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Research Data Management Competencies for Academic Libraries: Perspectives from Two Universities in South Africa

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Abstract

The rapid pace of technological change has significantly transformed the librarianship profession, impacting the required competencies for professionals working in library and information services (LIS). As new roles emerge within academic libraries, librarians need to assess their current knowledge and skills as well as identify additional knowledge and skills needed to adapt to evolving roles and responsibilities. This paper reports findings of a study conducted at two university libraries in South Africa. The objective of the study was to identify the competencies necessary for academic librarians in providing research data management services (RDM). While previous studies have explored the knowledge and skills required for academic librarians in Southern Africa and globally, there is a research gap concerning the specific competencies necessary for RDM. This study employed semi-structured interviews with librarians from two selected university libraries, using purposive sampling. The research also included document reviews and content analysis of relevant academic library job advertisements. The study's findings highlight key competencies such as information and data management practices, repository management, data curation, data collection management, understanding funders' policies, research methods and processes, as well as ICT and digitization skills. The findings also highlight the importance of robust training and self-development through online courses, webinars, and freely available materials as strategies to support RDM.

Keywords: Academic Libraries, Competencies, Research Data Management Services, South Africa

Introduction

Libraries organise information for easy retrieval, but the rise of vast amounts of data in the digital age has led academic libraries to adapt by developing electronic research collections, digital publications, and open access initiatives. However, managing the increasing volume of born-digital data has presented a challenge for libraries (Cox and Verbaan, 2018).

As the role of libraries has changed, there has been a growing demand for research data management services, prompting libraries to plan for these services. (Borghi et al.,2018). For example, the National Research Foundation (NRF) in South Africa requires grant recipients to make their research output openly accessible thus emphasising the need for libraries to provide research data management services (National Research Foundation, 2015). Since many academic libraries are preparing or may have already begun to implement research support services, it is important to ascertain whether libraries have the competency requirements to be able to provide research data management (RDM) services and whether libraries have opportunities for librarians to gain research data management skills (Cox and Verbaan,2018)

While it may be argued that libraries would be better suited to manage large amounts of data due to their traditional roles of organising information, this

may not necessarily be the case as there is no certainty that academic libraries are ready to embark on this task. To have a meaningful impact in data science and open science, academic librarians can provide valuable assistance and support. However, they may need to enhance their expertise and skill sets in order to do so (Federer et al., 2020). Frederick and Run (2019) argue that providing RDM services may be seen as merely an extension to the libraries existing work. However, Joo and Schmidt (2021) point out that "subject knowledge is critical to be able to assist researchers with locating and using data sets". The question as to whether academic libraries have the necessary knowledge, skills and experience to be able to transition effectively into these new roles required research into this area. Hence the purpose of this paper is to report on a study that enquired into the competency requirements of academic librarians for research data management services.

Research problem

Academic librarians in their support of institutional research are aware that there is increasing demand by universities and research councils to make research data openly available. Therefore, there is a need to investigate the research 'problem' of required competencies for academic librarians in providing research data management services. Studies have been conducted, both in Southern Africa (for example, Beitz, Dharmawardena and Searle, 2012; Raju, 2014; Johnson, 2016; Nkuebe, 2016; Chiware 2020) and globally (for example, Nonthacumjane, 2011; Blakiston, 2011; Brown, Wolski and Richardson, 2015; Tang and Hu 2019), on the knowledge and skills requirements for academic librarians but not with a specific focus on competencies required for RDM academic library services in the South African context. The objective of the study was to identify, using two South African academic libraries (that is, the Mangosuthu University of Technology (MUT) and the University of KwaZulu-Natal (UKZN) libraries) as case studies, the competency requirements of academic librarians in providing research data management services.

The following research questions were used to address this objective:

RQ1: What knowledge, skills and other competencies do librarians at MUT and UKZN currently possess to support research data management services?

RQ2: What knowledge, skills and other competencies do academic librarians require in order to effectively provide research data management services to their research communities?

RQ3: What strategies are required to ensure that academic librarians are equipped with the necessary knowledge, skills and other competencies in order for them to effectively provide research data management services to the library's research communities?

