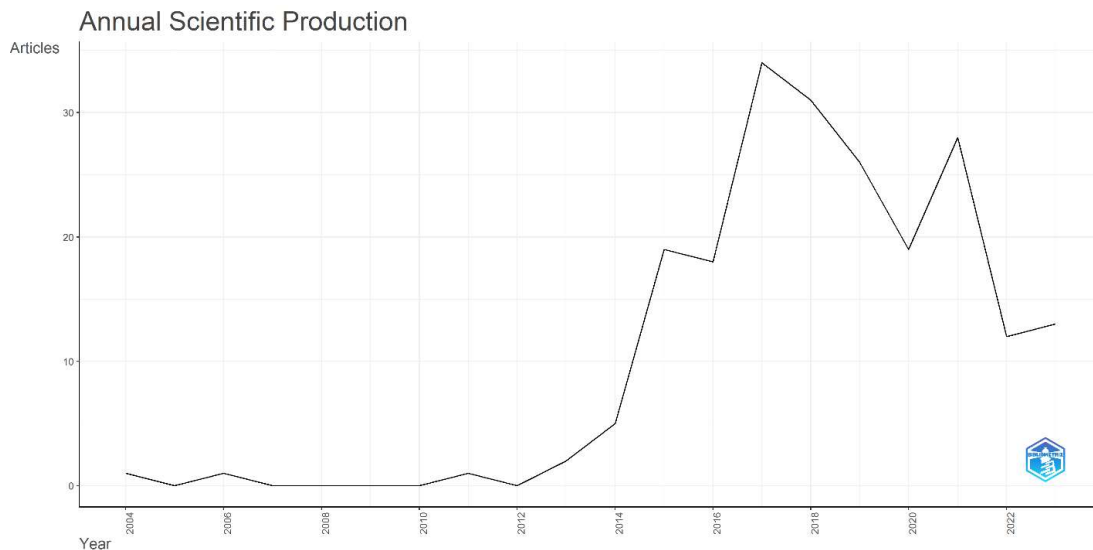Beginning in 2004 with just one paper, the investigation of an ethical and responsible open science framework rapidly gained momentum. The next years witnessed sporadic involvement up until 2013, when the trend experienced a notable acceleration following the publication of two works. A major increase in research activities followed, which was evidenced by a consistent rising trend in the number of academic articles published each year.

The number of articles significantly increased to five in 2014, demonstrating a growing understanding of the moral implications of releasing open research. The quantity of published works also expanded quickly in the years that followed, giving this phenomenon more momentum. With 19 articles published in 2015 and 18 articles published in 2016, there was a noticeable increase in the number of papers published between those two years.

The peak of this ascending trend occurred in 2017, when there were a total of 34 articles, a significant increase in the number of publications. This rise in scholarly production suggests more academic awareness of and interest in the moral issues surrounding open access to scientific publications. In the year 2018, there were a total of 31 articles, while the following year, 2019, there were 26 items. Furthermore, there has been a continuous interest in the subject matter in the years that followed, as seen by the continued publishing of pieces on a regular basis.

In spite of some variations, the year 2021 saw the publishing of 28 publications in the topic, therefore highlighting the enduring importance and durability of the nexus between open research publication and ethics. As of the present year, 2023, the prevailing pattern persists, with a total of 12 papers having been published so far. This signifies that the ongoing discussion pertaining to ethical issues in the realm of open research publishing continues to endure and undergo development.

To address the RQ.2 we have applied the bibliometric coupling technique to uncover the top publications, authors and countries in the field. And to understand the top journals we have applied Bradford's law.

Top Publication
The table 1 shows the top 10 publications in the field of ethical open science research, based on the norm citation score. The paper "The gender gap in science: How long until women are equally represented?" by Holman et al. (2018) has the highest number of total citations (372) and 16.84 norm citations. This study utilizes quantitative methodologies to forecast the temporal horizon at which women may attain parity in diverse scientific domains, drawing from prevailing patterns and trajectories. This study makes a valuable contribution to the continuing discourse surrounding gender equality, diversity, and inclusivity within the scientific community. It provides insights into the extent of development required to effectively tackle gender discrepancies in the field of science. The study utilized data obtained from the National Science Foundation's Survey of Doctorate Recipients to monitor the level of female representation within the fields of science, engineering, and medicine (STEM) for the period spanning from 1973 to 2015. The study revealed that there has been a notable increase in the proportion of women in STEM fields, rising from 28% to 40% throughout the

specified time frame. Nevertheless, there has been no significant change in the proportion of women occupying the most lucrative and prestigious positions within STEM fields. As an illustration, the proportion of women occupying tenure-track professor jobs in the fields of science and engineering has shown a modest rise from 23% to 28% throughout the specified timeframe.

Table 1: Top Publications

Title	Author, Year, Journal	Total Citations	Norm TC
The gender gap in science: How long until women are equally represented?	(Holman et al., 2018), PLOS BIOL	372	16.84
Stop this waste of people, animals and money	(Moher et al., 2017), NATURE	169	10.7
Archiving Primary Data: Solutions for Long-Term Studies	(Mills et al., 2015), TRENDS ECOL EVOL	88	7.67
Problems and challenges of predatory journals	RICHTIG G, 2018, J EUR ACAD DERMATOL VENEREOL	85	3.85
Predatory Publishing, Questionable Peer Review, and Fraudulent Conferences	BOWMAN JD, 2014, AM J PHARM EDUC	82	3.98
How predatory journals leak into PubMed	MANCA A, 2018, CMAJ	64	2.9
The Post-Embargo Open Access Citation Advantage: It Exists (Probably), It's Modest (Usually), and the Rich Get Richer (of Course)	OTTAVIANI J, 2016, PLOS ONE	48	2.72
Knowledge sharing in global health research – the impact, uptake and cost of open access to scholarly literature	SMITH E, 2017, HEALTH RES POLICY SYST	48	3.04
Ethical issues in publishing in predatory journals	FERRIS LE, 2017, BIOCHEM MED	45	2.85

The study also revealed that the disparity in representation between genders in STEM fields is not consistent across all academic areas. There exists a disparity in the representation of women throughout academic disciplines, with a higher likelihood of their presence in the biological and social sciences, and a lower likelihood of their representation in the physical sciences and engineering.

This paper is followed by "Stop this waste of people, animals and money" by Moher et al. (2017) (169 citations, 10.7 norm citation). This paper examines the prevalent problem of

research waste and inefficiency within the scientific community. The authors draw attention to the concerns surrounding the misallocation of resources, encompassing human labor, animal subjects, and financial investments. These concerns arise from a multitude of causes, including insufficient reporting, subpar study design, and the presence of publication bias. The issue of research waste is a substantial challenge within the scientific domain. The term "research waste" pertains to the superfluous or ineffective utilization of resources in the process of doing, reporting, and disseminating research. Waste can manifest in various forms, encompassing the utilization of incorrect procedures in research studies, the exclusion of crucial data, and the non-publication of unfavorable or inconclusive findings. Furthermore, the authors believe that Predatory journals are characterized by their susceptibility to manipulation. The acceptance of publications by these journals appears to be mostly independent of their quality, while their fees are significantly lower compared to those imposed by established open-access journals. The scholarly publishing firms in question are alleged to engage in opaque practices, generating revenue through fee collection without fulfilling their purported commitment to open access. Furthermore, these institutions are accused of neglecting essential functions such as peer review and archiving.

On the third position we have "Archiving Primary Data: Solutions for Long-Term Studies" by Mills et al. (2015) (88 citations, and 7.67 norm citation). The study examines the difficulties and resolutions associated with the preservation and dissemination of original data derived from extensive scientific inquiries. This work makes a valuable contribution to the ongoing discourse surrounding data management, reproducibility, and the responsible conduct of research. Its primary objective is to enhance the value and impact of long-term studies within the scientific community. Many biologists have welcomed the recent tendency in academic journals to mandate open access to source data that is included in articles. However, this development has raised concerns among researchers involved in long-term ecological and evolutionary studies. A global study conducted among 73 principal investigators (PIs) engaged in long-term research unveiled a prevailing inclination towards data sharing, particularly when the PI is involved or has given consent. Notably, an overwhelming majority of 93% of PIs have consistently engaged in the practice of data sharing in the past. A mere 8% of respondents voiced support for unregulated and unrestricted access to primary data, but a significant majority of 63% expressed substantial apprehension on this matter. In this discourse, Authors convey the perspective of the authors regarding a matter that holds significant scientific implications. Authors also examine the prospective expenses associated with the preservation of public data, while also presenting viable resolutions to effectively address the requirements of academic publications and researchers.

Top Journals

Bradford's Law is used to identify a discipline's top 10 sources in the table below. Bradford's Law divides scientific literature by topic into circular zones. Although these zones have fewer sources, they contribute to a large percentage of published articles. In this framework, zones are defined by the frequency of articles from each source (see Figure 4). The Table 2 below ranks the ten primary sources by field impact in decreasing order. It includes their rankings, frequencies, cumulative frequencies, and zones. First is "BMJ OPEN," with 16 articles in the field. The only source in Zone 1 is it. The next notable source is "NATURE," ranked 2. This

source has 13 articles, a cumulative frequency of 29. "NATURE" is also in Zone 1. Three and four articles from "PLOS ONE" contribute to Zone 1's 33 frequency.

