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Research Data Management at the University of Ghana: Myth or Reality?

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Abstract

This article explores Research Data Management (RDM) at the University of Ghana (UG). It emphasises on institutional awareness and attitudes, and whether the University Library is officially supporting this emerging strategic interest in research focused Higher Education Institutions (HEIs). Purposive sampling was used to select information-rich respondents from across the University (i.e. librarians, research administrators, ICT managers and senior researchers) who were interviewed on a range of issues about RDM. Institutional documents were also reviewed to corroborate the primary data and get a deeper understanding of the research problem. The study shows that while RDM is recognised at the institutional level as good research practice and integrity issue, the concept is tenuously understood in the local community. Unsurprisingly, however, there was a general appreciation and awareness of the need for RDM and the implications for such critical concerns as security, integrity, continuity and institutional reputation. The library is yet to take a strategic approach to RDM issues and there is clearly a dearth in RDM expertise within the library system. The study recommends that the library must be proactive in advocating and promoting RDM issues at UG, but first, the librarians must take advantage of numerous existing opportunities to build their capacity.

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Introduction

One of the issues of strategic importance to many higher education institutions (HEIs) in recent times has been the effective management of research data (Cox and Pinfield, 2014). The growth of data-intensive and collaborative science in nearly all knowledge domains, and the value and prospect of research data management (RDM) for advancing scientific research means that, research data is not only viewed as a strategic institutional asset for HEIs but also its effective management and sharing is gaining traction among governments, funding bodies, and researchers.

Research shows that the concept of RDM is new to Africa (Avuglah and Underwood, 2019; Patterton, Bothma and van Deventer, 2018; Ssebulime, van Deventer and Pienaar, 2018; Chigwada, Chiparausha and Kasiroori, 2017). South Africa remains the most significant case on the continent. The National Research Foundation (NRF) through its "Statement on Open Access to Research Publications" recognises open sharing of data and also mandates researchers to deposit their research data in open access repositories (NRF, 2015). There are also national level initiatives including the development of cyber-infrastructure to support data-intensive and collaborative research (Ng'eno and Mutula, 2018; Kahn, Higgs, Davidson and Jones, 2014). In response, many South African HIEs are beginning to develop RDM policies and programmes (van Deventer and Pienaar, 2015; Kahn et al., 2014). These notwithstanding, there is a dearth in the literature on RDM awareness and how it is perceived and practiced in Africa in general. van Deventer and Pienaar (2015) intimated that RDM experiences from the perspective of developing countries can provide valuable insight even for pacesetters from developed regions. Studies by Avuglah and Underwood (2019), Ng'eno and Mutula (2018), Chiware and Becker (2018), Ssebulime et al. (2018) and Chigwada et al. (2017) have been useful sources to glean insight on the RDM landscape in Africa beyond South Africa. They indicate a generally low level of RDM development and limited capacity with pockets of initiatives. This paper adds to the African story.

This article discusses selected findings from a research study conducted at a Ghanaian tertiary institution. The University of Ghana (UG) is the premier and one of the largest public universities in Ghana; reputed as a centre for academic and research excellence. Its vision is to become a world-class research-intensive University by the year 2024 (University of Ghana, 2014), to which end it aspires inter alia to increase its research funding streams by at least 150%, quadruple the number of its faculty publications in high-impact journals and connect to global research networks (University of Ghana, 2014). These aspirations are consistent with some of the opportunities that institutional RDM programmes provide (Hiom, Fripp, Gray, Snow and Steer, 2015). The study was also conducted in part because of the unique context of UG. Ghana as a country has no legislation or formal policy on research data management. Advocating, promoting and evolving an RDM culture in such a context might prove more challenging compared to regions where national legislation and policies of funding agencies necessitate RDM development and practice (Higman and Pinfield, 2015). This is why it is important to gauge the awareness, perception and attitudes of the local community about RDM in order to know how best to approach RDM advocacy and promotion. There is also little mention of RDM in the literature on Ghana. Therefore, the purpose of this article is to explore RDM at the University of Ghana (UG). It specifically focuses on the following objectives:

- To assess the RDM awareness, understanding, attitudes and practices within the UG research community.
- To find out whether and how the University Library was supporting RDM.

Literature Review

RDM has been defined variously in the literature by different scholars (Surkis and Read, 2015; Ray, 2014; Jones, Guy and Pickton, 2013; Whyte and Tedds, 2011). The scope and details of these definitions are also varied. In this paper, a widely cited definition proffered by the United Kingdom's Digital Curation Centre (DCC) is adopted. It defines RDM as "the active management and appraisal of data over the lifecycle of scholarly and scientific interest" (Jones et al., 2013). RDM involves more than just storing or archiving research data. It encompasses of a number of processes and activities relating to the collection, stewardship, ownership, protection, retention, analysis, sharing and reporting of research data (Eckard, 2014; Pienaar, 2011). It also concerns the expertise and technical capabilities required to carry out these processes and activities, the legal and policy frameworks that provide the context for them and the ethical concerns and imperatives that shape institutional and researcher practices (Ng'eno and Mutula, 2018; Cox and Pinfield, 2014).