The focus of this paper will be on RQ2 with brief references to RQ1 and RQ3.

Literature Review

Huang et al. (2020) observe that there has been growth in the support for open research. Davis and Cross (2015) state that a set of core competencies have begun to emerge for library support of research data and these competencies may be used to audit data management plan review services to be able to enhance these core competencies among academic librarians. According to Chiware (2020), research data management is evolving in South Africa, as is elsewhere in the world. This is because there were early adopters in the higher education and research sectors who began developing RDM guidelines and policies. A study by Cox et al. (2017) which looked at RDM activities in higher education libraries internationally showed that libraries were more focused on advisory and consultancy aspects such as data management plans and training. Cox et al. (2019) further argue that the major challenge when it comes to the implementation of RDM services, is the lack of skills. Kahn et al. (2014) looked at whether South African higher education institutions were ready for RDM and they confirmed then that while South African higher education institutions were ready for RDM, there was still a challenge of RDM skills shortage. This was more recently supported by findings in Chiware's (2020) study which found that there was limited skilled personnel to run research

data management services in South African academic and research libraries.

The study also revealed that there was still a lack of service development as libraries were more focused on advisory and consultancy aspects, as mentioned earlier. Tenopir et al. (2017) also attest to this by stating that libraries tend to focus more on consultative service rather than technical service. This was also found in a study by Faniel and Connaway (2018) who interviewed US-based library professionals about their experiences and goals with research data management and found services provided to researchers were consultation and education related. Chigwada, Chiparausha and Kasiroori (2017), in a study looking at RDM in research institutions in Zimbabwe had similar findings in that they found that there was also no centralised RDM service provided; and they observed issues with regards to lack of institutional guidelines, lack of technology, lack of infrastructure and lack of funding. Cox et al. (2019) are also in agreement with other literature that the major challenge when it comes to the implementation of RDM services is the lack of skills but also includes the debate of who should be involved in RDM services and the issue of acceptance of the service by researchers. Sanjeeva (2018) who looked at the new role for libraries in RDM also noted that there has been a 'great debate' about RDM and who should take the lead in the institution among the IT department, research administrators and librarians. Sanjeeva (2018) concluded that it is not a matter of who leads but all about collaboration amongst these departments to fulfil institutional needs. Libraries will have to collaborate and be team members in starting RDM services in their institutions (Sanjeeva, 2018). Universities and university research libraries, according to Kim (2021), are unquestionably examples of collaboration in action. libraries provide a wide range of services to meet the diverse needs of their users. They have developed an internal and external structure for addressing stakeholders' needs and working as team members because they are a part of the university and its organizational culture. In order to be successful in meeting the needs of their users and supporting the university's aims and objectives, they also regularly collaborate with other units on campus, particularly where there are strong shared interests and activities. Mush, Pienaar and Van Deventer (2020) also conclude that research data management is a collaborative effort, and various research stakeholders all have roles to play in providing effective research data management services. Mthembu and Ocholla (2022) agree, believing that capacity building will accelerate collaboration between departments and institutions, as well as highlight their role in the research process. They discovered a lack of capacity building programs to develop RDM skills in their study. The benefit of RDM in an institution is its impact on the university's visibility and there is also a strong connection between RDM services and the open access agenda that libraries have been promoting (Ng'eno and Mutula 2018).

According to Koltay (2019) libraries have been involved in information literacy and thus it should not be an unusual task for them to provide data literacy. Tang and Hu (2019) point out that US librarians have already begun to include in their reference and consultation services information and advice on issues related to data management; they are adding on to their existing training, matters related to open access and other academic communication, including copyright and intellectual property, metadata and technical standards, data archiving and preservation. Academic librarians can easily transit to helping users with managing data because they have been providing similar services. Dora and Kumar (2015) further state that librarians are already skilled experts in metadata, curation of data, and archiving and preservation and this makes it easier for them to simply add research data management to their role.