Table 2: Top Journals

| Journal	Rank	Freq	cumFreq	Zone
BMJ OPEN	1	16	16	Zone 1
NATURE	2	13	29	Zone 1
PLOS ONE	3	4	33	Zone 1
BIOCHEMIA MEDICA	4	3	36	Zone 1
JOURNAL OF KOREAN MEDICAL SCIENCE	5	3	39	Zone 1
JOURNAL OF THE EUROPEAN ACADEMY OF DERMATOLOGY AND VENEREOLOGY	6	3	42	Zone 1
TRENDS IN ECOLOGY AND EVOLUTION	7	3	45	Zone 1
AMERICAN JOURNAL OF MEDICINE	8	2	47	Zone 1
CLINICAL AND EXPERIMENTAL DERMATOLOGY	9	2	49	Zone 1
CURRENT MEDICAL RESEARCH AND OPINION	10	2	51	Zone 1
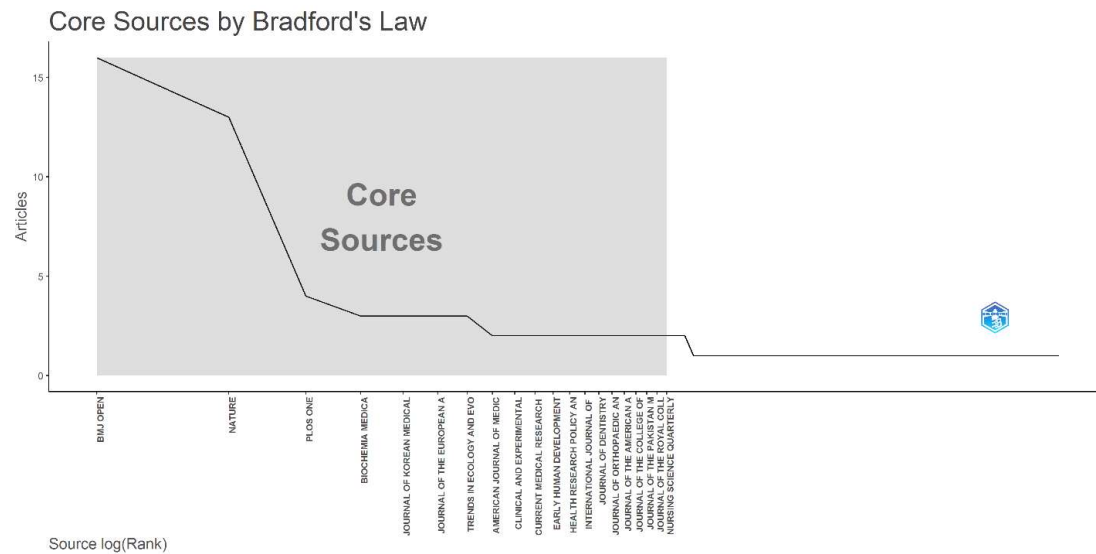
Figure 4: Top Sources Based on Bradford's Law

Corresponding Author Countries

The data (see Figure 5) offers valuable insights into the collaborative patterns observed in corresponding authorship across many nations, showing the widespread global engagement and collaboration in research pertaining to ethical considerations in the realm of open access publishing.
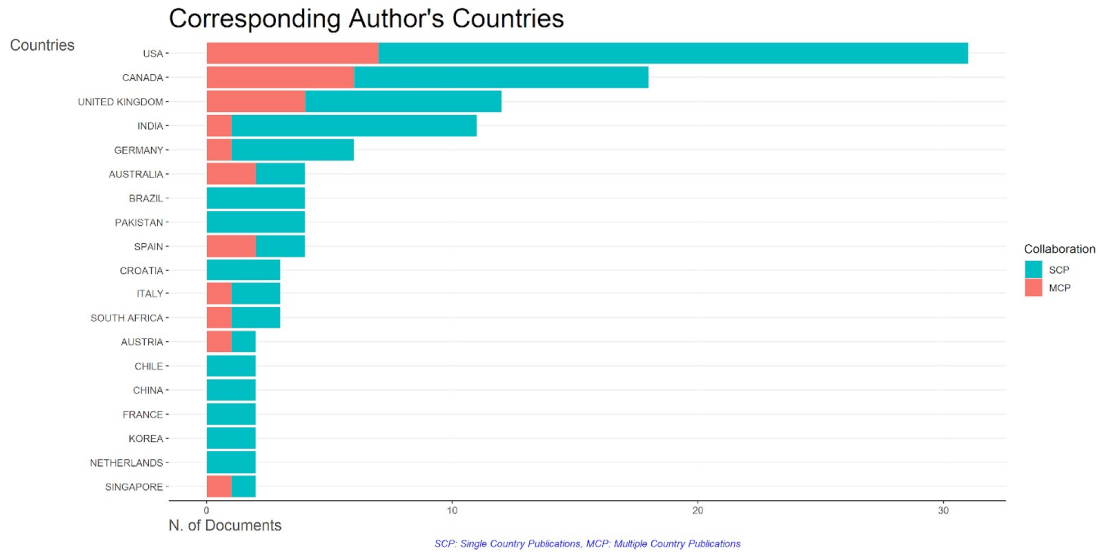
Figure 5: Corresponding Author's Countries

The United States of America (USA) has the biggest quantity of papers, totaling 31, encompassing a combination of single-authored articles (24) as well as works with multiple corresponding authors (7). The MCP ratio, with a value of 0.226, suggests that a significant proportion of papers originating from the United States involve collaborative efforts among many corresponding authors. Canada has a total of 18 articles, of which 12 are attributed to a single corresponding author, while the remaining 6 pieces have multiple corresponding authors. The MCP ratio exhibits a rather high value of 0.333.

To address or RQ.3 we have applied thematic mapping and factorial analysis using Vos, Viewer and Biblioshiny to uncover the leading thematic research clusters and dimensions in the research domain.

Thematic Clusters

We have applied text mining techniques, utilizing VosViewer and Biblioshiny (R studios) software to drive the network visualization (see Figure 6) clusters and thematic mapping.

Figure 6: Network Visualization based on Text Data

Using VosViewer text mining to extract publication titles, abstracts, and author keywords, the following clusters were formed (Figure 6).
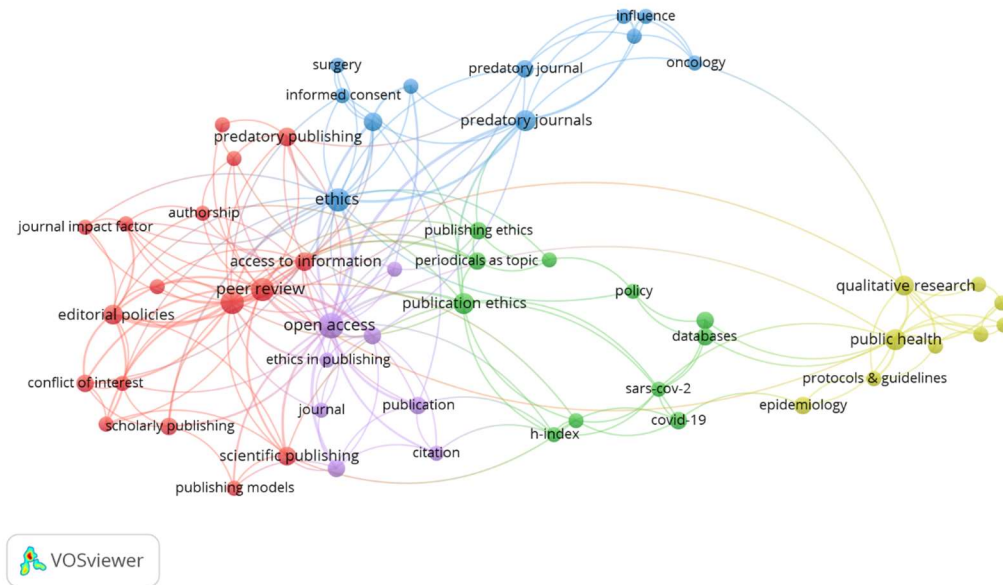
Cluster 1 Publishing and Ethics:
Ethical issues in open access publishing are central to Cluster 1. The publication process involves authorship, conflict of interest, peer review, publication ethics, and scientific misconduct. The presence of "open access journals" and "open access publishing" suggests a commitment to ethical research and transparency. This cluster emphasizes ethical standards for responsible and reliable open access articles.

Cluster 2 Emerging Research and COVID-19:
While not directly related to open science ethics, this cluster includes growing research domains like the pandemic. Ethical considerations are crucial for rapid scientific progress during crises. "COVID-19," "policy," and "SARS-CoV-2" may involve ethical issues related to research prioritization, data exchange, and information transmission. Transparent and influential research is morally required to address global issues, according to this cluster.

Cluster 3 Health and Research:
This cluster includes ethical considerations for open access publication, focusing on health-related topics. Medical research, especially community child health, epidemiology, and public health, emphasizes ethical conduct and dissemination. The ethics of careful study design and data collection are stressed in "research" and "qualitative research". This cluster emphasizes

the ethical obligations of ensuring the precision and ethical reliability of open-access health research.

Cluster 4 Impact and Communication:
This cluster emphasizes the ethical responsibility of writers and publishers to communicate research findings and effects openly. "Citation," "journal impact factor," and "predatory" are related to ethical research evaluation and avoiding unethical behavior. Thus, "scholarly communication" emphasizes the need for ethical communication protocols in open access materials, which fosters research community collaboration and responsibility.

Cluster 5 Ethics and Research Integrity:
Despite its diversity, Cluster 5 is ethically significant in responsible open access publishing. The terms "informed consent," "knowledge," "ethics," and "research management" emphasize the importance of ethical research, informed participant consent, and responsible data management. This cluster addresses the central issue of ethical considerations in open access publishing by strengthening research ethics regardless of focus.