The data and research lifecycles have been used to explain RDM. Surkis and Read (2015) discussed how the data lifecycle concept has been instrumental in explaining and understanding the scope and meaning of RDM. Carlson (2014) also noted how the lifecycle approach helps to cascade the relationships between the distinct stages of research data and the services needed to support the various activities throughout the stages. For instance, Higgins (2012) discussed the processes and activities required for curating and preserving research data throughout its lifecycle using the DCC Digital Curation Lifecycle model. The UK Data Archive Lifecycle also outlines specific RDM activities associated with each stage of the lifecycle. Scholars like Higgins (2012) and Pryor (2012) have also posited that data is centric to the research lifecycle and that specialist expertise is needed to effectively manage it. Lyon (2012) further maps the data support functions expected of librarians to the research lifecycle. RDM can, therefore, be viewed as a framework for supporting the data needs of researchers through every stage of the research lifecycle.

There has, however, been tendencies for misconceptions about the concept, especially in environments where the concept is fairly new or where experiences with RDM are very limited (Wiorogórska, Leśniewski and Rozkosz, 2018; Conrad, Shorish, Whitmire and Hswe, 2017; Darlington, Ball, Thangarajah, McMahon and Lyon, 2012). Renwick, Winter and Gill (2017) thus suggest that data literacy should be incorporated into information literacy training for researchers. This is very important because how the concept is understood and perceived within a research community is likely to shape the community's response to its development and uptake (Higman and Pinfield, 2015).

Proper and effective RDM is essential to managing research risks since every research is prone to a variety of data-related risks including data loss or corruption, and privacy or copyright breaches (Harris-Pierce and Liu, 2012) which can have significant, potentially catastrophic implications. It can help to curtail potential reputational damage to an institution (Whyte and Tedds, 2011), especially because good RDM practices ensures adherence to high and ethical research standards. Within well-established

institutional frameworks, potential risks can be picked up early in the research process (Avuglah and Underwood, 2019; CGIAR, 2017). The importance of RDM cannot be over-emphasised. Gathering data for research in itself can be an arduous task requiring the commitment of time and financial resources which are limited (Van den Eynden, Corti, Woollard, Bishop and Horton, 2011). The data may also have the potential for reuse or repurposing beyond the original research that produced it, or it may be practically impossible to recreate (Ng'eno and Mutula, 2018). Therefore, when research data is properly managed and openly shared, institutions are spared from expending extra funds to gather or create new data (Harris-Pierce and Liu, 2012). This is why RDM is becoming a matter of strategic importance to HEIs.

Libraries have been at the forefront of RDM promotion and initiatives. Cox and Verbaan (2016) intimated that there is a growing shift in the role of academic libraries towards more embeddedness and engagement in the research lifecycle, and RDM is one of the means towards such deeper engagement. The growing body of RDM literature on libraries, the increasing number of data initiatives as well as the creation of RDM portfolios in libraries shows that RDM is increasingly becoming a strategic focus for academic libraries, and studies by Searle, Wolski, Simons and Richardson (2015), Cox and Pinfield (2014) and Corrall, Kennan and Afzal (2013) among others demonstrate this.

RDM is considered a natural extension of the mandate of academic libraries who have always been the custodians and managers of scholarly outputs of which research data is inclusive (Lewis, 2010; Henty, 2008). Lewis (2010), Corrall (2012) and Lyon (2012) are popular for propounding RDM functions that resonate with Librarians' current expertise and services. While Lewis and Corrall present a hierarchical outlook of RDM roles ranging from broader issues of national-level advocacy and curriculum development to institutional-level local support, Lyon (2012) situates librarians' role within a research lifecycle model – The Research360 Institutional Research Lifecycle (Cox and Pinfield, 2014), giving legitimacy and making a stronger case for librarians. However, a recent study by Faniel and Connaway (2018) found that librarians' ability to successfully deliver RDM services and programmes hinges on the availability and adequacy of technical and human resources, the perceptions of researchers about the library, leadership support, and communication and collaboration with other stakeholders.

A 2017 international survey by Cox and his colleagues points to a growing leadership role for librarians in RDM in most HIEs especially in the area of advocacy and policy development (Cox, Kennan, Lyon and Pinfield, 2017). They also found that the scope of services is heavily tilted towards advisory and consultancy such as training on data literacy and supporting data management planning rather than on more technical support like curation. While efforts are afoot to bridge the skills gap, particularly in data curation skills, issues of resource adequacy, opportunities for collaboration with other service units as well as gaining legitimacy in the eyes of researchers and support from university leadership remain pressing challenges for academic librarians. Both studies by Faniel and Connaway, and Cox et al. help to contextualize the space within which academic libraries must strive to demonstrate value and prove their worth in this data landscape. Renwick et al. (2017) thus admonish librarians to engage with researchers to inform them about how they can support their data management needs. To do this, they need professional development opportunities to build capacity (Conrad et al., 2017), and they must collaborate with other services units such as IT and the Research Office on campus to deliver specialised support services for researchers (Wiorogórska et al., 2018; Renwick et al., 2017; Cox and

Verbaan, 2016) because RDM is a multi-stakeholder enterprise (Jones, Pryor and Whyte, 2013).