Research data sets are unique to the library collection; however, they do overlap with activities and interests that already exist in the library. For instance, academic libraries are already advocating for open access and are leading in the establishment of institutional repositories (Lee and Stvilia, 2017). Lafferty-Hess et al. (2020) opine that institutional repositories are a good place to start when it comes to data curation; many university libraries have been depositing research outputs in such repositories and this is now becoming more common in academic library work. Martin-Melon, Hernández-Pérez and Martínez-Cardama (2023) found that the most requested services were for librarians to assist in identifying datasets for students, they will be advising researchers on data analysis and data manipulation

and assisting researchers with data plans and in creating websites where the data will be made accessible. Fu, Blackson and Valentino's (2023) study suggested that it will be very effective if the library did not only just play a role in making data available but that it should also include a role in providing web applications that will enable data visualization or exploration. Therefore, librarians will have to gain skills in identifying such applications.

A study by Shelly and Jackson (2018) used content analysis to look into the role of libraries in supporting RDM in 13 Australian universities. The study found that there was a need for RDM advice and practical suggestions for researchers, particularly in the areas of metadata creation and data loading into repositories. Other studies (Dressel, 2017; Matlatse et al., 2018; Vilar and Zabukovec, 2019) too have reported important developments with RDM services offered by academic libraries. According to Ohaji, Chawner and Yoong (2019) librarians will play a major role in curating and managing research data. Tammaro et al. (2019) examined relevant job listings to explore data curation librarian responsibilities. They found that common responsibilities included instruction, reference, outreach, access, preservation, policy, data management, system design and research support. The study being reported in this paper also used content analysis of job advertisement to determine the competencies required for RDM services.

Joo and Schmidt (2021) found that the top three categories of knowledge and skills include developing and teaching instructional content related to data services, data management planning and data ethics. Participants also identified data structure, data citations and data repositories as important knowledge requirements for RDM. According to Hamad et al. (2021) knowledge of metadata standards plays an important role in discovery, storage, access and preservation of data. A study by Masinde, Chen and Muthee (2021) found that researchers also lacked skills in metadata creation and would require assistance with this from the library. In their study, Singh, Bharti and Madalli (2022) discovered that IT and technical skills, as well as knowledge of various research methods and the research lifecycle, are the most desired skills for professionals involved in RDM services. Academic libraries and librarians will have to have knowledge and skills for website design and understanding in using internal and external links to provide access to tools that help researchers manage data. In the study by Yoon and Schultz (2017), where content analysis of 185 US library websites was undertaken, it was found that most libraries had websites, but these websites did not clearly explain what RDM is and the scope of RDM services was not clearly explained. Additionally, Hswe and Holt (2011) reported that library data management planning websites merely provided links to the resources of other institutions; this means that libraries were, at the time, still lacking in creating their own content for RDM. A few years later this was corroborated by Yoon and Shultz (2017) who found that libraries were simply providing links to RDM websites. The study by Fu, Blackson and Valentino (2023) found that libraries will have to provide access to data by using repositories to deposit data, and therefore a knowledge of evaluating different repositories and how they work and function is important. Chigwada, Chiparausha and Kasiroori (2017) explain that to achieve data collection, libraries will have to partner with researchers in the very early planning stages of research. Chiware and Becker (2018) emphasise that the major role for librarians that will assist in the in standardised services of research data, is the formulation of an RDM policy for the institution.

According to Barbrow, Brush and Goldman (2017), libraries have little experience in managing research data at any stage of the research life cycle, and therefore to help them gain the skills required, libraries will have to educate themselves through training. In support of this Goben and Raszewski (2015) claim that libraries which seek to render RDM services should look to expand in the "foundational resources and information about the network of librarians exploring data, [and] support the stamen of professional development". Similarly, Wittenberg, Sackmann and Jaffe (2018) point out that a domain-based librarian training programme is one way for subject librarians to improve their data service capacities. Singh, Bharti and Madalli (2022), who in their study evaluated RDM services in academic libraries, mentioned that as part of their staff development programs, Indian academic libraries encourage their professionals to participate in webinars, online tutorials, seminars, conferences, and workshops, as well as courses related to RDM.