Factorial Analysis
Factorial analysis output with two dimensions is interpreted in Figure 7 and Table 3. Open access and predatory publishing conflict in the first dimension. The left side of the axis includes "open access" and "publishing ethics"—terms closely related to open access publishing. This publishing model wants to make research articles freely available to everyone. The right-hand terms, "predatory journals" and "conflict of interest," refer to predatory publishing. Predatory publishing exploits researchers by charging them for article publication in low-quality journals.

Second dimension: Second, ethical considerations conflict with the potential consequences or influence of a given action or decision. The uppermost phrases on the axis, "ethics" and "publication ethics", represent publishing ethics. The lower end of the axis, "impact factor" and "h-index", measure research influence.

The two dimensions represent the different open science publishing perspectives. One ethical issue in scholarly publishing is the risk of predatory practices and the need to maintain research integrity. Advantages include improved research accessibility and quality. Open science publishing perspectives can be understood using factorial analysis. It can also help develop ethical strategies for open science publishing and promote its benefits.
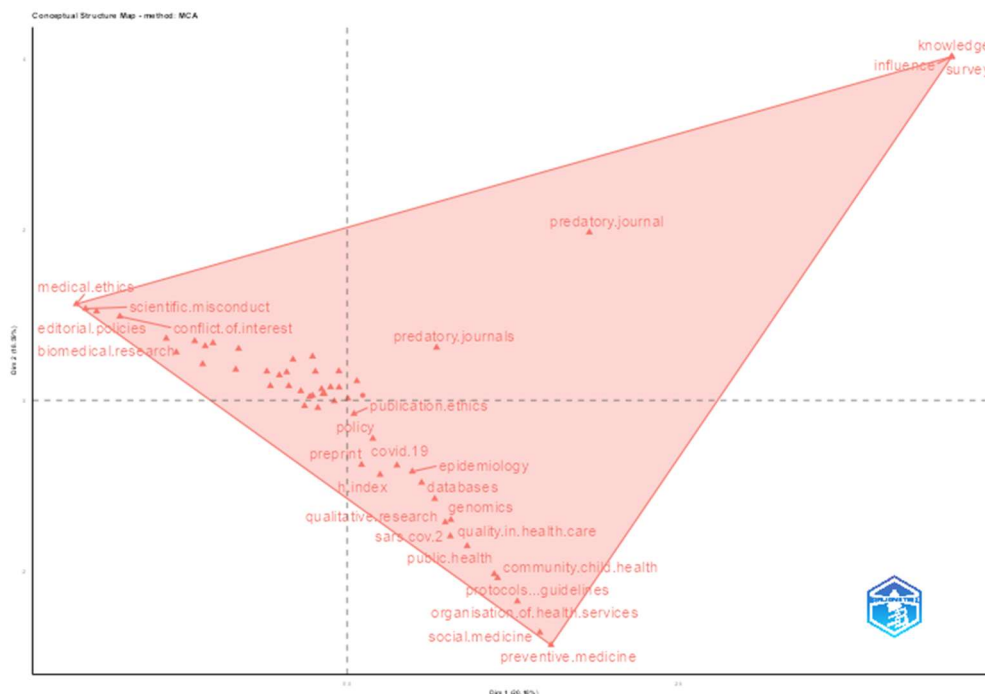
Figure 7: Factorial analysis

CONCLUSION AND RESEARCH IMPLICATIONS

The bibliometric analysis of the ethical implications of open science publications is a valuable first step in understanding this important topic. The findings of this study can be used to inform the development of future research in this area and to help ensure that open science is conducted in a responsible and transparent manner.

The bibliometric analysis undertaken on the ethical ramifications of open science publications has provided valuable insights into various noteworthy trends. The noticeable rise in the quantity of scholarly articles pertaining to this topic highlights a growing acknowledgment of the ethical intricacies inherent in the practice of open science. The inclusion of prominent journals such as BMJ Open, Nature, and PLOS ONE, along with notable authors (top publications) signifies the significant influence that these stakeholders exert in shaping discourse surrounding ethical considerations in the realm of open science.

The discourse has identified several focal points, including thematic clusters centered on ethics in publishing, the influence of emerging research and COVID-19, health-related research, impact and communication, and the ethical foundations that underpin research integrity. Factorial analysis has revealed two prominent dimensions in the field under study. The first dimension pertains to the conflict between open access and predatory publishing, while the second dimension focuses on the intricate interplay between ethical considerations and the potential consequences resulting from decision-making processes. Moving forward, the results emphasize the importance of developing thorough ethical principles that

guarantee the diligent and transparent implementation of open science. The establishment of responsible and ethically sound open science practices is of utmost importance within the scholarly community. This collaborative effort is necessary to cultivate a research environment that promotes both innovation and integrity.

The bibliometric analysis pertaining to the ethical ramifications of open science publications carries significant consequences for academics, professional librarians, and other relevant stakeholders. The study underscores the significance of ethical considerations in the context of open science publishing for researchers. It is imperative for researchers to possess a comprehensive understanding of the potential ethical dilemmas associated with open science publication, including the inherent risks of predatory publishing and the imperative to uphold research integrity. Researchers should possess knowledge of ethical norms pertaining to open scientific publication and should make efforts to adhere to these guidelines while disseminating their research findings.

For individuals working in the field of librarianship who possess the necessary qualifications and experience: Librarians possess the capacity to actively engage in the dissemination of knowledge pertaining to the ethical dimensions associated with open science publication, thereby contributing to the education of researchers in this domain. The authors have the capacity to furnish comprehensive insights regarding the diverse ethical quandaries implicated, encompassing the likelihood of predatory publishing and the paramount significance of sustaining study integrity. In addition, these platforms can assist researchers in locating and implementing ethical rules pertaining to the publication of open science.

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Unveiling Open Data Pakistan: Assessing the Availability, Accessibility, and Readability of Open Data Portal

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ABSTRACT

Open data portals are being introduced by many countries, offering data that anybody may access and use and repurpose. This study aims to evaluate the readability of datasets from "Open Data Pakistan" along with their availability and accessibility. The URL of Open Data Pakistan (https://opendata.com.pk/) was used as an input in an online readability checking tool (https://www.webfx.com/tools/read-able/) which produced the values of six well-known readability formulas as output including; Flesch Kincaid Reading Ease, Flesch Kincaid Grade Level, Gunning Fog Score, Smog Index, Coleman Liau Index, and Automated Readability Index. The average score of each formula was determined to analyze the standard readability of the open data portal. Further, the website was explored to evaluate the overall status of open data sets, showcases, and other features i.e. "Connect" of Open Data Pakistan. The findings indicated that the Open Data Pakistan website has a reading difficulty of 47.4 out of 100 on average. It indicated that it is hard for the general public to read. Further, the overall analysis of the portal directed that citizens have satisfactory access to and availability of open data. These findings provide insights into how open data can be made more accessible to encourage active participation and empower citizens to make informed decisions. Further, this study has implications for policymakers and stakeholders about the readability, availability, and accessibility challenges in open data. It also highlights the significance to consider readability and availability of open data publication policies and guidelines. It is recommended that the percentage of open data portals in the hard-to-read category be decreased, hence improving the information resources' accessibility.

Keywords: Open Data Pakistan, Availability, Accessibility, Readability, Open Data Portal

INTRODUCTION

In the era of data-driven decision-making and digital transparency, open data initiatives have emerged as a pivotal means to democratize information and foster greater citizen engagement. Governments, organizations, and institutions worldwide are embracing the

concept of open data, making non-sensitive data freely available to the public through dedicated platforms known as open data portals (Davies and Bawa 2012). These portals serve as gateways, providing citizens, researchers, policymakers, and businesses access to vast repositories of information that can drive innovation, enhance public services, and promote evidence-based policy development (Kitchin 2014). It has been asserted that open government data is crucial for fostering social control over the implementation of public policies, the use of general resources, government translucency, measures to combat corruption, legal action, and the development of cutting-edge data-driven apps for social good (Kozievitch et al. 2022). With the growing importance of open data portals as key resources for harnessing actionable insights, it becomes crucial to assess their effectiveness in adhering to fundamental principles such as availability, accessibility, and readability (Zuiderwijk et al. 2012).

Availability, the first critical aspect of public data portals, revolves around exactly how much these platforms offer comprehensive and up-to-date datasets. Institutions, organizations, and individuals can all find, share, combine, and reuse government information material thanks to the expanding availability and ongoing development of information technologies (Dawes 2010). According to Gurstein (2013), information should be made freely available in its whole, in inconvenient and flexible machine-readable formats, and for no more than the cost of its replication. Assessing the availability of data on open data portals is essential for understanding the breadth of information available to the public and identifying areas where improvements may be necessary (Zuiderwijk et al. 2015).

The second aspect of interest, accessibility, emphasizes the ease with which users can find, retrieve, and comprehend data presented on open data portals (Zuiderwijk et al. 2015). The goal of accessibility is to provide a way to get over barriers that prevent people from retrieving knowledge, provide photos with alternative text for those with eye impairments, give keyboard control as a choice to people with mobility difficulties, etc. (Lazar et al. 2010; Olalere and Lazar 2011; Reis et al. 2013). Studies have explored user experiences and challenges faced in navigating vast datasets, as well as language barriers and potential biases in data representation (Zuiderwijk et al. 2012).

The readability of a piece of writing determines how simple or complex it is to read and comprehend. Data processing produces information, and information is only useful when it can be understood. To make the contents accessible to a wide range of people, it is crucial to assess the readability of web pages (Ismail et al. 2019). A key mathematical formula for predicting the reader's level of comprehension of written content is the readability measure. An evaluation of readability describes how simple it is to give the reader content. A text document's readability score affects both the content's accessibility and reading speed. When a document's text is subpar, it takes the readers longer to understand it (Akgül 2022). Previous research has explored the use of data visualizations and data schemas in facilitating better comprehension and utilization of open data (Kitchin 2014). Designing websites with usability, accessibility, and readability in mind is especially important for government websites because they attempt to inform potential users about e-services. Websites with poor design have a

negative impact on usage and encourage less online interaction. (Akgül 2019; Baker 2009; Clemmensen and Katre 2012).

