Chapter 22
Research Data Management Services in Tertiary Institutions in Zimbabwe

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ABSTRACT

The chapter seeks to analyze how librarians in Zimbabwe are responding to increasing librarian roles in the provision of research data services. The study sought to ascertain librarians' awareness and preparedness to offer research data management services at their institutions and determine support required by librarians to effectively deliver research data services. Participants were invited to respond to the survey, and survey monkey was used to administer the online questionnaire. The collected data was analyzed using content analysis, and it was thematically presented. Findings revealed that librarians in Zimbabwe are aware of their role in research data management, but the majority are not prepared to offer research data management services due to a lack of the required skills and resources. Challenges that were noted include lack of research data management policy at institutional levels and information technology issues such as obsolescence and security issues.

INTRODUCTION

This study is a development from the baseline studies on the state of research data management in Zimbabwe done in 2017 and 2019 (Chigwada, Chiparausha & Kasiroori 2017; Chigwada, Hwalima & Kwangwa 2019; Chiparausha & Chigwada 2019). These studies were done to evaluate how researchers were managing their research data in research institutions in Zimbabwe. The major findings indicated that research data management was a new concept in Zimbabwe and researchers were managing their own research data. The need to create awareness among all the stakeholders, train both librarians and researchers, and having enabling institutional and national policies was emphasised. Pryor (2012) stated

DOI: 10.4018/978-1-7998-7258-0.ch022

that the research output in the 21st century is data which is the primary building block of all the information. He added that the data should be managed to ensure that it remains discoverable and accessible over a long time. Research Data Management was defined by (Whyte & Tedds 2011) as the organization and description of data from its entry to the research cycle through to the dissemination and archiving of valuable results. This purpose of this study is to assess the preparedness of librarians in Zimbabwe to offer research data management services since awareness had been created a number of studied had been done to provide a roadmap for stating these services (Chigwada, Chiparausha & Kasiroori 2017; Ndhlovu 2016; Ndhlovu 2018; Ndhlovu & Ngwenya 2017; Nhendodzashe & Pasipamire 2017; Chigwada, Hwalima & Kwangwa 2019; Chiparausha & Chigwada 2019). It is against this background that the study sought to meet the following objectives:

1. To ascertain librarians and researchers awareness on their role in research data management;
2. To determine the level of librarians' preparedness to offer research data management services; and,
3. To assess the challenges faced by librarians and researchers in research data management.

BACKGROUND

Research Data Management in Zimbabwe

Pryor (2012) reports that research data management has become a topical issue that has overtaken open access to scholarly publications. Nhendodzashe & Pasipamire (2017) reported that researchers have encountered increasing requests by funding agencies, institutions and publishers for the researchers to avail research data publicly. Chiware & Mathe (2015) concurred with Nhendodzashe & Pasimire by stating that research funding agencies and national governments are demanding that grant recipients preserve and share their research data. A study by Ndhlovu (2016) revealed that library staff does not have the skills required for effective data preservation in the digital environment.

In Zimbabwe, the generation of new knowledge is done by both public and private universities and other research institutions and non-governmental organisations. A study done by Chigwada, Chiparausha & Kasiroori (2017) revealed that researchers in Zimbabwe are responsible for managing their own research data since research data management is a new concept in Zimbabwe (Chigwada, Chiparausha & Kasiroori 2017; Ndhlovu & Ngwenya 2017; Nhendodzashe & Pasipamire 2017; Chigwada, Hwalima & Kwangwa 2019; Chiparausha & Chigwada 2019). Most research institutions are worried by the research output which is archived in institutional repositories and among the universities; a study done by Nhendodzashe & Pasipamire (2017) showed that the University of Zimbabwe Library was working towards the introduction of research data management services. The findings revealed that the institution has the technological infrastructure and economic resources but do not have the legal framework required in offering research data management services, and the librarians do not possess the requisite skills needed throughout the research data lifecycle. Ndhlovu & Ngwenya (2017) documented the state of preparedness of the National University of Science and Technology in offering digital curation and preservation services. It emerged that the librarians do not have the necessary skills in research data management and the information communication technology infrastructure to start the services. Librarians are currently skilling themselves to be able to offer research data services.

It has been observed that there are no data repositories to archive open research data in research institutions or universities in Zimbabwe (Chigwada, Chiparausha & Kasiroori 2017). Researchers who have been archiving research data were doing so in external repositories such as Mendeley data and they are being assisted by librarians to do so. If it is a research grant application that requires a data management plan as a prerequisite for submission, researchers had been approaching librarians for assistance in drawing workable data management plans. A lot has been talked about in terms of open access and institutions had adopted the movement leading to the formation of institutional repositories and the crafting of open access policies. However, it was perceived that researchers are not willing to open and archive their research data which they consider as an asset (Chigwada, Chiparausha & Kasiroori 2017). This is in line with the findings of a study that was done by the Confederation of Open Access Repositories (2017) which indicated that only 2% of researchers from Africa were prepared to archive their research data. Although a little is known about researcher's data management concerns according to Kennan & Markauskaite (2015), researchers are now mandated to archive their research data to improve data management and sharing practices (Chiware & Mathe 2015; Bezuidenhout & Chakauya 2018; Tenopir, Christian, Allard, & Borycz 2018; Zhou 2018; Cox et al. 2019). This pressure is coming from funders, publishers, the public, universities, and other research organisations.

Research Data Management in South Africa

Mosha, Luhanga, Mosha and Marwa (2019) indicated that research data management for researchers in Sub-Saharan Africa is still in its infancy and there is need to create more awareness of the service and researchers should have motivation to share their data. It has been noted that South Africa has documented more on research data management practices in Africa than other countries (Fernihough 2011; Lotter 2011; Lotter 2013; Lotter 2014; Patterton 2014; Kahn, Higgs, Davidson & Jones 2014; Chiware & Mathe 2015 Patterton 2016; Chiware & Becker 2018). A lot of initiatives were started such as the Data Intensive Research Initiative of South Africa (DIRISA), the Network of Data and Information Curation Community (NeDICC), and the projects initiated by individual institutions (van Deventer & Piennar 2015). In order to understand the processes and workflows, the people visited other institutions in the developed countries that were already running research data management projects such as JISC (van Deventer & Piennar 2015). At the University of Pretoria, the journey started in 2007 with the development of a Research Data Management Policy for the university and a full time staff member was assigned in 2013 until 2015 when a library and information technology task team was created to investigate infrastructure needed for research data management across the university (van Deventer & Piennar 2015). Some lessons learnt from these exercises showed that institutions must implement research data management practices that are appropriate and acceptable by researchers at their institutions. The importance of senior management support was also emphasised since they are responsible for providing the infrastructure and financial resources to make the research data management project a success (van Deventer & Piennar 2015).