Goben and Raszewski (2015) have recorded a webliography for libraries to self-educate themselves on research data management; the webliography includes foundational material, current awareness, and social media. The University of North Carolina (2020) developed a data science framework where they propose reskilling for subject librarian in tier stages based on the data services that they will be providing. This could be recommended for academic libraries which are looking to develop competencies in RDM. Wittenberg, Sackmann and Jaffe (2018) state that many higher education institutions can provide training for RDM and provide website links and institutional support that outline best practices in RDM.

It is evident that the literature is rich in deliberations on competencies required by academic librarians to effectively provide RDM services, as well as in discussions about opportunities for academic librarians to acquire the necessary knowledge and skills for providing RDM services.

Methodology

This study adopted a qualitative research approach, located within an interpretive paradigm to understand the competency requirements of academic librarians in providing research data management services in two particular university settings. A multiple case study design (Yin, 2018) was adopted using university libraries of two South African higher education institutions (MUT and UKZN). The primary method of data collection was semi-structured interviews with purposively selected academic librarians from the two research sites. Content analysis of academic library job advertisements with RDM responsibilities (n=31 out of a total of 171 academic library job advertisements) for the three-year period 2019 to 2022, was used as a supplementary method to obtain insight into the competencies required for academic library RDM services. Purposively selected librarians (n=10) participated in the study based on their capacity to contribute rich data that addressed the study's research questions. Thematic content analysis, which is used to present themes that relate to data collected (Erlingsson and Brysiewicz 2017; Braun and Clarke, 2022), was conducted. The researcher identified categories of themes based on respondents' knowledge and skills in RDM and from supplementary data collected via relevant job advertisements. The data was analysed using Excel and displayed in graphs and tables using descriptive statistics to capture frequency counts and percentage distributions, where applicable.

Findings and Discussions

While most interview respondents' job titles were Subject Librarians, the content analysis of job advertisements revealed a variety of job titles involving RDM services with Faculty Librarian being the more common job title (see Fig. 1). RDM services in academic libraries appear to be spread across a variety of professional job titles. RDM related posts often asked for a professional qualification in library and information science (LIS) which in South Africa could either be a four-year undergraduate degree or a three-year bachelor's degree plus a one-year postgraduate professional diploma in LIS. Some of the advertisements also mentioned an IT qualifications background as an advantage. As academic libraries move deeper into the age of the fourth industrial revolution (4IR), perhaps an advanced research degree should be a requirement for RDM services. There is support for this from Chiware and Becker (2018) who, in undertaking a South African study, established that most participants in the study who were involved in offering RDM services had a Masters or Honours degree. This is also evident in an international study by Tammaro et al. (2019: 97) which found that though most participants who worked with RDM were not in possession of a master's in LIS, they, however, had "advanced industry degrees" and prior research experience. Their study stressed the importance of knowledge of the research process in research data management and, it should be noted, that advanced degrees and research experience do tend to bring greater knowledge about the research process.

Fig. 1: Job titles from RDM related job advertisements (N=31)

In South Africa, there are three types of universities. Traditional universities refer to the older established universities in South Africa, prior to the higher education restructuring exercise following the establishment of a new democratic order in 1994. These universities are more research focused and offer degrees up to doctoral level (Ocholla and Ocholla, 2020). Universities of technology in South Africa are known to specialise in technology-oriented qualifications for skills-based vocational positions and comprehensive universities are new institutional types in the South African higher education system, offering a mixture of both technology-oriented and traditional theoretical and philosophically based qualifications (Kele and Mzileni, 2021). Fig. 2 illustrates that most of the RDM related positions in this study's content analysis of job advertisements were located in traditional universities (71% as opposed to 23% for universities of technology). This is likely because these universities are more research-focused and hence the need for RDM services in their university libraries. A similar situation is likely to play itself out in other parts of the world, irrespective of the nomenclature used to describe various types of higher education institutions.