Open government data (OGD) encourages collaboration across government departments, civil society organizations, academia, and the corporate sector. It enables the co-creation of solutions to social difficulties through the use of communal knowledge and skills. OGD is the idea of making publicly available, publicly created data in a machine-readable and easily accessible manner. It entails making available datasets, papers, and other material gathered and maintained by government entities, with no constraints on reuse. Transparency, accountability, and citizen involvement are the fundamental goals of open government data. Even though open data has a potential economic value measured in the millions and billions, not all open data is recycled (Nikiforova 2021).

Open data is a common occurrence today. Open government data portals are being introduced by more and more countries, offering data that anybody may access and use for their purposes. Considering that open government data (OGD) enables citizens to track the effectiveness and leadership of the government, this not only supports decision-making based on facts but also directly affects how individuals perceive the government and their trust in it. Governments are considered to be the primary benefactors of "GovTech," wherein government transparency and OGD policies are being created to facilitate citizens to access information and engage with the government. Civic Tech, on the other hand, consists of several initiatives that use OGD to serve the general welfare (Yoshida and Thammetar 2021). This necessitates the openness of "correct" or "accurate" data, i.e., information that will be valuable to consumers as well as to governments that will enable data opening and take advantage of it.

Researchers have looked into three more key issues that are mentioned in accessibility studies and that have an impact on users' access to websites that provide information. Websites are evaluated based on their readability, performance quality, and usability. Trust is essential for accessing e-government services since it enables websites to be utilized for e-government (Huang et al. 2009). However, usability, accessibility, and readability issues plague e-government websites frequently (Ho 2002; Youngblood and Mackiewicz 2012). These websites' readability, availability, and accessibility criteria are critical. If the contents offered are of high quality and easy for the great majority of people to grasp, the internet might remove obstacles to public access to quality information and, as a result, reduce disinformation. Websites run by the government or other organizations should be trusted sources for the general public. These websites' readability and quality scores are very important because, if the presented materials are of high quality and simple to understand by the vast majority of people, the internet may remove obstacles to public access to health information and, as a result, eliminate misinformation (Fogel et al. 2001).

It was found that no study exists on the availability, accessibility, and readability evaluations of open data in Pakistan. Therefore, the evaluation of open data in Pakistan is not adequately covered in the literature. This study proposes to evaluate the readability of datasets of "Open Data Pakistan" along with the evaluation of the availability and accessibility of datasets,

showcases, and status of data. It also measures the facility for comments, complaints, feedback, and suggestions in an open data portal.

This study proposed the subsequent research questions:

RQ: What is the accessibility, availability, and readability status of datasets of Open Data Pakistan?

LITERATURE REVIEW

The transmission of information and services to people is easier, faster, and more effective thanks to Web-based apps and the Internet, which also improve organizational effectiveness (Verkijika De 2018). Websites now play a novel role in communication among governments and their constituents as a platform and medium for sharing information, better access, delivering service, and transformation interactions with the public, other branches of government, corporations, and other stakeholders (Jun et al. 2014; Pérez-López 2015).

Availability of Open Data

The Public Sector Initiative (PSI), which contains guidelines for open data availability, accessibility, and openness, is adhered to by the majority of European nations. The only country that addresses data use and offers tactics to guarantee that data is widely and freely available to public bodies in society (Schauppenlehner and Muhar 2018).

Fernández et al. (2021) examined the COVID-19 open data that had been made available by the Spanish regions, along with the Ministry of Health. It was discovered that the Ministry of Health, as well as 15 regions of Spain, disclosed open data relating to COVID-19. Although the information displayed varied from one autonomous community to another on the open data portals, the areas included information that was PCR verified. The data were found to be plentiful and in reusable formats, however, the user had to consult a variety of sources to learn about the epidemiological situation at a national level.

The completeness and quality of the metadata are extremely crucial, Schauppenlehner and Muhar (2018) explained how two significant European and Austrian metadata platforms demonstrated that quick access to data and information was not guaranteed by the mere existence of metadata services. Open data policies typically refer to guidelines for making open data available, accessible, and transparent. The existing situation results in restricted access to open data for experts instead of general public access. Concerning the self-declared goals of contributing to society processes, both platforms performed miserably.

The degree of information disclosure on public websites is referred to as transparency or openness. To maintain transparency and openness at all levels of public values, governments post governance-related material online, such as financial statements and pertinent laws. With only 1% of documents or publications available, e-government Websites did the lowest in terms of the volume of material provided there. Websites received the highest rating (97%

of the possible points) for their capacity to offer various publications and documents. It was determined that the development of open data portals depends on the availability of data via websites (Akgül 2022).

Accessibility of open data

The accessibility of Internet pages is one of the most crucial components of offering public Websites equal access for anybody who can see, understand, browse, and connect to the Internet, including those with impairments (Akgül 2019; Verkijika and De 2018). According to Wibowo et al. (2021), the most crucial category in the semantic web data quality models is accessibility. OGD portals' accessibility is crucial for users in all respects (Nikiforova and McBride 2021).

Akgül (2022) found that the accessibility of Turkish e-government Websites was far from acceptable. Further, Verkijika and De (2017) examined 217 e-government websites and discovered that none of them entirely met the accessibility requirements. The bulk of the websites were found to have numerous accessibility problems. Máchová et al. (2018) found accessibility as a barrier regarding national open data. This issue has decreased the open data usability among stakeholders. Likewise, Austrian and European open data portals were analyzed by Schauppenlehner and Muhar (2018), who discovered significant conceptual flaws and discrepancies that severely restrict practical accessibility. More, Abanikannda et al. (2017) investigated how agricultural science researchers in South-Western Nigeria used open data and discovered accessibility problems with it.

Gill and Corbett (2017) used heuristic evaluation rules to assess the British Columbia OGD portals' usability and accessibility from a design standpoint. They explained how there are major impediments to the accessibility and usefulness of open data when consumers have trouble locating and interacting with it on a portal. According to Olalere and Lazar (2011), many websites have accessibility issues that were not intended to be there in the first place but were later added to web pages. The majority of today's e-government websites regularly update and modify their web pages, which means that they are not static. When available, the site accessibility statements are particularly beneficial to users since they offer a road map for understanding the site's degree of compliance, its features, and the procedures used. The results confirmed that the homepage of the government open data portals did not violate any accessibility laws.

Additionally, there are no meaningful text equivalents and the storm preparation information on the front page is inaccessible to those with disabilities. Sheoran et al. (2023) showed how open data databases may offer high-quality information, for example, specific road systems and infrastructure that are available, which is helpful for accessibility analyses. Additionally, accessibility maps include information that is rather simple to grasp, which might aid the stakeholders in starting conversations about current issues and suggesting additional solutions.

Readability of open data

Readability metrics have been applied to a variety of fields, including academia, patents, newspapers, government websites, and medicine. When a low-literate person reads a text document or web page for the first time, they assist in determining the level of readability and ensure the level of understanding of the material. Texts with polysyllabic words and lengthy, complex sentences, for instance, penalize inexperienced writers (Akgül 2021). W3.0rg provided guidelines for the readability of web content. This standard aims to make text material readable by users and assistive technology while also ensuring that the information required to interpret it is readily available.

Risoldi et al. (2012) compared the readability of customers' healthcare data on websites supported by the U.S. government to that on websites supported by private businesses. Three verified metrics— SMOG Formula, Flesch Reading Ease, and Flesch-Kincaid Reading Level — were employed to assess the web pages' readability. Mann-Whitney U test was applied to compare the average readability of websites supported by the government versus those supported by businesses. According to the Flesch-Kincaid Reading Level and Flesch Reading Ease tests, commercially financed websites were much more challenging to read. According to the SMOG Formula, there was no significant change. Consumer-oriented health information on the Internet had poor overall readability. Further, An appraisal of the readability of Indian open government data revealed that over 43.28 percent of them have language that is difficult to understand (Ojha et al. 2018). Turkish e-government websites had a very poor level of readability, as evidenced by the fact that state and local governments' websites received a FRES score of "difficult to read'' (Akgül 2019).

Akgül (2022) looked at the usability, readability, and public values of Turkish national-level open government Websites. Findings exposed that 12. 79 was the average Gunning Fog Index (GFI) score. This suggested reading levels suitable for the average college graduate. Similarly, Yeung et al. (2022) evaluated and compared the content's readability and quality of online materials on COVID-19 immunization that were published on official/governmental websites. The websites' typical Flesch Reading Ease score and Flesch-Kincaid Grade Level that answer frequently asked questions about vaccinations were 40.9 and 12.1, respectively. It was determined that the OCVID-19 vaccination's open data portals were not easily readable. Ismail et al. (2019) provided an analysis of the site rankings, readability, and accessibility of the top 20 government websites in India (N = 20). Six reputable strategies are used to gauge how readable the website's material is. These websites' readability scores were found to be within acceptable bounds. However, because the results are based on the United States grading scale, a national grading system concerning readability must be developed. Serry et al. (2023) assessed the readability of web pages from two websites run by the Victorian government that were intended for the general public and that were in charge of disseminating important health information about the COVID-19 pandemic in 2020. The resulting extent of text difficulty was greater than the degree of text difficulty that is normally based on levels for senior primary schools for health promotion materials. The target audience (public or professional) had no bearing on this. Effective engagement with the text posted on both sites required reading at the senior secondary level.