Methods

This paper is based on an original Master's degree study carried out to develop a strategy for RDM implementation at the University of Ghana. The case study method was adopted for the study. This current article reports on selected results that focus on RDM awareness and attitudes from the perspective of key stakeholders within the University. A total of seven respondents, comprising two Senior Librarians, two Senior ICT Managers, two Senior Researchers (Professors) and one Research Administrator were purposively selected to provide information on awareness and understating about RDM, policies, capabilities, attitudes, practices and expectations on RDM. This sample size is adequate for single case research as this one (Creswell, 2013). Semi-structured interviews and document analysis were the data collection methods used and thematic analysis method was used to analyse the data. Combining data collection methods allowed for the mixing of the data from both sources as well as corroborating the primary data with secondary sources. The institutional documents that were analysed are: "UG Strategic Plan 2014-2024"[1], "UG Research Policy"[2], "UG Research Policy Guideline on Good Practices: Record Keeping and Data Management"[3], "UG Research Ethics Policy"[4], "UG Intellectual Property Policy"[5], "UG Institutional Repository Policy" and "UG Library System Draft Strategic Plan 2014-2019". Both the institutional repository policy and the draft strategic plan of the Library are only available to University staff. Ethical clearance was given both from the University of Ghana and the University of Pretoria for this research.

Results

RDM Awareness, Understanding, Attitudes and Institutional Practice

The analysis of the data revealed that the respondents had a vague understanding of what RDM constitute, and often referred to it in terms of research data storage or preservation. The following were some of the comments by the respondents (labelled as [R1]-[R7]) describing their understanding of RDM and their awareness about the concept.

1 UG Strategic Plan 2014-2024: http://www.ug.edu.gh/sites/default/files/documents/UG%20Strategic%20Plan.pdf
2 UG Research Policy: http://www.orid.ug.edu.gh/sites/orid.ug.edu.gh/files/pictures/UG%20Research%20Policy.pdf
3 UG Research Policy Guideline on Good Practices: Record Keeping and Data Management: http://www.orid.ug.edu.gh/sites/orid.ug.edu.gh/files/pictures/Guidelines%20on%20Good%20Practices.pdf
4 UG Research Ethics Policy: http://orid.ug.edu.gh/sites/orid.ug.edu.gh/files/UG%20Research%20Ethics%20Policy.pdf
5 UG Intellectual Property Policy: http://orid.ug.edu.gh/sites/orid.ug.edu.gh/files/pictures/UG%20Intellectual%20Property%20Policy.pdf

> "Another way to look at it is a way for us to keep for them in one place what they could easily lose so that whenever they want it they can get access to it" [R3].

> "So I think really that's where the University should go, having a platform like that where datasets for research can be stored" [R4].

> "…so we need to build some sort of a repository or data management system and back it up with a policy so that every research that emanates from the system, the data is deposit in the repository like we do for the repository for publication of research articles" [R5].

In fact, one of the respondents emphatically admitted to the tenuous understanding of RDM among librarians.

> "I don't think we've understood it… there's some confusion… maybe there is a slight understanding, but I don't think we have understood it totally… We'll need to know what data management is in the first place and we need to also understand why data management?" [R3].

The data further shows a general appreciation and awareness of the need for RDM and the implications for such critical concerns as security, integrity, continuity and institutional reputation. Even more promising is the recognition of such implications by the University as captured in the "UG Research Policy Guideline on Good Practices: Record Keeping and Data Management":

> "The primary role of data management is to ensure the highest possible degree of integrity, reliability, and continuity in research. It also affords some level of institutional memory".

Particularly is the general acknowledgement and awareness of poor data management as a risk. The following were some of the comments made by the researcher-respondents on this issue:

> "When you lose your data it means the time, money, energy spent is gone, and the purpose of research is to try to solve a problem, so you have not solved or resolve an issue if the data is lost. If anything, you have caused financial loss" [R6].

> "So now everything seems ok, but one day suppose somebody comes and say this nice data you generated let's see your data repository and it's not there and we say it's [Mr 'A'] who's keeping it on his computer and he is nowhere to be found, or what is the evidence that he is not even doctoring them [the data] now and then? I think there may be issues, so maybe the earlier we look at it the better. And people have doctored information, not from here, abroad, so it can happen" [R7].