Research Data Management in Other Countries

A study by Avuglah & Underwood (2019) showed that research data management at the University of Ghana is currently underdeveloped but there is a great potential for growth. It was noted that there is no formal research data management infrastructure although it is considered as an essential issue in the

research process. The authors recommended the need for a clear and comprehensive policy framework to garner support from management through their commitment to support research data management practices. Chawinga & Zinn (2020) pointed out that Africa lags behind in research data management and might be losing the valuable data which is important in the research process. In Malawi, researchers generate a lot of research data but data preservation is poor since the Mzuzu University uses high risk storage facilities to store research data (Chawinga & Zinn 2020). It was also pointed out that both researchers and librarians lacked the skills and competencies needed in research data management coupled with the absence of research data management policies, lack of incentives, and unavailability of data infrastructure. The authors recommended the need for a robust data storage infrastructure and organise training workshops to equip librarians and researchers with research data management skills.

Role of Librarians in Research Data Management

According to Pryor (2012), librarians' traditional role of intellectual output stewardship remains even in the digital age hence the need for them to play an active role in research data preservation. Considering that data is the primary building block of information and scholarly research output (Pryor, 2012), librarians remain key players in research data management as they are heavily involved in information dissemination. Burnett (2013) indicates that librarians have experience in information organisation leading to their involvement in developing best practices for research data management. He adds that librarians are involved in formulating local institutional data management plans.

AIP Publishing (2016) lists seven responsibilities of librarians in research data management. These responsibilities are as follows:

1. Assisting researchers in crafting a research data management plan before embarking on a research project.
2. Help researchers to develop data models and identify appropriate standards.
3. Guide research in mindful data and metadata collection.
4. Develop and contribute computational and statistical expertise.
5. Recommend tools and resources so data can be easily organized and shared and fulfill compliance requirements.
6. Support efforts to archive, place in repositories, and preserve research data from threats.
7. Locate already existing shared data that can be used to answer the research question or for reuse and new uses.

Flores et al. (2015), Pinfield et al. (2014), Rambo (2015), Stang (2016) and Yu (2017) reported that librarians are involved in research data services design and implementation, showing activity in technical infrastructure development as well as support and advisory services. The authors also note that librarians have been spearheading advocacy work for the adoption of research data management by institutions. A study by Tenopir et al. (2014) revealed that librarians received training on research data management in three different ways namely in-house staff workshops or presentations, taking courses on research data management and attending conferences or workshops on research data management. This would help in skilling the librarians to ensure that they are able to offer the research data services.

Role of Researchers in Research Data Management

There are a number of stakeholders who are involved in the management of research data but amongst them all, researchers play a bigger role since they are the owners of the data. They have the responsibility of ensuring that their research data is well managed and is accessible. Researchers are the creators and users of research data and they should ensure that research data is properly stored, managed, and shared. This shows that researchers should be knowledgeable about the FAIR (Findable, Accessible, Interoperable, Reusable) data principle to make them part of the data management planning. With a proper and well-crafted data management plan, researcher would be able to apply the correct procedures in collecting, annotating, storing and backing up the data to make sure that the research data is used, reused, accessed and retained. Researchers who share their data should be incentivised as a way of motivating them and encouraging others to do the same to increase the visibility of the research data leading to more citations (Bezuidenhout & Chakauya, 2018).

Marchionini (2012), Whitmire et al (2015), and Chigwada et al. (2017) stated that most researchers manage their own research data and are not knowledgeable about the emerging trends in research data management. It was discovered that some researchers make use of the registry of research data repositories to identify the correct research data repository for their subject area. Although there are many research data repositories, studies showed that most researchers store their data on local hard drives, departmental servers, computer storage options such as compact disks, digital versatile disks, portable hard disks and pen drives, and cloud based storage facilities such as Dropbox, One drive, or Google drive (Buys & Shaw 2015; Tripathi et al, 2017). In terms of maintenance of the research data, researchers were using graphs, tables, SPSS spreadsheets, CSV, and .xls files.

Requirements for Effective Research Data Management

There are several prerequisites for effective research data management. This section provides a synopsis of the requirements for effective research data management highlighted in past studies. The National Research Council (2004) stresses the importance of providing security to the stored research data; the security mechanisms include the provision of reliable back up facilities. AIP Publishing (2016) add that it is critical to ensure that data are held securely and relevant authentication and authorization mechanisms in place to avoid unauthorised access. Lotter (2014) pointed out the need to carefully assess the infrastructure needed for research data management services before implementation. The infrastructure and investment should match the mission, objectives and strategic aims of the institution. The UK Data Archive (2018) states the importance of knowing the legal, ethical and other obligations towards research data management on research participants, funders and the institution before starting a research data management project. Henderson and Knott (2014) observe that the successful implementation of RDM services require new staff who are knowledgeable on the current trends in research data management or the upskilling of those who are already there to take up new roles and responsibilities.

Librarians' Perceptions Towards Research Data Management

Librarians who participated in a study carried out by Tenopir, et al (2014) expressed confidence that they had the skills required to assist their clientele in research data management services. Although some librarians confirmed the critical role librarians play in research data management, a study by Pinfield

et al. (2014) reported that some librarians saw themselves being in an ambiguous position and were uncertain about their role in research data management. The findings from a research that was done by Mosha, Luhanga, Mosha and Marwa (2019) indicated that research data management in Sub-Saharan Africa is in its early stages which calls for an awareness need to encourage both researchers and librarians to perceive it in a positive way. This would be a way of motivating researchers to share their data while librarians would be able to archive the research data and make it accessible to other researchers. Buys & Shaw (2015) stressed that librarians perceive research data management highly and most researchers are only willing to share their data after publishing the research output if it is a requirement from the funders. In addition to this, Kennan & Markauskaite (2015) stated that some librarians are not aware of the researcher's needs and most researchers were not participating in policy formulation and the development of the research data management infrastructures leading to the low uptake of the practice.