RESEARCH DESIGN

This study targeted datasets of "Open Data Pakistan". Datasets readability was evaluated by a measure (Flesch-Kincaid Grade Level and Flesch Reading Ease score). This readability metric, which is most frequently used, assigns an understanding level to the delivered English text on a scale from 0 to 100 points. The higher the score, the simpler it is to read and comprehend the information/data, and the harder to understand the content the lower the score. Higher grades indicate simpler reading material, with a typical 11-year-old easily understanding scores ranging from 90 to 100. Scores ranging from 60 to 70 are regarded as typical readability, easily comprehended by children between the ages of 13 and 15. Lower grades imply complex readings (Flesch 1948). Further, the Smog Index, Coleman Liau Index, and Automated Readability Index were also used to evaluate the readability of the open data portal of Pakistan.

Several previous studies also applied the Flesch-Kincaid Grade Level and Flesch Reading Ease, Gunning Fog Score, Smog Index, Coleman Liau Index, and Automated Readability Index to check the readability of open data portals (Akgül 2022; Ismail et al. 2019; Ojha et al. 2018; Risoldi et al. 2012).

The readability findings of the open data portals are produced by the online readability checking tool using the URL of the open data portal as input in May 2023. The values of six well-known readability formulas, including Flesch Kincaid Reading Ease, Flesch Kincaid Grade Level, Gunning Fog Score, Smog Index, Coleman Liau Index, and Automated Readability Index, were output by an online readability checking tool using the Open Data Pakistan URL (https://opendata.com.pk/). To evaluate the open data portal's standard readability, the average scores of each formula were calculated.

The researchers evaluated how many datasets exist, showcases, and the status of open data to check the availability and accessibility by visiting the website in May 2023. Further, each showcase was explored to respond to the study's research question.

RESULTS AND DISCUSSION

Current Status of the Open Datasets

The study found 837 datasets (818 secondary research and 19 primary research). The datasets belong to 14 categories including Public Safety, Economy & Finance, Health, Education, etc. from different locations of Pakistan such as KPK, Sindh, Baluchistan, Islamabad, Lahore Gilgit Baltistan, and Azam & Jammu Kashmir. Datasets are available in different formats i.e. CSV (439), XLSX (198), URL (19), XLS (14) DOCX (5), sav (2), DO (1) DTA (1), ZIP (50), PDF (173), XLS (14) HTML (1) PNG (1) PPT (1) and RAR (1). Additionally, 13 showcases were found on sports, health, gender, attacks, environment, climate, crime reporting, consumer, residential electricity consumption dataset, brain drain, COVID-19, and suicide bombings. Users can access the full datasets page by clicking on the launch website/preview or directly clicking on

the download button. There is a facility to view, download, share, add to favorites, and even nominate for Viz of the day for a showcase. Any user may view the number of views of a showcase. However, we cannot see the number of downloads and shares. Further, we may view comments if a data set has been commented on by users. These datasets are made available to the public for free, allowing individuals, researchers, and organizations to access and analyze the data. The availability of open data promotes transparency, accountability, and evidence-based decision-making in Pakistan.

Moreover, the open data provides the facility of "connect" for feedback, complaints, and suggestions regarding open datasets. However, this feedback or complaints are not visible to other viewers.

These findings show that Open Data Pakistan (ODP) has a good number of datasets from different fields of life. It also indicated that all Pakistan units represent datasets of ODP. Datasets are strengthened by the different formats, i.e. CSV, XLSX, URL, XLS, DOCX, sav. Users can easily access the complete datasets, which they can explore, download, share, and even submit as candidates for the Viz of the Day display. Open Data Pakistan offers the "connect" option for comments, complaints, and innovative ideas relating to open datasets. Open data accessibility encourages accountability, openness, and fact-based decision-making in Pakistan.

Readability Findings

A key mathematical formula for predicting the reader's level of comprehension of the written piece is the readability measure. An evaluation of readability describes how simple it is to give the reader content. A text document's readability score affects both the content's accessibility and reading speed. When a document's text is inadequate, it makes the readers understand it. The readability score was determined using the six formulas from the online readability checker tool, including the Flesch Kincaid Reading Ease, Flesch Kincaid Grade Level, Gunning Fog Score, Smog Index, Coleman Liau Index, and Automated Readability Index. This was done to analyze the readability of open data in Pakistan.

(a) Flesch–Kincaid Reading Ease (FKRE)
This readability metric, which is most frequently used, assigns an understanding level to the delivered English text on a point scale ranging from 0 to 100 (Table 1). The information is easier to read and understand the higher the score, and the harder to understand the content the lower the score. Higher grades indicate simpler reading material, with an average 11-year-old easily understanding scores between 90 and 100. Scores between 60 and 70 are regarded as typical readability, easily understood by children between the ages of 13 and 15.

Table 1: Flesch–Kincaid Reading Ease (FKRE): Text Readability Point Scale

Readability Score	Understandability level
90–100	Very Easy
80–89	Easy

70–79	Fairly Easy
60–69	Standard
50–59	Fairly Difficult
30–49	Difficult
0–29	Very Confusing

The readability score of FKRE is 47.4, which indicates that OPD's content is hard to read for the general citizens. Literature also supported this result and indicated that the FKRE score was above the average cut of value (Akgül 2019, 2022; Ismail et al. 2019; Serry et al. 2022).

(b) Flesch–Kincaid Grade Level (FKGL)
The essential metrics used by the Flesch-Kincaid Grade Level (FKG) and FRES are the same, however, a different weighting factor is used. An average eighth-grade student is thought to understand the topic if they receive a score of 8.2 (Kincaid et al. 1975). This method serves as a benchmark test for the US government's Defence department. This formula treats any grade value above 12 as being equal to grade value 12. A score of 5.0 likely implies grade school level and a score of 7.4 indicates that a typical 7th-grade kid can understand the content (Ismail et al. 2019). The FKGL's score of ODP is 7.8 indicating that the data readability is good. It provides evidence that readability is easily comprehended by the general public. The findings supported by the Ismail et al. (2019) and Risoldi et al. (2012) studies, however, some studies found FKGL score difficult to read for the average grade level public (Akgül 2019, 2022; Serry et al. 2022).

(c) Gunning Fog Index (GFOG)
The Gunning Fog Index (GFI) determines how many years of education are required to understand an English text after just one reading. The text readability statistic is based on the number of difficult words and the length of the sentences. A typical index would have six for the Bible, 10 for Time Magazine, fourteen for The Times Newspaper, and above than fifteen academic publications. Anything above 12 indicates texts that are too challenging for the majority of readers to understand, with a score of 7-8 being optimal (Gunning 1952).

Similar to the Flesch scale, the Fog Index measures words with three or more syllables based on their name. Anything above 12 on this index is too difficult to read, and a score of 7 or 8 is appropriate. That is, in general, a score of 5 is readable, 10 is hard, 15 is difficult and 20 is very difficult to grasp the text. It estimates the number of years of formal education required for first-time reading comprehension (Ismail et al. 2019). Table 3 shows the GFI score and grade level.

The findings of the average GFI readability assessment revealed that the average GFI score was 6.2. This suggested reading levels that a typical sixth grade could understand. This GFI score indicated that the readability of open data in Pakistan is easy to understand even for citizens having a sixth-grade education level based on word measures. The findings are also supported by Ismail et al. (2019). However, the others, (Akgül 2019, 2021, 2022) found that the GFI score was insignificant indicating hard to read for the general public.

(d) SMOG Index

The SMOG, or "Simple Measure of Gobbledygook," is an abbreviation. A readability test that pays close attention to word length to determine the amount of knowledge necessary for someone to read and comprehend the written word. The recommended score is 7, according to the WCAG (Web Content Accessibility Guidelines). The difficulty of reading grows as the number rises (Henry 2018).

The SMOG Index formula is thought to be suitable for secondary-age readers, or readers from the fourth grade to college level. The outcome, which is based on grade levels used in US schools, suggests that the average student who can read the material fits inside that scale. For instance, the typical 7th-grade student can understand the material with a score of 7.4 (Ismail et al., 2019). The score of the SMOG index for the OPD is 6.2. It indicated that the written text is easy to comprehend by secondary-age readers (13 and 15 age group). The findings are also supported by Akgül et al. (2019) and Ismail et al. (2019). However, Serry et al. (2022) findings did not support a minimum of 8.2, showing that the written text was hard to read for secondary-age readers. Further, Risoldi et al. (2012) study showed SMOG score was insignificant for the readers.

(e) Coleman Liau Index (CII)

Instead of syllables per word and sentence length, it is based on letters. To grasp the text, it also employs a US grade-based system. According to the character-based formula proposed by Coleman and Liau (1975), computerized evaluations of character understanding are easier and more accurate than counting syllables and sentence length (Coleman and Liau, 1975). Table 3 shows the details of the Coleman Liau Index (adopted https://clickhelp.com/).

The Coleman Liau Index score for the ODP is 14.8. This score indicated that the text was too hard for the majority of the readers. The findings are also supported by the literature (Ismail et al. 2019).

(f) Automated Readability Index (ARI)

It is derived from ratios that describe the difficulty of words and sentences. In addition to basing its output on the US grading level system, ARI provides a number that roughly indicates the age required to understand or comprehend the content (Kincaid et al. 1975). It demonstrates that if ARI outputs the number 10, that corresponds to a high school student, who is 15 to 16 years old; a number 3 indicates that third graders, who are 8 to 9 years old, should be able to understand the material. The ARI output score for ODP is 5.3. It indicated that students from grade 5 and above (ages 10-11 years) can comprehend the text. This also suggested that the citizens having 5th-grade education can read the datasets of ODP. The findings are also supported by the literature (Ismail et al. 2019).