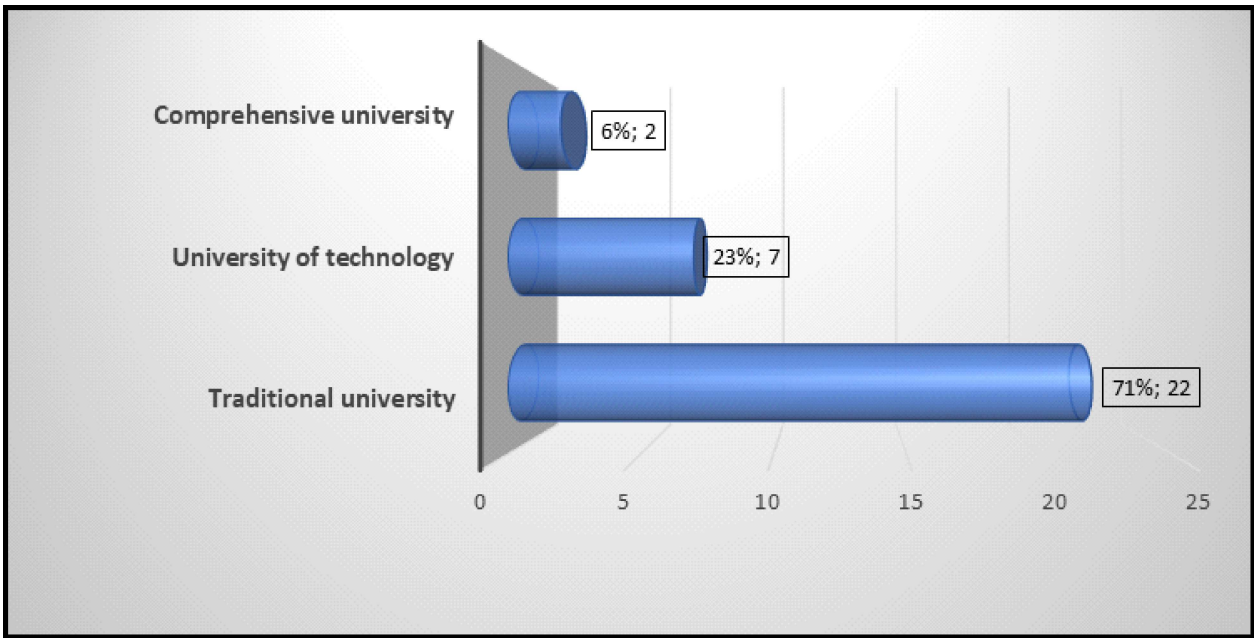

Fig. 2: Type of higher education institution within which the RDM related post is advertised (N=31)

Interviewed academic librarians were asked what knowledge (that is, theoretical and practical understanding of a subject gained through formal education or experience) they believed academic librarians at MUT/UKZN required to effectively provide RDM services to their research communities. Their responses are captured in Table 1 where 9 out of the 10 interviewed librarians emphasised knowledge of: Information and data management practices; Data centres, repositories and collections; and Data curation. The content analysis of job advertisements revealed the most required knowledge set for RDM services to be Research methods (68% of RDM related job advertisements), the Research process (65%) and Scholarly communication (52%) (see Table 2). In a large-scale study of 240 librarians across five continents, Tang and Hu (2019) made similar findings where almost 23% of librarians indicated that advanced data management skills involving research knowledge were necessary to curate and manage datasets.

Table 1: Knowledge requirements for RDM services from interviewed librarians (N=10)

Knowledge areas identified	Frequency
Information and data management practices	9
Data centres, repositories and collections	9
Data curation	9
Managing data collections	7
Funders' policies	7
Data publication requirements of journals	6
Licensing and intellectual property	4

Table 2: Knowledge requirements for RDM services from job advertisements analysed (N=31)

Knowledge requirements	Frequency	Percentage
Research methods	21	68%
Research process	20	65%
Scholarly communication	16	52%
Data sources	8	26%
Data curation	8	26%
ICTs and e-services	5	16%
Marketing methods	2	6%

Relevant verbatim responses from interviewed librarians regarding knowledge requirements for RDM services, included:

> *"Knowledge on how to do data management plans so they can take this to researchers, how to store data in its different formats and it's important for librarians to be aware of the different data that is collected in different fields."*