Awareness and Perception of Researchers Towards Research Data Management

Most researchers are sceptical about sharing their research data since they are worried about misuse of the data as they are not aware of their rights to the datasets. In light of that, some researchers think that sharing or publishing the data in the journal article is enough for data sharing, although this is not enough to replicate the results (Tripathi et al., 2017). Although the attitude of some researchers was positive towards data sharing, Tenopir et al. (2018) noted that researchers had concerns about sharing their own data. Ndhlovu & Ngwenya (2017) concurred with these findings by pointing out that researchers who know about research data management had negative perceptions towards data sharing due to lack of institutional policies and standards that protect their data from misuse. Tenopir et al. (2015) and Majid, Foo & Zhang (2018) added that some researchers were willing to share their data only if they can be cited by other researchers and if their rights as authors and generators of the data are protected. This calls for a need to rigorously train researchers on good data management practices as well as assisting researchers to draw good data management plans and to archive, use and reuse their research data.

Challenges Faced by Librarians in Research Data Management

Researchers face various challenges when managing research data according to their discipline as well as the institutional and national context (Erway, 2013; Flores et al., 2015; Tenopir et al. 2018). Studies that were done (Cox et al., 2012; Chiware & Mathe, 2015; Ndhlovu, 2016; Tenopier et al., 2012) indicated that there are a number of challenges that are faced by librarians when offering research data management services. These challenges include limited skillsets, lack of understanding of the diversity of research data, how to balance existing roles with new research data management roles, lack of understanding by librarians of the motives and practices of researchers, lack of domain-specific knowledge and using current experiences for creation of research data contexts, engaging researchers who view librarian's role as that of supporting teaching, and lack of resources and infrastructure for research data management.

Yoon & Schultz (2017) reported that limited funding, unskilled personnel and equipment and lack of broader institutional support have been among the recurring challenges affecting research data management by librarians. Similar observations were raised by Chiware & Mathe (2015) who reported that availability of resources and infrastructures and limited data management skills among library staff affected research data management by librarians in South Africa. Barbrow et al. (2017) pointed librarians

to a number of resources that are available on the Internet which can help in learning on research data management. These include courses, training materials and social communities. Therefore, it is crucial for research institutions to train their librarians and researchers and raise awareness on the importance of practising good research data management. It is also the duty of the librarians to change the negative perception of researchers towards research data management by educating and assisting them throughout the research process.

Challenges Faced by Researchers in Research Data Management

Researchers are faced with challenges in determining the correct data repository for their preserving and sharing their research data. This is because of the imposition of data repositories by some stewards and researchers endure the pressure of knowing the different features, functionalities, limits in terms of data sets size that should be archived in the repository (Baker and Yarmey, 2009; MetaArchive Cooperative Outreach Committee, 2015). It has been observed that some researchers fail to document their data due to lack of knowledge in creating metadata and the use of non-standardised methods of documenting data according to Tenopir et al. (2011), Steinhart et al. (2012) and Rolando et al. (2013). This problem is made worse by lack of metadata standardisation which prevents researchers from archiving and sharing their research data Yoon (2017) and Tenopir et al. (2018). In order to deal with these challenges, there is need to train researchers on best practices of research data management from idea generation to ensure that the research data is well managed throughout the research life cycle. There is also need to improve the metadata standards to ensure that the datasets are discoverable, valid, accessible and reusable.

Kennan & Markauskaite (2015) noted that there is a challenge of data overload due to the availability of digital data which is collected and analysed using computers leading to the advent of big data. There are challenges that are related to digital data management and curation which are technological obsolescence, the fragility of technology, absence of guidelines on good practice of research data management, lack of evidence on best infrastructure for research data management, and inadequate financial and human resources to manage research data (Harvey 2010). Researchers in Zimbabwe lack knowledge and skills required to create data management plans which are a requirement in most research grants applications (Ndhlovu and Ngwenya (2017). It has also been noted that some researchers were not trained on research data management and cannot effectively manage their research data Conrad, Shorish, Whitmire & Hswe (2017). .

The emergency of huge amounts of scientific data caused a challenge of failing to handle research materials proficiently, and this had been worsened by the absence of research data management policies in universities and research institutions. As a result, there is too much time and effort that should be channelled towards proper research data management, leading to the negative perception of researchers in managing and sharing their data. Bezuidenhout & Chakauya (2018) concluded that researchers are affected by the thought of losing their intellectual property rights,, failure of attribution, data misuse, lack of funding, the digital divide, poor internet connectivity, poor information communication technology infrastructure, researchers who are computer illiterate, lack of incentives for researchers who share their data, and lack of commitment from the government and other key stakeholders in endorsing good research data management practices. Research institutions and universities should be intentional in dealing with research data management challenges and the negative perception of researchers. Librarians also need to market their research data management roles within their institutions since Tenopir et al. (2018)

indicated that some researchers are not aware of the expertise of librarians in dealing with research data management issues, and the assistance that can be rendered from the library.

THE ROAD TO RESEARCH DATA MANAGEMENT AT AN ACADEMIC LIBRARY

Studies done in Zimbabwe indicated that there is no institution with a data repository but efforts are being made to introduce research data management services by librarians and other stakeholders in research institutions (Chigwada, Chiparausha & Kasiroori 2017, Chiparausha & Chigwada 2019). A proposed framework for research data management services in research institutions in Zimbabwe was crafted by Chigwada, Hwalima & Kwangwa (2019) to document the road map that can be used to introduce research data services. It was observed that human, financial and technological resources should be available in order to introduce successful research data management services (Shen & Varvel 2013). A case of an institutional library (Library A) which is in the process of establishing a research data repository was studied to showcase what has been done so far as well as the success and challenges that had been encountered.

Infrastructure Profile

Library A used an infrastructure profile that was provided by Davidson (2015) to showcase the components of good research data management services. This process was done to get an inventory of the existing services to eliminate duplication of effort in introducing research data management services. The profile consists of the following components:

1. Means of raising staff awareness of funders research data requirements,
2. Research data policy,
3. Strategy or implementation plan for research data services,
4. Research data management advice and support services,
5. Active data storage,
6. Persistent identification for datasets,
7. Data register or catalogue,
8. Data access procedures,
9. Secure data access,
10. Institutional publications repository, and
11. Data repository for longer term access and preservation.