> "For me, these days, people are moving from hard copy notebooks to electronic and I see a big risk, because you wake up one day and the computer is not waking up, and if you don't have a backup then it's gone" [R7].

These concerns were accentuated in the "UG Research Policy Guideline on Good Practices: Record Keeping and Data Management" which states:

> "If the data are not properly protected, the investment, whether public or private, could become worthless. The responsible handling of data begins with proper storage and protection from accidental damage, loss, or theft."

Interestingly, the researcher-respondents did not seem to be sure of any internal mechanisms to assist them in averting the identified risks.

> "…currently, I have no knowledge of any kind of systems like that to help curtail such risks" [R7].

They also indicated that they have never received any training relating to the management of research data, using phrases like "Never before" [R6] and "Not here, not in the USA" [R7] to respond to the RDM training question.

The analysis, however, reveals that generally, researchers managed their own data. This is clearly espoused in the UG Research Policy and the Guideline for RDM and further corroborated by the researcher-respondents. The Guideline on Data Management states:

> "Most of the specific tasks of data management fall to the PI and Research Director."

The UG Research Policy also states:

> "Under normal circumstances the original materials and data sets will be held by the PI who undertook the research."

Responding to questions on RDM practices, respondents had the following to say:

> "…so you analyse and keep it on your computer, if it is hard copy you save them in files and then you publish… so everybody keeps their data and unfortunately if they die that is the end of the data and the University as far as I am aware cannot get to it" [R7].

> "…it doesn't even come up that researcher 'A' or somebody says [they] want to keep [their] datasets on the IR" [R4].

> "So I prefer I am able to store the thing myself" [R6].

The data also shows that writing a data management plan (DMP) is currently not a requirement for internal funding at UG, neither is there an indication that the University was planning to incorporate data management planning into the research process at UG. The following comments by respondents reflected that:

> "So far, I haven't seen that [requirement for a data management plan] in the internal funds that we give researchers... international donor I believe will require for data management plans but, as far as our internal grants are concerned, I have not seen that on our forms yet, but like I said that could be the next level" [R5].

> "Not really, it's more interested in how you are going to execute, analyse the data, the outcomes and how you are going to disseminate the [outcome]. Normally that's what I have seen, but there may be a question 'how long will you keep the data?'" [R7].

> "I have not had the need to write an RDM plan" [R6].

Generally, attitudes towards RDM issues at UG is positive. The document analysis shows that adherence to good data management practices is a major policy principle in the "UG Research Policy", and the "UG Research Policy Guideline on Good Practices: Record Keeping and Data Management" outlines several of these best practices. Some of the respondents in their responses also corroborated some of the provisions in the policy and guideline. For instance, the document analysis reveals that UG has a keen interest in an RDM culture, particularly, in safeguarding institutional data and the sharing of data among researchers within its local community. The Research Policy states:

> "The credibility of research findings depends on record keeping and good data management. In order to achieve this, the University will create a meta-database of research materials/ data repositories."

The Guideline on RDM further states:

> "Once a researcher has published the results of an experiment, it is generally expected that all the information about that experiment, including the final data, should be freely available for other researchers to check and use."

This, however, may not be the general feeling among researchers and the local community.

> "…as far as sharing of data and management of data is concerned, the University is fully interested" [R5].

> "So as an employee of the university the data should belong to the

> institution so [that] future generations can tap in, so when a [researcher] retires they should not carry their laptop and folders away and we can't have it,… or maybe the university may look at it that way so that even if not at a central place, each school or department should have a data system to collect data and protect it, whether its small, specific, exclusive like mine or not, I think they are still useful" [R7].

> "…Yes, what I want to share I will share but when I want to share, I have to determine that… I prefer I am able to store the thing myself until if someone needs it and if I think I can give it fine, but just to leave it so that somebody else decides who can have access to it, it's problematic" [R6].

When asked whether they will use a centrally managed institutional infrastructure to manage their data, both researcher-respondents had divergent opinions.

> "So even depositing your DNA things there, it's not that you are very happy about it… but the raw data that I used in writing the paper that one I won't give it to anybody… So I prefer I am able to store the thing myself" [R6].

> "…especially these days that the university itself is spearheading grants, I don't see why not so that the outcomes of those grants can be owned by the university… I'm from [name of research Institute withheld] and we thought at one point the Institute for that matter the university should have control on data but we couldn't get far because there was no institutional framework to back it, so people did not really cooperate… the principle of it, you are here working and being paid so technically the data is owned by the University of Ghana, particularly, those large databases that people can tap in… the idea was how do we secure data and we thought the institute could afford a server and can be shared and indeed we allowed access from all department and senior members at the institute… our interest was first of all the institute having control over data and also safeguarding individuals from losing data" [R7].

The researcher-respondent [R7] however admitted that the position taken may have been influenced by the respondent's previous experience as an Administrator in the University.