> *"Librarian must have knowledge on how to manage data collections."*

> *"I think librarians will need to be aware of the funders' policies and requirements; data centres; how to create data management plans; how data is published and how data must be cited."*

A question on what skills (that is, the ability to perform a task well) they thought academic librarians at MUT/UKZN required to effectively provide RDM services to their research communities, was posed to interviewed librarians. ICT skills (reported by 10 of the 10 respondents); Digitization, and Preparing datasets for deposit (both mentioned by 8 of the 10 interviewees) as key skill set requirements, were identified by the responding librarians – see Fig. 3. A librarian commented that, *"Librarians will have to have ICT skills as well as skills on digitization"*. Noteworthy skills that emerged from the job advertisement content analysis included: Digital literacy and instructional design skills (52%); Institutional repository and metadata skills (48%); and Data and information literacy skills (45%) – see Fig. 4. While not high in the frequency counts, Data curation skills (see Fig. 4) also featured significantly in the job advertisement content analysis. In the job advertisements analysis, bibliometrics skills surfaced as a skills requirement for RDM services, but did not feature as a prominent skill set among the interviewees. These skills were also mentioned as prominent skills required for RDM in the following studies: Ohaji, Chawner and Yoong 2019; and Brochu and Burns, 2018. Tang and Hu (2019) add that librarians must be proficient in data management.

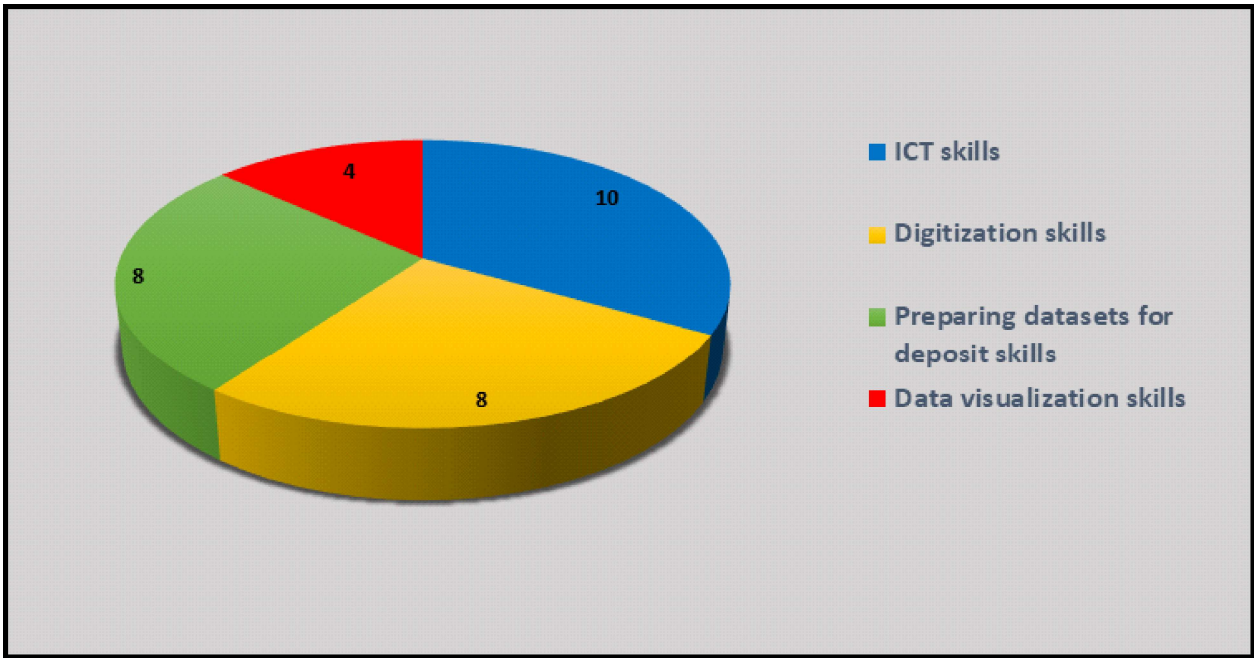

Fig. 3: Skills required by MUT/UKZN academic librarians to effectively provide RDM services as identified by interviewed librarians (N=10)