Summary of the Readability Findings

The summary of the readability evaluation of ODP is shown in Table 2. The readability analysis of ODP shows that FKRE is 47.4, indicating that the content of ODP is challenging for the general public to read. Further, the FKGL score for Pakistan's open data is 7.8, which indicates

that the readability of the data is good. It demonstrates that readability is easily understood by the general audience. Moreover, according to the results of the average GFI readability evaluation, ODP has an average GFI score of 6.2. Based on word metrics, this GFI score revealed that the readability of ODP is simple to understand even for citizens with a six-grade education level. Open Data Pakistan has an SMOG index score of 6.2. It shows that secondary readers (those between the ages of 13 and 15) can easily understand the written text. Open Data Pakistan has a score of 14.8 on the Coleman Liau Index. This shows that the text is too hard for the majority of the readers. The ARI output score is 5.3. It suggested that students in grades 5 and up (about 10 to 11 years old) can understand the text.

Table 2: Summary of the Readability Findings

Readability measures	Readability score	Level	Age	Grade Level
(a) Flesch–Kincaid Reading Ease (FKRE)	47.4	Very Confusing	17 and above	College level
(b) Flesch–Kincaid Grade Level (FKGL)	7.8	Good	12 and above	7th Grade
c) Gunning Fog Index (GFOG	6.2	Easy to understandable	11 and above	6th Grade
(d) SMOG Index	6.2.	Easy to comprehend	13 and 15	9th Grade
(e) Coleman Liau Index (CII)	14.8	Too hard to read	17 and above	11th Grade
(f) Automated Readability Index (ARI)	5.3.	Understandable	10 and 11	5th Grade and above

The readability tool also provided an overall score of the readability of the websites. The overall average readability score of the ODP is 47.4 out of 100. The 100 is the highest readability score. The readability tool output score of the ODP shows a very low score indicating readability of the content is difficult to comprehend for the average citizen. On a scale of 0 to 100, at least a 60 score is an acceptable readability recommendation for web content (Flesch 1948). A text with a reading score of 60 to 70 is similar to a grade level of 8 to 9, thus 13 to 15-year-olds should be able to understand it.

These findings suggested that "Open Data Pakistan" may call for a higher level of reading comprehension, making it appropriate for readers with advanced degrees or specialized subject expertise. For readers who are less knowledgeable about the subject, it could be advantageous to simplify the writing or include more explanations. Government operations and decision-making processes can be better understood as a result of open data, which makes it possible for people, researchers, and businesses to access and analyze government data. Governments can streamline their operations and enhance service delivery by increasing data-driven policy formation and evidence-based decision-making. Open data also enables the development of cutting-edge services and products that benefit society as a whole.

CONCLUSION

This study evaluated the availability, accessibility, and readability of datasets, showcasing, and status in the "*Open Data Pakistan*" (ODP) portal. It evaluated the ODP portal's capability for comments, complaints, feedback, and ideas. The study found 837 datasets in the ODP portal along with 14 categories till May 2023. These datasets are available in different formats. Citizens may access full datasets to view, share, and even download them. Moreover, the "Connect" tab is available on the home page for feedback, complaints, and suggestions regarding the ODP portal. Additionally, the readability was checked by the readability checker tool online. The overall readability statistics showed that ODP (https://opendata.com.pk/) has a 47.4% ease of reading which is low and indicates hard to read.

It ought to be simple enough for 13 to 14-year-olds to understand. The availability and accessibility of open data in Pakistan for the citizens are satisfactory however, the readability of the website is not good (47%). It is suggested that the proportion of open data portals in the difficult-to-read category be reduced, increasing the accessibility of the information resources by including easy-to-read phrases in web material.

This study is limited to assessing the readability analysis of ODP. It did not cover the content analysis or usability analysis of ODP. Further, this study used the Flesch-Kincaid Grade Level and Flesch Reading Ease Score to check the readability of Open Data Pakistan. Although it is a well-known scale used to measure the readability of open government portals. However, this online tool for the readability evaluation of ODP can be a limitation of this study.

The study might offer insight into the success of these activities in reaching and involving the public by assessing the readability of open data in Pakistan. It can provide knowledge about how open data can be made more available to promote active participation and give citizens the capacity to make wise decisions. The study also has ramifications for stakeholders and policymakers on the readability, accessibility, and availability issues with open data, emphasizing the significance of taking readability into account in data publication policies and guidelines. It will open new avenues to discuss readability, accessibility, and usability of open data portals in Pakistan that lead to set standards, guidelines, or best practices.

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Work in Progress: A Modified Delphi Study of Research Data Governance in Malaysian Research Performing Organizations

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ABSTRACT

The rapid growth of research data and its influence on research practices has led to an increased recognition of the importance of research data governance (RDG) worldwide. Nevertheless, a dearth of literature exists that explicitly delineates RDG activities undertaken by research performing organizations (RPOs). This study intends to bridge this gap by utilizing a modified Delphi method, which involves a systematic solicitation and collection of feedback from a pool of experts, comprising research data practitioners. This is accomplished through a series of carefully designed sequential surveys, focused specifically on RDG implementation in RPOs in Malaysia. This paper describes an in-progress study to develop consensus among research data practitioners on the importance of organizational roles in RDG task areas at the strategic, tactical, and operational functions. It provides preliminary, partial results for Round 1, regarding RDG task areas carried out by RPOs, based on 26 responses. Statements were rated on a 5-point scale: an interquartile deviation (IQD) ≤ 0.5 and a consensus level (CL) ≥85% were considered as consensus. Analysis of the responses revealed a significant consensus among the experts on 14 out of 18 RDG task areas that RPOs should implement. This study has the potential toward the development of an RDG framework covering the governance task areas, activities, and structure based on the consensus achieved. By providing an RDG framework that can be used as a set of best practices, this study can assist RPO leaders in considering implementing RDG and its efforts in their organization.

Keywords: Research Data Governance; Research Data Management; Data Stewardship; Open Science; Delphi Study

INTRODUCTION

Research data governance (RDG) plays a crucial role in organizations' data management strategies, aiming to maximize the value of data while minimizing costs and risks associated with data-related activities (Abraham, Schneider, and vom Brocke, 2019). However, the sensitivity of data governance to different domains and actors within organizations makes it a complex issue to address (Manik et al., 2022; Kabanda et al., 2023; Paparova et al., 2023). In developed countries, RDG has become standard practice, and research institutions typically provide information about data governance, such as data management and sharing policies on their official websites. This ensures proper management of data assets i.e.; providing accessibility to high-value datasets, and promotes transparency and accountability in data-related processes i.e.; enabling validation of research results. However, the situation is different in developing countries, where research on data governance is limited (Manik et al., 2022) and many have not developed strong research governance structures and processes (Juma et al., 2021). Developing countries often face significant disparities in data governance, which can lead to inequalities in access to and use of research data. It is still being determined which research organizations in the developing world that have data governance structures and processes, and there may be a lack of formal policies in place, as data governance is often perceived as unnecessary.

Nevertheless, in the absence of formal policies, researchers in developing countries often engage in informal data governance practices as part of their daily research work. Despite the lack of explicit guidelines, they may adhere to specific principles and procedures to ensure research data's quality, integrity, and security. However, by establishing formalized guidelines and receiving institutional support, the effectiveness and consistency of these practices can be upheld and even enhanced. This study aims to fill the research gap by investigating the extent of RDG implementation in research performing organizations (RPOs) in Malaysia. The study outlines an ongoing effort to achieve consensus among research data practitioners in strategic, tactical, and operational functions regarding the importance of organizational roles in RDG task areas, presenting preliminary results from Round 1 (of 3) of a Delphi study. The ultimate objective is to develop a comprehensive RDG framework through consensus building. The findings of this study are expected to contribute to the establishment of best practices in RDG, enabling leaders of RPOs to consider the implementation of data governance efforts. This framework will serve as a valuable resource, promoting effective research data management, fostering collaboration, and ensuring the reliability and usability of research data.
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LITERATURE REVIEW

RDG plays an essential role in producing and sharing scientific knowledge. Effective RDG is crucial for building and enhancing research capacity, and implementing this will contribute to the development of robust data governance frameworks that support high-quality research, promote collaboration and attract funding and partnerships. For successful implementation, organizations need a comprehensive understanding of the entities involved, their responsibilities, and the factors influencing adopting data governance practices. According to

Kouper et al. (2020), RDG encompasses multiple entities contributing to the governance process. These entities are recognized as those responsible for making decisions in governing research data and are vital in fostering research communities that generate scientific knowledge. It is worth noting that researchers often engage in multiple research communities, such as disciplinary, interdisciplinary, and data lifecycle communities. This highlights the importance of interconnectedness and collaboration in effective RDG.

In their study, Merkus et al. (2021) focused on identifying data governance capabilities and designing Data Governance Maturity Models. Their research emphasized the significance of having a validated set of capabilities to ensure effective governance. By utilizing the Generic Capability Reference (GCR) model, they validated the identified capabilities, which serve as a foundation for developing maturity models. Organizations can leverage these capabilities to assess their current data governance status and formulate strategies for improvement. Furthermore, the successful implementation of RDG in organizations is influenced by various organizational factors. Manik et al. (2022) examined the behavior of Indonesian scientists regarding RDG. The findings revealed that increasing scientists' awareness of technology transfer and RDG positively impacts their attitudes and adoption of data governance practices. Hence, organizational strategies should prioritize enhancing awareness and promoting best practices to facilitate the integration of data governance principles into scientists' routines.