As a way of raising awareness among the researchers, the librarians spearheaded the project by doing a study on research data management services in Zimbabwe (Chigwada, Chiparausha & Kasiroori 2017). These studies had an aim of assessing the research data management landscape in research institutions in Zimbabwe and also create awareness among the institutions on the importance of managing research data. The findings indicated that a few researchers were aware of the subject and there was need to educate and train researchers on this emerging issue. Campus wide campaigns were done whereby librarians talked about research data management on every forum, be it departmental board meetings, faculty board

meetings, research board meetings. Librarians trained other information professionals to ensure that they were at the same level as a way of improving their skills and knowledge on research data management.

Stakeholders of Research Data Management Services

The main stakeholders were identified during the initial study by Chigwada, Chiparausha & Kasiroori (2017). Ingram (2016), Latham (2017), Jones, Pryor & Whyte 2013, and Cox & Verbaan (2016) indicated that the stakeholders for establishing research data management services are librarians, records managers, research officers, researchers, library schools, IT professionals, funders, government, and other research data management providers. Library A engaged all the stakeholders from the inception of the idea of the research data management project. The librarians initiated the project and engaged the research office, IT, researchers and the ethics committee. The major stakeholders were the researchers who are responsible for creating and using the data.

However, the project was stalled by the challenges that were faced by the librarians in trying to introduce research data management services at Library A. Although librarians were enthusiastic about the project, there was generally a lack of support from the research and administration who viewed research data as an asset that they can use to generate income. As a result, they were not willing to archive their research data in data repositories. Library A wanted to do a pilot of the project but the researchers were not forthcoming leading to the death of the project. However, librarians did not give up and they are still research for best practices to encourage researchers to archive their research data so that a data repository can be created and maintained at the institution. Efforts are being made to educate researchers and other stakeholders on the importance of making use of various data repositories that are available so that the research data is accessible and usable.

RESEARCH METHODOLOGY

The study combined both quantitative and qualitative methods. A semi-structured questionnaire was used to collect data form the respondents. The respondents comprised of librarians from academic libraries in Zimbabwe. The researchers collected responses using an online survey and thirty-three responses were received from the forty eight questionnaires which were sent out. Data analysis was restricted to the 33 librarians who participated in the survey. The questionnaire was administered online using survey monkey. The questionnaire was developed using the study's research objectives listed above. Respondents were first required to consent to participate in the study.

RESULTS

The findings from the study showed that apart from librarians, researchers, information technology personnel and hired consultants were responsible for RDM at their institutions. On the roles of librarians, participants indicated that librarians were responsible for archiving research data; providing access to the research data; training their constituencies on how to access research data available on to the research data repositories; and training researchers on how to submit research data on to the research data repository.

Participating librarians perceived that there were a number of benefits derived from RDM and these include enhancing the visibility of research data and increases the number of citations; reducing the risk of data loss by keeping your research data safe and secure; demonstrating research integrity and validation of research results; showcasing research data outputs to a global audience; attracting new collaborators and research partners; strengthening the research environment and infrastructure; ensuring compliance with the research data expectations of funders and publishers; and, improving the impact of funded research through knowledge transfer.

The study sought to gauge the participants' rating of the importance of research data repositories at their institutions. The majority of participants (54.5%) felt that research data repositories were very useful as indicated by Figure 1.

Figure 1. Participants' rating of research data repositories usefulness
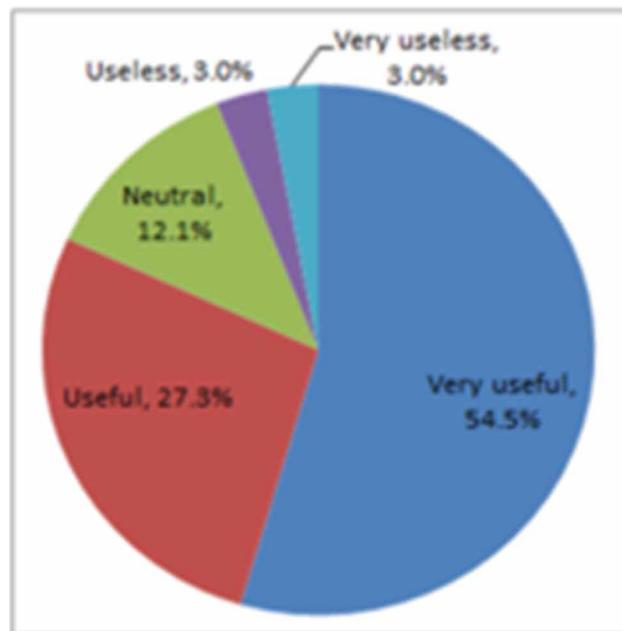
The participants were asked to rate the preparedness of their institutions to offer research data management services vis-a-vis the requirements for effective research data management services. Figure 2 below presents the findings where 5 respondents indicated that they have partnered with data cite while 22 librarians indicated that they have skilled personnel in their institutions.

The participants rated themselves on specific research data management competencies as shown in Figure 3 below. Sharing of research data topped the list with 23 respondents while data curation and reuse was the least competence with 7 respondents.

Participants reported that they had undergone training on research data management as shown in Figure 4 below. The majority of the librarians (15) went through self-training while 4 of them took short courses on RDM.
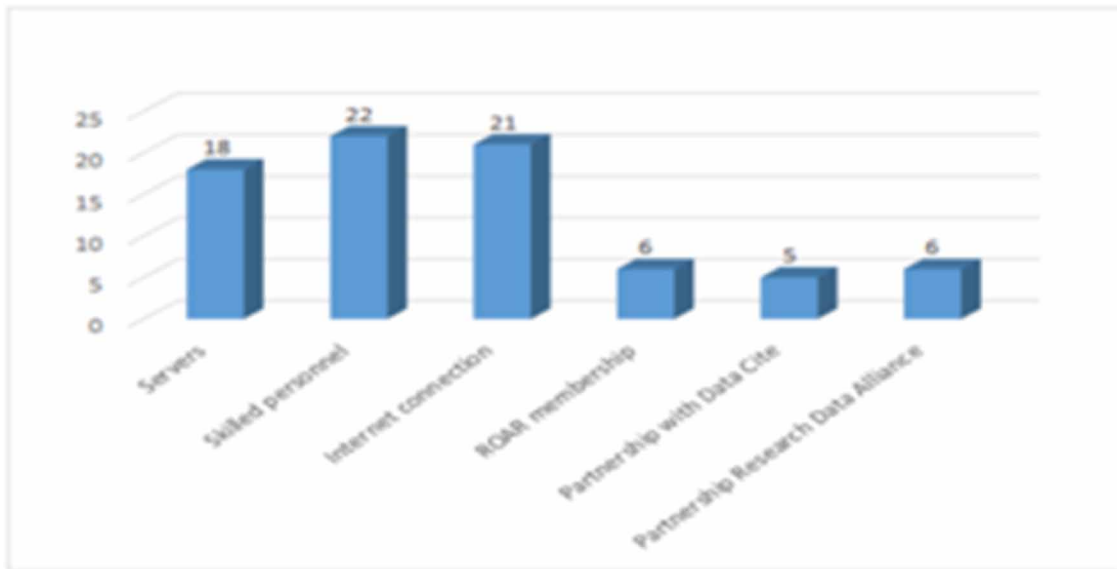
Figure 2. Institutional preparedness