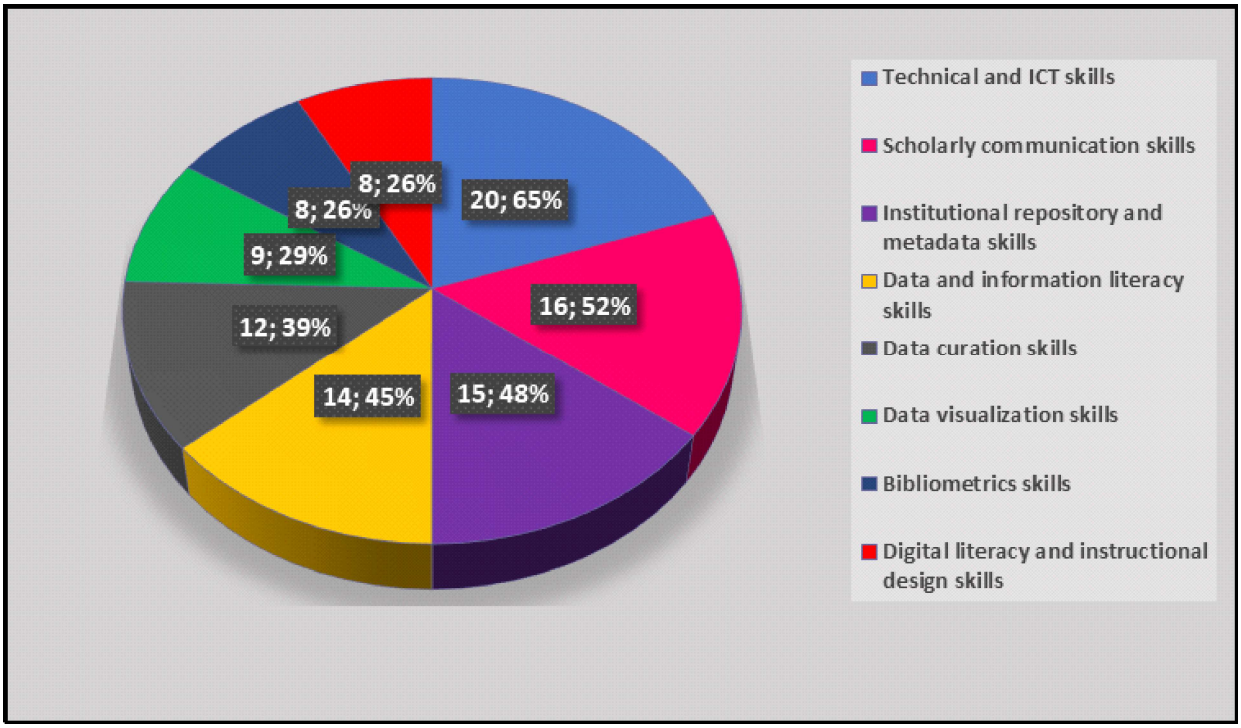

Fig. 4: Skills requirements for RDM services from job advertisement analysis (N=31)

The study also probed librarians' personal attributes required for provision of RDM services. Interviewees identified attributes such as being flexible, tech-savvy, willing to learn, and being able to adapt to change as being significant to work in this emerging field. These personal attributes are also highlighted in the literature, for example, Ohaji, Chawner and Yoong (2019), where adaptability and flexibility are noted as being likely attributes required for RDM. This is correlated by Federer (2018) who emphasises that soft skills such as eagerness to learn are encouraged for RDM services.

It would seem from these findings on knowledge, skills and attributes from the two cases (MUT and UKZN) that there are a number of competencies needed for RDM services. The most dominant knowledge sets that emerged from this study include knowledge of: Information and data management practices; Data centres, repositories and collections; Data curation; Managing data collections; Funders' policies; Research methods; and Research processes. Dominant skillsets required for RDM services that emerged from the study include ICT skills; Digitization skills; and Preparing of datasets for deposit. Dominant personal attributes (or 'other competencies') emerging from the study include: Flexibility; Adaptability; Being tech-savvy; and A willingness for continuous learning.