Furthermore, the results show that trust was an underlying factor to the researchers' willingness to share or deposit their data in a central RDM infrastructure. They were likely to patronise a central infrastructure only if they have the assurance that it is effective and will guarantee the safety of their data and more so if they have greater control over sharing decisions.

> "No, because I don't trust human beings…" [R6].

> "But I suspect maybe part of the problem may be lack of trust, people may think if they probably [store it themselves] nobody can go into my database…" [R7].

> "For me, I will try to convert every [data] I collect into a paper for long term storage. …when I go to the field and I collect these samples and deposit it here I might not write a paper on it immediately, so that's why they tell you that these things that you are depositing here we will guarantee that no one will see it, but after two years it will become public. So, if I think that within two years, I will be able to write a paper and so if you take that information [after that time] you can use it for anything, fine…when I write a paper that information is free for everybody, I don't have a problem with that, but the raw data that I used in writing the paper that one I won't give it to anybody. So, when I collect a sample and I am going to put it in the herbarium, I know that that sample anybody at all can have access to it, that is why I have actually put it there. But the raw data that I have actually collected, which I think is important to me, which I can use in future, I won't give it to anybody" [R6].

Library Support for RDM

The researcher wanted to explore whether and how the library was supporting RDM at UG. The response from the respondents suggested otherwise. These were some of the comments relating to the readiness of the library with respect to RDM:

> "Unfortunately, that has not come up, we are looking more at the output – the eventual published articles… rather than the raw data that has been collected and I don't think the library has really thought of how that [research data] could be managed as a library… I think we need to retool. Because in the first place, when we look at the library school from which many of us are trained, we don't even talk about those things [RDM] at all, so we really don't have what it takes, [but] I think we can learn. We don't have the right skills [and tools] now, but we are capable of doing it so long as we are retooled, I think there is so much out there that we can read, and learn, and maybe visit people who are doing it and be exposed to what is being done, we can come and replicate it here" [R3].

With respect to developing RDM infrastructure, respondents said the library is far from what was desirable.

> "…I don't think we've reached there yet, we have not built capacity for storage of data as compared to other institution where they have a repository where every research that goes on, the data that is gathered is put in the repository for access by other researchers" [R5].

Others also felt there were human resource constraints that will make it difficult for the library to delve into this new and additional responsibility of RDM support:

> "I think early on I talked about staff strength. Even with the end product of research – the published materials – even getting access to that is a problem how much more the fundamental data set that was used to generate it, so that will be a problem" [R4].

> "…you can't do everything looking at the limited resources in terms of human resources, we can't employ more because of the cap on employment…" [R5].

> "…so if we are going to do this then we'll need dedicated people, people whose job[s] are just to go for these datasets and make sure they put them in an organised format and submit them on the platform" [R4].

When asked to suggest what will help libraries and other units to successfully provide support for RDM, almost all respondents consistently mentioned policy. These were some of their comments:

> "… but [here] they might hold on to their dataset and not want to share it, unless of course, it is a mandatory thing from the very top, from the vice-chancellor… but if that is not done, I don't think people will be bordered to or interested to keep it on our IR, they will not even think about it" [R4].

> "But again, we are looking at the policy direction, if we have a policy that says it is binding on you as a researcher, once you publish in any research outlet put your research [data]…" [R5].

> "And maybe have a policy whether we are storing for five years, again it should be [back up] because anybody can destroy information and if we say we are storing five years then nobody has any business destroying information within that period" [R7].

> "We can have a policy and a system in place on how UG data should be captured, managed and shared, I think it will be of a great benefit to the University" [R5].

Discussions

Data management is believed to be a natural part of the research process and researchers' workflow (Avuglah and Underwood, 2019; Vilar and Zabukovec, 2019; Hickson, Poulton, Connor, Richardson and Wolski, 2016), however, its formalisation and standardisation due to government and funding agencies mandates means that RDM sometimes represents a cultural change (Awre et al., 2015) which can trigger considerable resistance from research communities (Wiorogórska et al., 2018). According to Higman and Pinfield (2015), the way stakeholders respond to RDM and its development may be influenced by their level of understanding and awareness about the concept. For instance, the study by Piracha and Ameen (2019) found that researchers with a very good understanding of the RDM concept perceive heads of libraries and research societies as best positioned to develop institutional RDM policies while those