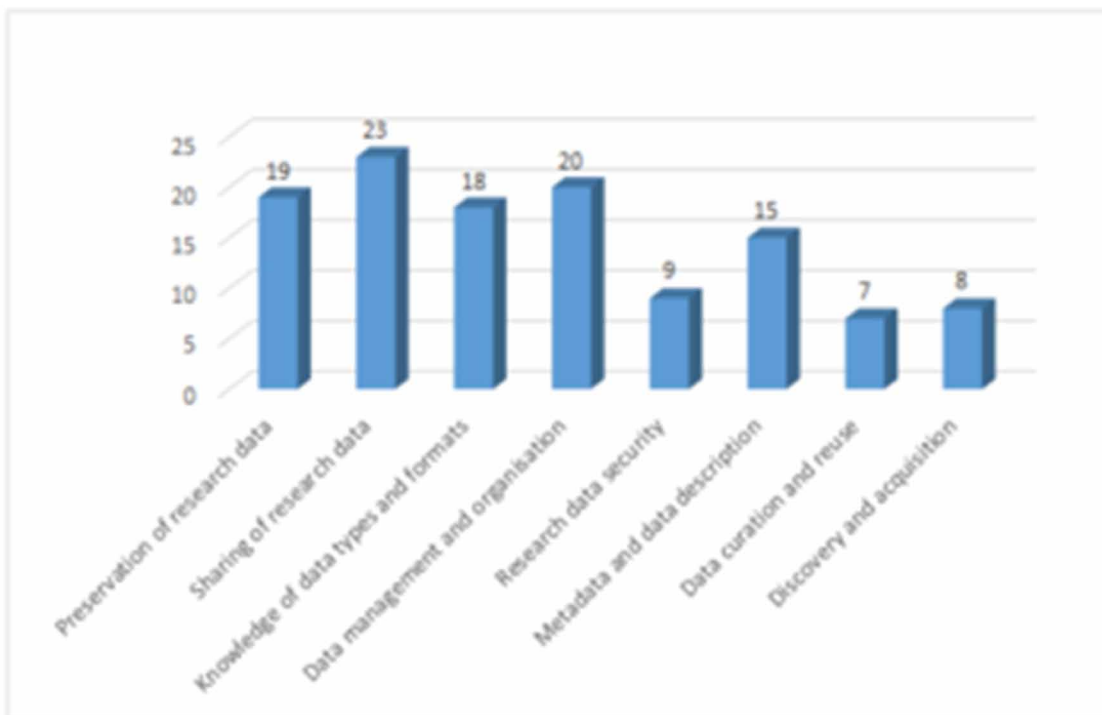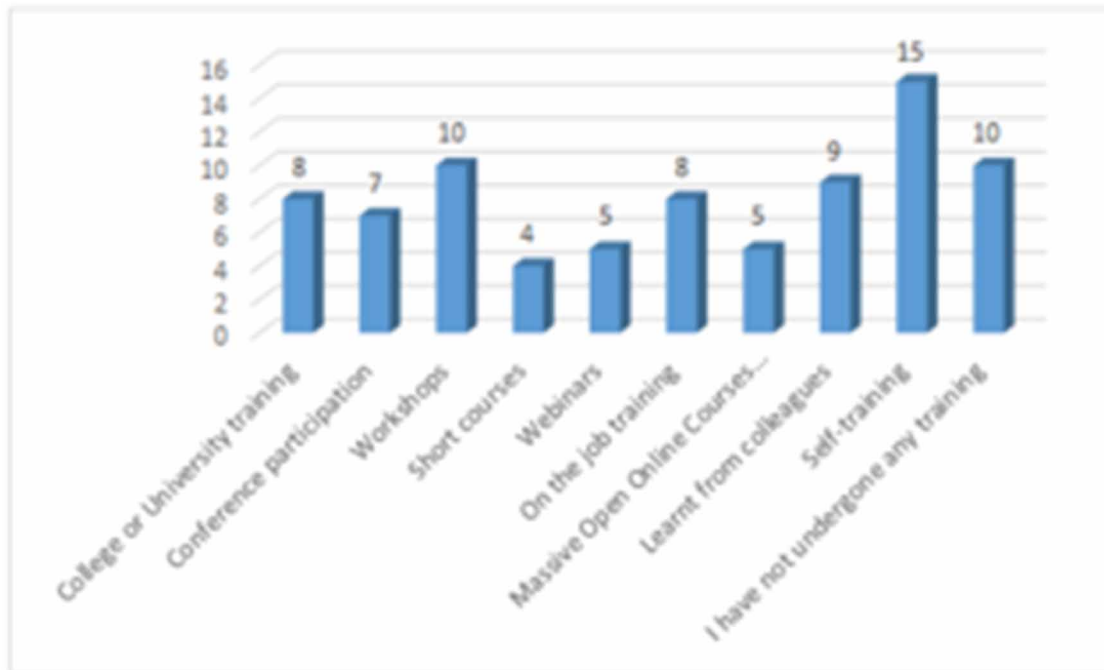*Figure 3. Librarians' competencies*

Figure 4. Research data management training undergone

It was found out that technological obsolescence, security, lack of guidelines on good practice, inadequate, financial and human resources, lack of evidence about best infrastructures, use of different vocabulary between librarians and researchers, and lack of research data management policy and institutional commitment to research data management were the prevalent challenges faced. Training, utilising available technology, restricting access, establishing research data management policies were proffered as possible solutions to the challenges.

DISCUSSION

The study confirms findings in other studies (Rambo, 2015; Stang, 2016; Yu, 2017) that research data management is a responsibility of various professionals including librarians. This study revealed that apart from librarians, researchers, information technology personnel and hired consultants were responsible for research data in various institutions in Zimbabwe.