Interviewed academic librarians were asked to draw from their experiences with research communities served by MUT/UKZN Libraries to identify strategies that they believed would need to be put in place to ensure that academic librarians at these institutions are equipped with the necessary knowledge, skills and other competencies in order for them to effectively provide research data management services to the library's research communities. Interviewed librarians believe training, support and collaboration with other departments are key strategies to ensure librarians have the necessary competencies to effectively provide RDM services. Some useful responses included:

> *"Training and benchmarking are needed especially from the universities that already have an understanding of data management."*

> *"Robust training is needed in the area of RDM so that librarians can be able to facilitate RDM services."*

> *"Training for librarians is required to train and support researchers in RDM. Librarians should also work closely with other support services including technical services and research officers to ensure that the terminologies and practices are relevant to the researcher and the field in which they work."*

> *"Libraries will need to work with IT services and legal advisor to understand the legal implications of making data available."*

> *"It is important for academic libraries to have a clear project plan on how they will implement research data management involving all stakeholders."*

Librarian respondents in the study indicated that for RDM to be successful libraries should be institutional role-players. This is supported by Perrier, Blondal, and MacDonald (2018). It emerged from the study that academic libraries need robust training and benchmarking for librarians to ensure they remain up to date in a rapidly evolving field such as RDM. Such support will enable academic libraries to successfully implement RDM services. Similar observations were noted by Wittenberg, Sackmann and Jaffe (2018) about academic libraries' support for professional development through training programmes, workshops and conferences, suggesting a commitment to developing librarians individually. Data collection development policies will have to be in place to address licensing issues. Policies will also assist researchers with guidelines on creating their data management plans (DMPs). Wittenberg, Sackmann and Jaffe (2018), and Rod, Zhou and Rousseau (2023) elaborate on the institutional role that the organisation should play in providing RDM services, and these include guidelines and policies, infrastructure and funding, data storage, and intellectual property support. Such support will enable academic libraries to successfully implement RDM services.

Academic librarians need to be equipped with the necessary knowledge, skills and other competencies to effectively provide RDM services to their research communities. In summary, this means having robust training (in the form of institution sponsored training programmes, workshops and conferences) as well as self-development via online courses, webinars and other materials freely available online. A key strategy may also include the library becoming a key institutional role-player in the implementation of the institution's RDM.

Conclusion and Recommendations

The findings of this study indicated dominant competencies required by academic librarians to effectively provide RDM services to their research communities. These knowledge sets include knowledge of Information and data management practices; Data centres, repositories and collections; data curation; managing data collections; funders' policies; research methods; and research processes. Dominant skillsets required for RDM services that emerged from the study include ICT skills; Digitization skills; and Preparing of datasets for deposit. Dominant personal attributes (or 'other competencies') emerging from the study include flexibility; adaptability; being tech-savvy; and a willingness for continuous learning. An important finding from the study is that a LIS professional wishing to engage in RDM is not expected to possess all of these and other relevant competencies. Hence the need for LIS professionals engaged in RDM to work as a team, both in terms of current skills possession as well as future learnings for efficient RDM services to research communities.

Findings also revealed that strategies to support and reskill for RDM include robust training and self-development via online courses, webinars and other materials freely available online, and institutional support; and collaboration with other campus departments such as IT and the research office who also possess competencies relevant to supporting RDM services offered by the library.

Based on the findings, this paper recommends that strong training should be provided for academic librarians to upskill and close the gap between current competency possession and required competencies. To identify campus roles and responsibilities and for proper workflow in RDM implementation by the academic library and its campus associates, institutional support in the form of policy formulation, guidelines provision, infrastructure, funding, and other relevant support should be provided. Collaboration and cooperation among relevant institutional partners should be implemented in order to identify campus roles and responsibilities and to ensure proper workflow in the implementation of RDM by the academic library and its campus. While this study focussed on just two academic libraries as an exploratory exercise in ascertaining academic library competency requirements for RDM services, more research is needed, possibly on a larger scale involving more academic libraries in South Africa and elsewhere for purposes of comparison and benchmarking.

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