with poor perception about the concept recommended the Higher Education Commission. The results of this study show that the respondents had a tenuous understanding of the concept of RDM, often perceiving it just in terms of data storage or preservation. This may be because RDM is new in Ghana as is the case in many developing nations (Piracha and Ameen, 2019; Chigwada et al., 2017; Renwick et al., 2017). This revelation is also not unusual and can be seen even in some developed regions. In fact, Wiorogórska et al. (2018), Conrad et al. (2017), Hickson et al. (2016) and Darlington et al. (2012) all show that it is quite normal for people to misunderstand or have misconceptions about new and emerging concepts like RDM, particular if the concept is new to their environment and where their experiences with RDM are very limited. The finding is consistent with previous studies. For instance, Darlington et al. (2012), reported that researchers at the University of Bath, UK demonstrated similar limited knowledge of RDM and like UG most of them treated RDM as data storage. Hickson et al. (2016) note that researchers are mostly unaware of the basic principles of RDM and receive little to no training beyond what they learn through their own research practice. What this means is that there is a need to educate researchers and increase awareness about RDM at UG and the library needs to take a leadership role or play an active role in this regard (Patterton et al., 2018). Already there are several documented experiences on how to approach data literacy education and raising RDM awareness which librarians at UG can glean valuable lessons from (Vilar and Zabukovec, 2019; Patterton et al., 2018; Matlatse, Pienaar and van Deventer, 2017; Kahn et al., 2014).

Jahnke and Asher (2012) intimated that researchers are not naive to know that poor data management can have serious repercussions for their research. They add that opportunities for researchers to consult superior expertise on the matter will be highly beneficial to them. Indeed, the results of this study show that, despite the tenuous grasp of the concept of RDM among respondents, there was a general appreciation and awareness of the need for RDM and the implications for such critical concerns as security, integrity, continuity and institutional reputation. Particularly, respondents acknowledged poor data management as a risk. This is also recognised at the Institutional level with such implications captured in the Research Policy and Guideline for RDM. Some of the risk identified in the results include: the risk of losing data, reputational risks to the institution where data cannot be made available for audit and verification, project failures and financial loss. Interestingly, the researcher-respondents who participated were not sure or aware of any internal mechanisms to assist them in averting the identified risks. All these concerns reflect those in extant literature (Harris-Pierce and Liu, 2012; Van den Eynden et al., 2011; Whyte and Tedds, 2011). Proper RDM practices can help avert several research and data-related risks. Such recognitions are also encouraging and useful for making a case for RDM because they can be used as internal drivers for promoting RDM at UG. It is also indicative of how the lack of a formal approach to proper RDM can pose a risk to institutions and thus require the University to take a proactive stance on RDM.

Furthermore, attitude towards RDM at UG is positive – at least at the institutional level. Adherence to good data management practices is a major policy principle in the University's Research Policy and RDM Guideline. Institutional documents show that the institution is keen on a data management culture, particularly, in safeguarding institutional data and the sharing of data among researchers within its local community. However, not all researchers are fully amenable to the idea of sharing research data (especially active data) or using an institutional service to manage their data. These findings corroborate previous studies. Arsev, Guleda and Zehra (2017) reported positive

attitude towards data sharing among researchers and a recognition of its benefits while the study by Wiorogórska et al. (2018) also reports incoherence between institutional level data regulations and everyday practices of researchers, adding that such disparities make the argument for RDM training even more valid and solid.

What is also evident from the data is that researchers value their data extremely and are keen on its security. It is a "trade secret" to them. They are, however, concerned with publishing research papers from the data rather than data management or sharing per se. Understandably, researcher's career progression and rewards are often tied to the research they conduct and their impact rather than on what they do with the data itself (Jahnke and Asher, 2012). This probably contributes to the disparity between institutional aspirations and practices and preferences within the local community.

The data further show that trust is a factor in researchers' willingness to share data or use central RDM infrastructure. The researchers were likely to patronise a central infrastructure for their RDM only if they have the assurance that it is effective and will guarantee the safety of their data and more so if they have greater power over sharing decisions. These findings are consistent with previous studies (Vilar and Zabukovec, 2019; Arsev et al., 2017; Williams et al., 2009). Vilar and Zabukovec (2019) noted that while researchers need assistance in making data management choices, their patronage of institutional solutions is contingent on the trustworthiness of their relationship with the different stakeholders involved. What is more, a 2009 study by the Research Information Network (RIN) and the British Library found that some researchers, especially those in the life sciences, are averse to the idea of data sharing and publishing and may only do so if allowed to finish publishing research papers based on data, and reserve the right to personally make publishing and sharing choices instead of a third party doing so in their stead (Williams et al., 2009).

Researchers are, however, not best positioned to effectively manage their research data on their own (Vilar and Zabukovec, 2019; Arsev et al., 2017; Jahnke and Asher, 2012). This is in part because many of them have not received any formal training on how to properly manage their own data (Wiorogórska et al., 2018). This study found that no RDM training was currently being offered to researchers and support staff, yet researchers manage their own data. This is clearly espoused in the UG Research policy and RDM Guideline and corroborated by the researcher-participants. This is consistent with the situation in other developing countries as reported by Patterton et al. (2018) Ssebulime et al. (2018), Chigwada et al. (2017) and Renwick et al. (2017) and even in some institutions in the developed regions (Vilar and Zabukovec, 2019; Wiorogórska et al., 2018).