Findings of this study reaffirm assertions made in previous studies by Pryor (2012), Tenopir, et al. (2012) that librarians were getting involved in research data management at various stages of the research data cycle. This study indicates that librarians in Zimbabwe are actively participating in training researchers on how to submit research data on to the research data repository, archiving research data, providing access to the research data and training their constituencies on how to access research data available on the research data repositories.

As UK Data Archive (2018) reported, participants in this study concurred that research data management was beneficial to institutions and individual researchers in that it enhanced the visibility of research

data and increase the number of citations, facilitated research data safety and security, demonstrated research integrity, enabled validation of research results. Furthermore, participants in the study reported that showcasing research data outputs to a global audience improved the impact of funded research through knowledge transfer thereby attracting new collaborators and research partner. These sentiments resonated well with the participants' overwhelming usefulness rating of the benefits of research data management at the various institutions in Zimbabwe.

Participants had mixed feelings on the preparedness of their institutions to offer effective research data management services. Just half of the institutions (18) had required servers for effective research data management. Two thirds of the respondents felt that their institutions had good Internet connectivity and required personnel to manage research data. However, nearly all institutions (82%) were not members of the Registry of Research Data Repositories neither had they partnered Data Cite nor Data Alliance. These findings confirm earlier observations made by Chigwada et al. (2017).

Librarians in Zimbabwe who participated in the study felt that they were knowledgeable and skilled about data types and formats, metadata and data description, research data organisation, management, preservation and sharing. Participants however indicated that they lacked expertise on research data discovery, acquisition, security, curation and reuse. The latter findings show that the participants fall short of attributes of competence listed by AIP Publishing (2016) and the National Research Council (2004) for effective research data management.

As literature suggests (Chiware & Mathe, 2015; Cox et al., 2012; Ndhlovu, 2016; Henderson & Knott, 2014; Tenopier, et al., 2012; Yoon & Schultz, 2017) training is still required because there is limited data management skills among librarians. As such, participants had to undergo various forms of training to equip themselves with the necessary skills for effective research data management. Findings from the study show that participants underwent on-the-job training, college or university training, attended massive open online courses (MOOCS), webinars, conferences and workshops, enrolled for short courses or engaged knowledgeable colleagues to gain more knowledge and skills on research data management. However, 10 of the participants indicated that they had not received any form of training which render them not prepared to offer research data services in their institutions.

The study reaffirms assertions from other studies (Chigwada et al., 2017; Cox et al., 2012; Chiware & Mathe, 2015; Ndhlovu, 2016; Tenopier et al., 2012) on the challenges faced by librarians when managing research data. Technological obsolescence, security, lack of good practice, inadequate, financial and human resources, use of different vocabulary between librarians and researchers, lack of policies and institutional commitment are affecting research data management. Training, utilising available technology, restricting access, establishing research data management policies and engaging consultants are considered as possible solutions.

SOLUTIONS AND RECOMMENDATIONS

From this study, it can be pointed out that librarians in academic libraries are aware of their role in research data management. The librarians are not yet prepared to offer research data management services in their institutions since they lack the skills that are needed to competently offer the service. The resources that are required for research data management are also not available in most of the libraries which is a major drawback. As a result of the challenges that were pointed out in this study, there is need to create awareness and train librarians so that they can be knowledgeable of the part they can play in

research data management. The authors therefore, recommend the upskilling of librarians to ensure that they possess the required skills and knowledge on managing research data. There is also need to create awareness among the researchers on the role that can be played by librarians in the research data life cycle. Libraries should also be supported through providing the resources that are essential in research data management such as servers, good ICT infrastructure and functional institutional policies. This shows that academic institutions should be intentional in their support for research data services.

FUTURE RESEARCH DIRECTIONS

A study showcasing the academic institutions who are offering research data services in Zimbabwe can be undertaken as case studies indicating how they introduced the services in the form of the roadmap that they followed. This can help to unpack the opportunities and challenges that the institutions took advantage of in order to successfully offer research data services despite the economic challenges.

CONCLUSION

It can be ascertained that although librarian are aware of their role in research data management, institutional support in terms of resource provision and policy is limited. This is a major drawback towards the preparedness of academic librarians to offer research data management services in Zimbabwe. The challenges being faced are mostly skills based and this shows that a lot of training is required to equip the academic librarians with the necessary skills and knowledge required to offer research data services.

REFERENCES

AIP Publishing. (2016). *Research data management: a brief overview for physical sciences librarians.* https://www.aip.org/sites/default/files/aippub/files/RDMFlyer.pdf

Avuglah, B. K., & Underwood, P. G. (2019). Research Data Management (RDM) Capabilities at the University of Ghana, Legon. *Library Philosophy and Practice (e-journal).* 2258. https://digitalcommons.unl.edu/libphilprac/2258

Baker, K. S., & Yarmey, L. (2009). Data stewardship: Environmental data curation and a web-of-repositories. *International Journal of Digital Curation*, *4*(2), 12–27. doi:10.2218/ijdc.v4i2.90

Barbrow, S., Brush, D., & Goldman, J. (2017). Research data management and services: Resources for novice data librarians. *Internet Resources, 78*(5). https://crln.acrl.org/index.php/crlnews/article/view/16660/18116

Bezuidenhout, L., & Chakauya, E. (2018). Hidden concerns of sharing research data by low/middle income country scientists. *Global Bioethics, 29*(1), 39-54. doi:10.1080/11287462.2018.1441780

Burnett, P. (2013). *What is the role of a librarian in Research Data Management?* http://blog.inasp/info/research-data -management-role-librarians/

Buys, C. M., & Shaw, P. L. (2015). Data Management Practices Across an Institution: Survey and Report. *Journal of Librarianship and Scholarly Communication*, *3*(2), 1225. doi:10.7710/2162-3309-1225

Chawinga, W. D., & Zinn, S. (2020). Research data management at a public university in Malawi: The role of "three hands". *Library Management*, *41*(6/7), 467–485. doi:10.1108/LM-03-2020-0042

Chigwada, J., Chiparausha, B., & Kasiroori, J. (2017). Research Data Management in Research Institutions in Zimbabwe. *Data Science Journal*, *16*(0), 31. doi:10.5334/dsj-2017-031

Chigwada, J. P., Hwalima, T., & Kwangwa, N. (2019). A Proposed Framework for Research Data Management Services in Research Institutions in Zimbabwe. In R. Bhardwaj & P. Banks (Eds.), *Research Data Access and Management in Modern Libraries* (pp. 29–53). IGI Global. doi:10.4018/978-1-5225-8437-7.ch002

Chiparausha, B., & Chigwada, J. P. (2019). Accessibility of Research Data at Academic Institutions in Zimbabwe. In R. Bhardwaj & P. Banks (Eds.), *Research Data Access and Management in Modern Libraries* (pp. 81–89). IGI Global. doi:10.4018/978-1-5225-8437-7.ch004

Chiware, E., & Mathe, Z. (2015). Academic libraries' role in Research Data Management Services: A South African perspective. *South African Journal of Library and Information Science*, *81*(2). Advance online publication. doi:10.7553/81-2-1563

Chiware, E. R., & Becker, D. A. (2018). Research data management services in southern Africa: A readiness survey of academic and research libraries. *African Journal of Library Archives and Information Science*, *28*(1), 1–16.