Additionally, the implementation of RDG involves collaborative networks and platforms for data sharing. Becker et al. (2022) addressed the challenges of role assignment within health research data sharing networks. Their study emphasized organizations' pivotal role in assigning and clarifying roles to mitigate uncertainties. Organizations can facilitate efficient data sharing by adopting a systematic and principled approach while addressing legal and ethical concerns associated with General Data Protection Regulation (GDPR) and health research. Higman and Pinfield (2015) investigated the development of research data management (RDM) policies and practices in UK Higher Education Institutions (HEIs). They underscored the role of organizations in shaping RDM policies and practices and utilized Actor Network Theory (ANT) to analyze institutional perspectives. Understanding organizations' intricate relationships and dynamics provides valuable insights into the driving forces and challenges of implementing RDG.

In conclusion, the literature review briefly highlights the significance of RDG, emphasizing the need for formalized guidelines for implementation, validated capabilities, enhanced awareness and collaborative networks to ensure effective governance, promote data sharing and suitable research practices.

OBJECTIVE AND METHOD

The objective of this study is to investigate the implementation of RDG task areas and activities within RPOs in Malaysia. Ultimately, the study seeks to create an RDG framework for RPOs. This framework may serve as a comprehensive reference enabling organizations to

establish and evaluate the implementation and practices of RDG. To accomplish this objective, the study formulated the following research question for guiding inquiry: *What research data governance task areas do data practitioners believe are essential for implementation by research performing organizations*? Given the scarcity of information on RDG in Malaysia, the modified Delphi approach is considered appropriate, as suggested by Rowe and Wright (2011). This is because it enables the attainment of consensus among a group of data practitioners regarding RDG practices that hold importance for RPOs, making it a highly suitable method. Anonymity plays a significant role in this approach as it allows professionals to express their thoughts freely without concerns about criticism or bias (Goodman, 1987; Barrett and Heale, 2020). Additionally, it provides a systematic methodology for gathering and synthesizing expert opinions.

Ensuring the validity of the results, the recruitment of suitable experts is crucial in the Delphi study (Rowe and Wright, 2011). Therefore, participants in the study will rely on their various direct knowledge and experiences to reach specific conclusions (Barrett and Heale, 2020). A purposive sampling method was employed to assemble a panel of experts with comprehensive research data experience throughout its lifecycle. The panel consisted of data practitioners, encompassing individuals involved in various aspects of RDM throughout its entire life cycle. This includes researchers, librarians, policymakers, and research officers who actively engage in activities such as data generation, management, and utilization. The general sampling criteria for the Delphi study are as follows: participants should have affiliations with any RPO in Malaysia and demonstrate a willingness to engage and share their valuable experiences actively. Moreover, they should possess practical expertise and knowledge encompassing diverse research data handling and support facets, including data generation, management, and consumption. Additionally, having previous experience or ongoing engagement in the formulation of research data policies for their affiliated institution(s) provided an additional advantage to the participants.

In addition to the general sampling criteria, there exist specific criteria where participants were selected based on their contributions and involvement in the Malaysia Open Science Platform (MOSP)[1], categorizing them based on three levels of governance: strategic, tactical, and operational (Korhonen et al., 2013). Notably, participants at the strategic level included deputy vice-chancellors, directors, deputy directors of research management offices, chief librarians, and Malaysia Open Science Alliances (MOSA) members. Tactical level participants comprised certified data stewards trained under MOSP, while operational level participants comprised those who completed the upskill training program to become **Data Stewards** organized by the Academy of Science Malaysia (ASM), comprising librarians, research officers, information technology officers responsible for institutional/digital repositories, and liaison librarians.

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[1] Malaysian Open Science Platform is an initiative with five research universities for a duration of a three-year (2020-2022) project funded by the Ministry of Science, Technology and Innovation (MOSTI), spearheaded by Malaysia Open Science Alliance and implemented by the Academy of Sciences Malaysia (ASM). See https://www.akademisains.gov.my/mosp/about/what-is-malaysia-open-science-platform/

As such, the study divided the participants into three categories: strategic, tactical, and operational by utilizing three sets of questions, i.e.; set A (strategic), set B (tactical), and set C (operational), by aligning them with the participants' positions and tasks within their respective institutions. A total of 109 individuals who met the criteria were invited to participate in the study: 49 for strategic , 15 for tactical , and 45 for operational . At the time of writing this paper, 26 (24%) participants had been recruited for the Delphi study's initial round. The findings were based on the preliminary, partial results for Round 1 regarding RDG task areas carried out by the RPOs, based on 26 responses.

The instrument was written in the English language. Its development drew upon a previous content analysis of policy documents produced by leading RPOs worldwide. The instrument design for this study underwent a rigorous testing phase involving a small group of eight (8) data practitioners from all levels of governance. This pilot testing was conducted to identify issues related to question meaning, wording, structure, and sequence. Additionally, this testing phase helped evaluate the comprehensibility of response categories and determine the average time required for completion (Check and Schutt, 2012). The insights gained from this testing phase were instrumental in refining the instrument. The refined instrument design aims to enhance participant engagement while ensuring the validity and accuracy of their responses (Check and Schutt, 2012). Before proceeding with the pilot testing, the questionnaire underwent a thorough proofreading process to identify any grammatical errors or double-barrelled statements.

The instrument included a personal demographics section and two primary constructs. Part A consisted of generic questions about RDG key players and their roles & responsibilities, while Part B contained more specific statements about RDG task areas for RDG stakeholders. Part A had eight items, while Part B consisted of eleven subsections corresponding to different stakeholders. The stakeholders included the Organization (18 items), Executive Sponsor (2 items), Data Governance Leader (7 items), Research Data Governance Committee (7 items), Office of Research Data Governance (4 items), Research Data Governor (13 items), Research Data Steward (17 items), Administrative Offices (17 items), Research Data Consumer (3 items), and External Bodies (7 items).

Different sets (A, B, and C) had varying stakeholders for Part B, but statements related to the organization were included in all sets. The study collected participants' personal or demographic characteristics such as age, gender, management level, affiliation, position, and research data related roles. The estimated time required to answer all the questions was 45 minutes. Table 1 presents the breakdown of questions across each set.

Table 1. Breakdown of Questions for Each Set

Construct	Set A	Set B	Set C
Part A (RDG key players and their roles & responsibilities)	√	√	√
Part B: The Organization	√	√	√
Part B: Executive Sponsor	√		
Part B: Data Governance Leader	√		
Part B: Research Data Governance Committee	√		
Part B: Office of Research Data Governance	√		
Part B: Research Data Governor		√	
Part B: Research Data Steward		√	
Part B: Administrative Offices			√
Part B: Research Data Consumer			√
Part B: External Bodies			√

Administration of the instrument in this study was conducted electronically, utilizing the secure online form builder Cognito Forms (Cognito, 2023). The panel of experts received a secure link via email, enabling them to complete the questionnaire online conveniently. Each round's questionnaire remained accessible to respondents for approximately two weeks. Participation in the previous round was a prerequisite for panel members to progress to the subsequent rounds, ensuring a cohesive and continuous engagement throughout the study. The analysis relies on descriptive statistics, with the data set to be analyzed using Ms. Excel. Preliminary and partial results for Round 1 are presented, highlighting the RDG task areas undertaken by organizations based on 26 responses. Statements were assessed using a 5-point scale with response options ranging from 1 = Not Important to 5 = Very Highly Important, and a consensus was determined with an interquartile deviation (IQD) of ≤ 0.5 and a consensus level (CL) of ≥85%.

RESULTS

Demographics

The survey gathered feedback from 26 data practitioners representing diverse age groups, genders, and management levels. The most significant percentage (35%) of participants fell within the 35-39 age category. In terms of gender distribution, the majority of respondents were female, accounting for 81% of the total, while males made up the remaining 19%. Regarding governance levels, two eligible participants responded to two different sets, namely set A and set B. A total of 9 responses from the 7 participants in Set A and 8 responses from the 6 participants in Set B were obtained. Additionally, 11 participants responded to set C. The distribution of participants based on age groups, gender, and governance levels is presented in Table 2.

Table 2. Participants' Age Groups, Gender, and Governance Levels

Item	Description	Frequency	Percentage
Age	35-39	9	35%
	40-44	8	31%
	45-49	5	19%
	50-54	3	12%
	55-59	1	4%
	TOTAL	**26**	**101%**
Gender	Female	21	81%
	Male	5	19%
	TOTAL	**26**	**100%**
Governance level	Set A (Strategic)	7	27%
	Set B (Tactical)	6	23%
	Set C (Operational)	11	42%
	Set A and B	2	8%
	TOTAL	**26**	**100%**

Regarding organizational or RPO affiliation, the majority (88%) were affiliated with public universities. The remaining participants represented research institutions (8%) and ministries (4%) as shown in Table 3.

Table 3: Participants' Organizational Affiliation

Affiliation	Frequency	Percentage
Ministry of Higher Education	1	4%
Public University	23	88%
Research Institution	2	8%
TOTAL	**26**	**100%**

Participants were asked to indicate their professional positions within their organizations, and they could choose multiple positions. Most participants (69%) were librarians encompassing various roles and experiences, such as chief librarians, librarians who attended data stewardship training and liaison librarians. Researchers accounted for 15% of the participants; some (12%) were also principal investigators/research leaders and supervisors/mentors, while research officers comprised 12%. Executives represented 8% of the participants, while heads of research comprised 4%. Table 4 indicates the distribution of participants' positions.