The results also show that researchers are not required to write a DMP when applying for institutional research funding. There is also no indication that the institution is planning on embedding data planning in the research process. This notwithstanding, Federer (2016) posits that whether a formal DMP is required of researchers or not, data planning is a vital initial step to better understand critical logistical imperatives for a research project such as the amount of funding that will be adequate to conduct the study. To add to this, Wiorogórska et al. (2018) asserted that DMPs provide a rubric that enables researchers and research support staff to think properly and actively about the management of research data and its application in a research project. It clarifies the issues on data authorship and ownership, privacy and confidentiality, defines RDM responsibilities, and describes the dataset, storage, retention, sharing and accessibility options. This, in the long run, saves time when publishing the data and also makes it more discoverable, comprehensible and reusable.

The results further reveal that the University Library is yet to take a strategic stance on RDM. A recent and arguably only study on RDM at UG found that the Library was engaged in managing the institutional repository (IR), providing data analysis packages for small scale projects and information literacy instruction but had not yet ventured into the area of RDM advocacy and promotions, data literacy education, data curation and DMP support (Avuglah and Underwood, 2019). Whereas these roles resonate with data management functions, it is clear that there is inadequate capacity in terms of expertise and curation skills to fully participate in this emerging area of Library and Information Science (LIS) work (Cox and Pinfield, 2014). The limited support and lack of expertise can be ascribed to the fact that RDM is new to the UG community and awareness and knowledge about the concept are very low among the community members. Despite the existence of technology facilities in the University that could be potentially utilised for RDM purposes (Avuglah and Underwood, 2019), respondents felt the situation in the library was far from what is desirable. For instance, the library is yet to build enough capacity to utilise the IR to manage datasets. These findings are consistent with what persists in other parts of the continent. Human, financial and infrastructure constraints are common challenges that institutions in Africa wanting to adopt RDM face (Chiware and Becker, 2018; Chigwada et al., 2017). Due to such constraints, Chiware and Becker (2018) concluded that most institutions across Southern Africa were unprepared to comprehensively support RDM in their institutions and have not been able to harness their IRs to manage datasets and other research materials. These studies also attest to the skills gap.

There is a need, therefore, for librarians to build their capacity as a trusted source of help for researchers and to take up this new and emerging role as data management consultants, data literacy trainers and data curators. Supporting the librarians and other research support staff to attend RDM training, short courses, conferences and workshops is a good starting point (Piracha and Ameen, 2019). The librarians must also be proactive themselves, there are several resources online, including scholarly articles, primers, training manuals and online tutorials which they can consult to increase their knowledge and prepare themselves to effectively advocate, promote and train researchers and their colleagues on RDM. They must also build trustworthy relationships with researchers and seek opportunities for collaboration with other relevant stakeholders of the University such as the Research Office, IT department, Archives and so on (Vilar and Zabukovec, 2019; Faniel and Connaway, 2018), to deliver RDM support for the University community. The deficiency also provides an opportunity for the Department of Information Studies at the University of Ghana (currently the only LIS School in Ghana) to consider updating its curriculum (Piracha and Ameen, 2019) to help develop the knowledge, skills and competencies of up and coming library and information professionals (Matlatse et al., 2017).

Some efforts have already commenced to raise awareness about RDM and stimulate discussions on the subject among Ghanaian academic and research librarians. In 2018, the Consortium of Academic and Research Libraries in Ghana (CARLIGH) organised its third international conference in Accra, Ghana on the theme: "Managing Research Outputs for National Development: Trends and Issues". The conference brought together researchers, faculty, librarians, ICT professionals, data analysts, and industry players to deliberate on and share experiences in the area of research data and its management. The pre-conference workshop also focused on exposing conference participants to the concept of RDM and the key issues surrounding national policy formulation on data management. An earlier version of this article was presented at this conference, the proceedings of which have very limited circulation. More importantly,

this effort must be sustained with more of such conferences, workshops and training programmes to improve RDM uptake in Ghana in general. The Ghana Library Association (GLA) can also play a role in this regard (Piracha and Ameen, 2019).

Finally, respondents overwhelmingly recommended that a definite policy on RDM was necessary to evolve a cultural change. They believe this was the only way the library and other stakeholders can get the legitimacy they require to be successful in promoting and supporting RDM. This study and the one by Avuglah and Underwood (2019) show that RDM issues are covered in the University's Research Policy and Guideline on RDM but the issue is that some people were not aware of them. Raising awareness about and enforcing current provisions on RDM might be a good point of departure. In addition to policy, librarians must also work at gaining the respect, confidence and trust of the researchers for RDM (Faniel and Connaway, 2018). This can be achieved through broad-based consultations and engagements with the research community, especially during the policy development stages.

Conclusions and the Way Forward

In summary, this study reveals that the situation at UG is similar to what is the case in other parts of Africa and even some developed regions. The concept of RDM is tenuously understood. Researchers know that poor data management can be costly for their research. Researchers and support staff appreciate and are aware of the need for RDM and the implications for such critical concerns as security, integrity, continuity and institutional reputation. Researchers manage their own research data and have never received any RDM-related training. Formal data management planning is not officially embedded in the research process. The library is not ready to fully support RDM. It is yet to take a strategic approach to RDM issues and there is clearly a dearth in RDM expertise within the library system.