Confederation of Open Access Repositories. (2017). *Survey of Research Data Management: Results Kathleen Shearer and Filipe Furtado, Confederation of Open Access Repositories (COAR)*. https://www.coar-repositories.org/files/COAR-RDM-Survey-Jan-201.pdf

Conrad, S., Shorish, Y., Whitmire, A. L., & Hswe, P. (2017). Building professional development opportunities in data services for academic librarians. *IFLA Journal*, *43*(1), 65–80. doi:10.1177/0340035216678237

Cox, A., Verbaan, E., & Sen, B. (2012). Upskilling liaison librarians for research data management. *Ariadne*, *70*. http://www.ariadne.ac.uk/issue70/cox-et-al

Cox, A. M., Kennan, M. A., Lyon, L., Pinfield, S., & Sbaffi, L. (2019). Maturing research data services and the transformation of academic libraries. *The Journal of Documentation*, *75*(6), 1432–1462. doi:10.1108/JD-12-2018-0211

Cox, A. N., & Verbaan, E. (2016). How academic librarians, IT staff, and research administrators perceive and relate to research. *Library & Information Science Research*, *38*(4), 319–326. doi:10.1016/j.lisr.2016.11.004

Davidson, J. (2015). *Developing an organisational profile for research data management services - a guide for HEIs*. Digital Curation Centre. https://www.dcc.ac.uk/projects/opd-for-rdm

Erway, R. (2013). *Starting the Conversation: University-wide Research Data Management Policy*. OCLC Research. Available at http://www.ocrl.org/content/dam/research/publications/library/2013/2013-08.pdf

Fernihough, S. (2011). *E-Research: an implementation framework for South African organisations*. A research report presented to the Graduate School of Business Leadership, University of South Africa in partial fulfilment of the requirements for the Master's Degree in Business Administration. http://uir. unisa.ac.za/handle/10500/4474

Flores, J. R., Brodeur, J. J., Daniels, M. G., Nicholls, N., & Turnator, E. (2015). *Libraries and the Research Data Management Landscape*. https://www.clir.org/wp-content/uploads/sites/9/RDM.pdf

Harvey, R. (2010). *Digital curation: a how to do it manual*. Neal-Schuman Publishers.

Henderson, M. E., & Knott, T. L. (2015). Starting a Research Data Management Program Based in a University Library. *Medical Reference Services Quarterly*, *34*(1), 47–59. doi:10.1080/02763869.2015. 986783 PMID:25611440

Ingram, C. (2016). *How and why you should manage your research data: A guide for researchers*. https:// www.jisc.ac.uk/guides/how-and-why-you-should-manage-your-researchdata

Jones, S., Pryor, G., & Whyte, A. (2013). *How to Develop Research Data Management Services - a guide for HEIs'. DCC How-to Guides*. Digital Curation Centre. https://www.dcc.ac.uk/resources/how-guides

Kahn, M., Higgs, R., Davidson, J., & Jones, S. (2014). Research Data Management in South Africa: How We Shape Up. *Australian Academic and Research Libraries*, *45*(4), 296–308. doi:10.1080/00048 623.2014.951910

Kennan, M. A., & Markauskaite, L. (2015). Research data management practices: A snapshot in time. *International Journal of Digital Curation*, *10*(2), 69–95. doi:10.2218/ijdc.v10i2.329

Latham, B. (2017). Research Data Management: Defining Roles, Prioritizing Services, and Enumerating Challenges. *Journal of Academic Librarianship*, *43*(3), 263–265. doi:10.1016/j.acalib.2017.04.004

Lotter, L. (2011). *What can take the dark out of the long tail? Efforts to address the challenges of 'small science'*. Presentation given at the Centre for High Performance Computing Conference 2011, Cape Town, South Africa. Retrieved from https://www.chpcconf.co.za/files/2011/2011_08_L%20Lotter.pdf

Lotter, L. (2013). *Data curation implementation at the Human Sciences Research Council: Case study*. Presentation given at the eResearch Africa Conference 2013, Cape Town, South Africa. Retrieved from http://www.eresearch.ac.za/sites/default /files/image_tool/images/140/HSRC%20Case%20study.pdf

Lotter, L. (2014). *Reflections on the RDM Position in South Africa*. Paper presented at the LIASA Research Data Management Workshop, Cape Town, South Africa. https://www.dcc.ac.uk/webfm_send/1631

Majid, S., Foo, S., & Zhang, X. (2018). Research data management by academics and researchers: perceptions, knowledge and practices. Maturity and innovation in digital libraries. *20th International Conference on Asia-Pacific Digital Libraries*, *ICADL 2018, Hamilton, New Zealand, November 19-22, 2018*, *Proceedings*, 166-178. 10.1007/978-3-030-04257-8_16

Marchionini, G. (2012). *Research Data Stewardship at UNC: Recommendations for Scholarly Practice and Leadership*. University of North Carolina.

MetaArchive Cooperative Outreach Committee. (2015). *Getting to the Bottom Line: 20 Cost Questions for Digital Preservation.* https://www.metaarchive.org/cost-questions

Mosha, N. F., Luhanga, E. T., Mosha, M. V., & Marwa, J. J. (2019). Research Data Management among researchers in higher learning institutions of Sub-Saharan Africa. In P. Ngulube (Ed.), *Handbook of research on connecting research methods for information science research* (pp. 479–488). IGI Global. doi:10.4018/978-1-7998-1471-9.ch024

National Research Council. (2004). *Climate Data Records from Environmental Satellites: Interim Report*. The National Academies Press.