Table 4: Participants' Professional Positions

Position	Frequency	Percentage
Executive	2	8%
Head of Research	1	4%
Librarian	18	69%
Principal Investigator/Research Leader, Supervisor/Mentor, etc.	3	12%

Research Officer	3	12%
Researcher	4	15%

In addition to inquiring about the respondents' professional positions, which may imply certain assumptions about their work responsibilities, questions about the specific roles related to research data performed in their work were also asked. These research data-related roles encompassed activities such as accessing, analyzing, and manipulating research data, developing and overseeing research data policies, ensuring legal and regulatory compliance for research data, overseeing overall data and information governance, ensuring the quality and compliance of RDM, actively participating in research activities, monitoring key risk indicators of data misconduct, ensuring data and information governance, and providing support for the implementation of RDM policies.

A significant number of participants had responsibilities that encompassed a wide range of data-related roles, covering almost all aspects. Out of the 26 participants, 54% were involved in supporting the implementation of RDM policies, 38% were engaged in activities such as accessing, analyzing, and manipulating research data, as well as developing and leading research/publication data policies. Additionally, 31% of the participants were actively involved in research activities, 27% were focused on ensuring the quality and compliance of RDM, 23% were responsible for overall data and information governance, and 19% were tasked with ensuring legal and regulatory compliance for research data, as well as maintaining overall data and information governance. One participant (4%) was specifically assigned to monitor key risk indicators for data misconduct. Furthermore, four individual participants added "Other" as their data-related tasks and mentioned activities such as raising awareness about open data on campus, being a member of the RDM team, validating publications and grants, and establishing a unit dedicated to managing RDM and preparing policies. Table 5 presents the breakdown of the distribution of research data-related roles.

Table 5: Participants' Research Data-Related Roles

Role	Frequency	Percentage
Accessing, analyzing, and manipulating research data	10	38%
Developing and overseeing research data policies	10	38%
Ensuring legal and regulatory compliance for research data	5	19%
Overseeing overall data and information governance	6	23%
Ensuring the quality and compliance of RDM	7	27%
Actively participating in research activities	8	31%
Monitoring key risk indicators of data misconduct	1	4%
Ensuring data and information governance	5	19%
Providing support for the implementation of RDM policies	14	54%
Raising awareness about open data on campus	1	4%
Being a member of the RDM team	1	4%
Validating publications and grants	2	8%
Establishing a unit dedicated to managing RDM and preparing policies	1	4%

Research Data Governance Task Areas

What RDG task areas do data practitioners believe are essential for implementation by research performing organizations? This section addresses this research question based on the findings from Round 1 of the Delphi study. The scale used for rating the task areas ranged from 1 (Not Important) to 5 (Very Highly Important). A consensus rate of 85% and above was considered indicative of agreement among the participants. Overall, the results indicate a high level of consensus among the participants regarding the importance of the RDG task areas assessed in this study. Out of the 18 task areas evaluated, 14 of them achieved a consensus rate of 85% or higher.

Table 6 highlights among the task areas evaluated, most respondents (54% to 58%) agree on the importance of various items by rating them 'very highly important'. These task areas include enabling good RDM, ensuring appropriate use of research materials, investigating unethical practices, providing training on RDM, providing facilities for RDM, protecting the rights of researchers, maintaining RDG policies, and owning research data and intellectual property (IP) created. This belief of 'very highly important' indicates that the respondents recognize the significance of these tasks in facilitating effective RDG. It suggests that there is a shared understanding among the participants regarding the essential of these task areas in promoting ethical practices, preserving data integrity, and safeguarding the rights of researchers.

However, the tasks such as taking custody of research data as necessary and providing long-term stewardship for research data did not achieve a consensus level, with 81% of respondents rating them between 4 to 5. This condition suggests that some participants do not consider these task areas as high priorities in the context of RDG. Furthermore, ensuring research data availability also received relatively lower importance ratings, with only 80% of respondents considering it either 'highly important' or 'very highly important'. The relatively lower prioritization of data availability than other tasks suggests a potential gap in recognizing the significance of making research data accessible and usable for the broader research community. Additionally, recognizing researchers' contributions received the least importance ratings compared to all, with only 76% of respondents considering it either 'very important' or 'very highly important'. While acknowledging and attributing credit to researchers for their contributions is essential for fostering a collaborative and equitable research environment, it appears to be less prioritized than other tasks within RDG.

The importance ratings assigned to various tasks highlights the need for prioritizing tasks that ensure data integrity, compliance, and effective management in research environments. Therefore, these initial findings can inform decision-making processes and resource allocation strategies to enhance RDG practices and implementation.

Table 6: Level of Importance for Research Data Governance Task Areas

Task	1	2	3	4	5	M	IQD	CL

	1	2	3	4	5	M	IQD	CL
Ensures research data availability	0%	12%	8%	42%	38%	4	0.5	80%
Supports grant holders' compliance	0%	4%	4%	46%	46%	4	0.5	92%
Maintains metadata catalogue of research data	0%	4%	4%	46%	46%	4	0.5	92%
Protects rights of researchers	0%	4%	12%	27%	58%	5	0.5	85%
Establishes governance committee	0%	8%	8%	35%	50%	4.5	0.5	85%
Maintains research data governance policies	0%	4%	4%	35%	58%	5	0.5	93%
Enables good research data management	0%	4%	4%	38%	54%	5	0.5	92%
Engages with stakeholders	0%	8%	4%	38%	50%	4.5	0.5	88%
Ensures appropriate use of research materials	0%	8%	0%	38%	54%	5	0.5	92%
Investigates unethical practices	0%	8%	8%	31%	54%	5	0.5	85%
Takes custody of research data as necessary	0%	12%	8%	35%	46%	4	0.5	81%
Owns research data and IP created	0%	12%	4%	27%	58%	5	0.5	85%
Develops best practices for research data sharing	0%	12%	4%	35%	50%	4.5	0.5	85%
Provides training on research data management	0%	8%	4%	35%	54%	5	0.5	89%
Provides long-term stewardship for research data	4%	8%	8%	35%	46%	4	0.5	81%
Provides facilities for research data management	4%	8%	4%	31%	54%	5	0.5	85%
Ensures facilities compliant with regulations	0%	8%	8%	35%	50%	4.5	0.5	85%
Recognizes contributions of researchers	4%	8%	12%	38%	38%	4	0.5	76%

Note: 1 - Not Important   2 - Slightly Important   3 - Moderately Important
          4 - Very Important   5 - Very Highly Important   M – Median
          IQD – Interquartile deviation   CL – Consensus Level
          *The shaded items do not reach group consensus

DISCUSSION AND CONCLUSIONS

The preliminary research findings of the importance ratings assigned to different task areas within RDG, although lacking robustness and reliability, may provide valuable insights into the priorities and areas of focus. Tasks associated with RDG, such as maintaining governance policies and enabling good RDM, were recognized as highly important. This highlights the importance of establishing robust policies and practices that ensure data integrity, accessibility, and compliance with ethical standards (Brous, Janssen, and Vilminko-Heikkinen, 2016; Thompson, Ravindran, and Nicosia, 2015; DAMA International, 2017). Organizations should invest resources and effort into developing and implementing effective governance frameworks that will contribute to enhancing RDM practices (Lefebvre and Spruit, 2021; Marlina and Purwandari, 2019; Wong, Maarop, and Samy, 2020; Abraham, Schneider, and vom Brocke, 2019). Protecting researchers' rights and intellectual property also emerged as significant priorities. Additionally, recognizing the value of researchers' contributions and

ensuring appropriate use of research materials were also rated as highly important tasks. These findings emphasize the need to foster an environment that promotes innovation (Sharif et al., 2018), recognizes researchers' contributions, and upholds ethical practices in research (Nielsen, 2017; Parmiggiani and Grisot, 2020; Hendey, Gold, and Pettit, 2018). Engaging with stakeholders and providing training on RDM were important tasks. These findings highlight the importance of collaboration and capacity building in effective RDM. It is evident that organizations should invest in initiatives that facilitate stakeholder involvement and provide comprehensive training programs to equip researchers with the necessary skills for managing and sharing data effectively (Liu, Zotoo, and Su, 2020; Gunjal and Gaitanou, 2017; Lefebvre, Schermerhorn, and Spruit, 2018).

However, it is evident that ensuring the availability of research data is perceived as less important compared to other tasks. Additionally, taking custody of research data was also rated relatively lower in importance compared to other tasks. Furthermore, providing long-term stewardship for research data and recognizing the contributions of researchers also received low importance ratings. The preliminary nature of these findings emphasizes the need for further validation and verification before drawing definitive conclusions. In the subsequent round, these task areas lacking consensus will be revisited, prompting participants to re-evaluate the importance assigned to them.

In conclusion, understanding the importance ratings of the task areas emphasizes the need for a holistic approach to RDG. Organizations should prioritize tasks related to enabling good RDM, compliance, and ethical practices while considering the specific context and needs of their research environment. Overall, RDG provides the necessary structure and guidelines for responsible and effective RDM, which is foundational to the principles and practices of open science. By integrating RDG into their workflows and addressing these priorities, RPOs can enhance data accessibility, integrity, and collaboration, ultimately contributing to the advancement of scientific knowledge and innovation. The researchers too can ensure that their data is properly managed, shared and utilized in an open and transparent manner.

ACKNOWLEDGEMENT

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The International Conference on Libraries, Information and Society (ICoLIS2023) was organized by the Department of Library and Information Science, Faculty of Arts and Social Sciences, and the Universiti Malaya Library, Kuala Lumpur, Malaysia.

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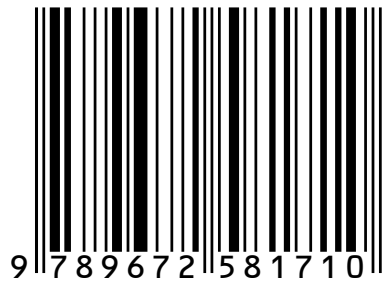
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