Ndhlovu, P. (2016). *The state of preparedness for digital curation and preservation: a case study of the National University of Science and Technology Library* (MSc Thesis). National University of Science and Technology, Zimbabwe. http://ir.nust.ac.zw

Ndhlovu, P. (2018). The State of Preparedness for Digital Curation and Preservation: A Case Study of a Developing Country Academic Library. *IASSIST Quarterly*, *42*(3), 1–22. doi:10.29173/iq929

Ndhlovu, P., & Ngwenya, S. (2017). Research data management services: an investigation of research data management practices at the National University of Science and Technology. *7th annual international conference on communication and information science*.

Nhendodzashe, N., & Pasipamire, N. (2017). *Research data management services: are academic libraries in Zimbabwe ready? The case of University of Zimbabwe library*. Paper presented at IFLA WLIC 2017, Wroclaw Poland – Libraries Solidality. Society in Session S06 - Satellite Meeting: Library Theory and Research Section joint with Preservation and Conservation Section and Information Technology Section. http://library.ifla.org/1728

Patterton, L. (2014). *Research data management at the CSIR: An exploratory survey.* Unpublished internal report, Council for Scientific and Industrial Research, South Africa.

Patterton, L. (2016). *Research data management practices of emerging researchers at a South African research council.* Submitted in fulfilment of the requirements of MIS (Research), Department of Information Science, Faculty of Engineering, Built Environment and Information Technology, University of Pretoria. https://repository.up.ac.za/bitstream/handle/2263/59502/Patterson_Research_2016.pdf

Pinfield, S., Cox, A. M., & Smith, J. (2014). Research data management and libraries: Relationships, activities, drivers and influences. *PLoS One*, *9*(12), e114734. doi:10.1371/journal.pone.0114734 PMID:25485539

Pryor, G. (2012). *Managing research data*. Facet Publishing. doi:10.29085/9781856048910

Rambo, N. (2015). *Research data management: Roles for libraries*. Issue brief. ITHAKA.

Rolando, L., Doty, C., Hagenmaier, W., Valk, A., & Parham, S. W. (2013). Institutional readiness for data stewardship: findings and recommendations from the research data assessment. Technical report, Georgia Institute of Technology, Atlanta.

Shen, Y., & Varvel, V. E. Jr. (2013). Developing Data Management Services at the Johns Hopkins University. *Journal of Academic Librarianship*, *39*(6), 552–557. doi:10.1016/j.acalib.2013.06.002

Stang, T. (2016). *How growth in research data is spurring a shift in the librarian's role, Librarians: the new research data management experts.* http://www.elsevier.com/connect/librarians-the-new-research-data-management-experts

Steinhart, G., Chen, E., Arguillas, F., Dietrich, D., & Kramer, S. (2012). Prepared to plan? A snapshot of researcher readiness to address data management planning requirements. *Journal of Escience Librarianship*, *1*(2). Advance online publication. doi:10.7191/jeslib.2012.1008

Tenopir, C., Christian, L., Allard, S., & Borycz, J. (2018). Research Data sharing: Practices and attitudes of geophysicists. *Earth and Space Science (Hoboken, N.J.)*, *5*(12), 891–902. doi:10.1029/2018EA000461

Tenopir, C., Dalton, E. D., Allard, S., Frame, M., Birch, B., Pollock, D., & Dorsett, K. (2015). Changes in data sharing and data reuse practices and perceptions among scientists worldwide. *PLoS One*, *10*(8), e0134826. doi:10.1371/journal.pone.0134826 PMID:26308551

Tenopir, C., Sandusky, R. J., Allard, S., & Birch, B. (2012). Academic librarians and research data services: Preparation and attitudes. *IFLA Journal*, *39*(1), 70–78. doi:10.1177/0340035212473089

Tenopir, C., Sandusky, R. J., Allard, S., & Birch, B. (2014). Research data management services in academic research libraries and perceptions of librarians. *Library & Information Science Research*, *36*(2), 84–90. doi:10.1016/j.lisr.2013.11.003

Tripathi, M., Chand, M., Sonkar, S. K., & Jeevan, V. K. J. (2017). A brief assessment of researchers' perceptions towards research data in India. *International Federation of Library Associations and Institutions*, *43*(1), 22–39. doi:10.1177/0340035216686984

UK Data Archive. (2018). *Create and manage data: Research Data Lifecycle*. https://www.data-archive.ac.uk/create-manage

Van Deventer, M., & Piennar, H. (2015). Research Data Management in a Developing Country: Personal Journey. *International Journal of Digital Curation*, *10*(2), 33–47. doi:10.2218/ijdc.v10i2.380

Whitmire, A. L., Boock, M., & Sutton, S. C. (2015). Variability in academic research data management practices: Implications for data services development from a faculty survey. *Program: Electronic Library and Information Systems*, *49*(4), 382 - 407. . doi:10.1108/PROG-02-2015-0017

Whyte, A., & Tedds, J. (2011). *Making the case for research data management*. http://www.dcc.ac/webfm_send/487

Yoon, A., & Schultz, T. (2017). Research Data Management Services in Academic Libraries in the US: A Content Analysis of Libraries' Websites. *College & Research Libraries*, *78*(7), 920. doi:10.5860/crl.78.7.920

Yu, H. H. (2017). The role of academic libraries in research data service (RDS) provision: Opportunities and challenges. *The Electronic Library*, *35*(4), 783–797. doi:10.1108/EL-10-2016-0233

Zhou, Q. (2018). Academic libraries in research data management service: Perceptions and practices. *Open Access Library Journal*, *5*(06), e4693. doi:10.4236/oalib.1104693

KEY TERMS AND DEFINITIONS

Academic Library: It can be a physical or digital space that houses scholarly research materials that support the university or college teaching and learning activities.

Data Repository: A location that holds data and makes it available to researchers. It can be general or subject specific.

MOOCs: Online courses aimed at unlimited participation and open access via the web. It is an acronym which stands for massive open online courses.

On the Job Training: It is a concept of learning by doing where workers learn new skills by performing the work in the actual work environment.

Research Data Management: It is the process of organising, storing, preserving, and sharing of data collected and used in a research project.

Self-Training: This is when a learner takes the initiative to learn using his/her own resources.

Tertiary Institutions: it is a form of post-secondary education which offers degrees, diplomas, technical, or teacher education courses.

Webinars: It is a seminar conducted over the internet.