This study provides a useful background for further and future RDM studies at UG and Ghana at large. It also has practical implications for RDM strategy development and institutional planning at UG. The recognition of the importance of RDM provides an opportunity to promote and raise awareness about RDM within the institution. The results also provide a basis for international comparisons. It provides insight into RDM in academic and research institutions in Ghana.

Going forward, the University should begin to engage with the local community towards a more formalized and institutional uptake of RDM. Innovative approaches should be adopted to drive awareness about the University's position on RDM and the existing RDM guidelines, and compliance with the existing guidelines should be heartily encouraged. Given the tenuous understanding about RDM, the University Library should consider educating the local research community on RDM and its importance, this can be done as part of their information literacy training (Renwick et al., 2017). They should also capitalize on the institutional recognition of RDM as research integrity imperative and actively participate in the future development of RDM. They can start with RDM advocacy and promotion. Patterton et al. (2018) provide innovative and cost-effective approaches for doing so in resource-constraint institutions. To be successful, however, the librarians must take advantage of numerous existing opportunities to build their own capacity to take up these new and additional roles. Support from the University leadership is also needed in this regard. It is further recommended for academic and research libraries in Ghana to be proactive in this space and not relegate themselves to the background. They must see RDM as an opportunity

for deeper embeddedness in the research process (Cox and Verbaan, 2016). They should build capacity – through conference attendance, researching and studying research reports on RDM; seek collaborative opportunities and providing innovative support even in the absence of an official mandate. The Library School in Ghana and the GLA must all help to develop RDM knowledge, skills and competencies (Piracha and Ameen, 2019). The Library School should upgrade its graduate curriculum to include issues about RDM. They may also develop special training programmes for practising librarians. The GLA as well can organise conferences, workshops and training programmes on RDM for librarians and other stakeholders to drive awareness and up-skill librarians.

Finally, further research is recommended on RDM at UG and in Ghana. Investigations into institutional research data assets stock, researchers' practices and preferences, as well as service requirements, should be carried out. Future studies should include other critical stakeholders beyond the ones in this study. More participants should also be engaged (larger sample size) in order to gain a more realistic and comprehensive picture across the institution. Further studies can also explore opportunities at the national level that can be harnessed for institutional RDM development and collaborative research at UG and other HEIs in Ghana.

Limitations

Although the number of participants engaged for this study is consistent with the requirement for a single case study as this one (Creswell, 2013), it is acknowledged that the scale and nature of the study may not necessarily paint a true and fair picture in some of the findings. The triangulation of data sources was adopted as a strategy to mitigate this challenge by corroborating some of the findings from the primary data with secondary sources which were mainly institutional documents. This, however, does not diminish the veracity of the findings which are still instructive and provide useful pointers for consideration.

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Appendix

Semi – Structured Interview Guides

Interview guide for senior official at the University of Ghana Library System (UGLS)

1. Can you please describe briefly what your role at the library is?
2. Please describe how the library currently supports the research process at UG. (*If response does not make reference to RDM, ask follow up question*)
    2.1. What about providing support for the data generated by researchers? Is there any sort of training, support service or guidance (such as materials, workshops, audio or videos etc.) that is provided for researchers in terms of how to manage or share their data throughout the research lifecycle? (*If no support for RDM, ask follow up question*)
    2.2. Does the library have any plan for implementing (setting up) services to support RDM anytime in the future?
3. Do you consider that there is the need for the University and the library for that matter to provide support for researchers of UG in terms of how they manage and share their research data?
4. In your opinion who should be responsible for RDM development and support at UG?
5. Can you please tell me if there are some staff here in the library who may be knowledgeable in aspects of RDM (e.g. providing training and guidance on data management, or knowledge in data curation, DMPs etc)? And if there are, are they known to researchers in the university community and are they consulted for assistance?
6. In your opinion, do you consider that the staff of the library possess the right knowledge and skills and are they well equipped to provide support for data curation and RDM at UG?
    6.1. (**If Yes to Q6**) Could you please elaborate on some of these knowledge, skills, and tools that currently exist in the library to support data curation and RDM?

6.2. (**If No to Q6**) What kind of training or tools would you require or suggest to be made available to be able to support RDM and data curation in the library?

7. In your opinion, would it be necessary for the University to identify and create a catalogue of important data assets within UG? And do you find the skills of the library staff relevant in this regards, particularly in the creation of metadata?

8. Does the institutional repository (IR) currently managed by the library permit deposit of datasets?

   8.1. (**If Yes to Q8**) are researchers actually depositing their dataset? Who is responsible for curating these data? Who determines which data to keep? And how long can the data be kept in the repository?

      8.1.1. Are there policies guiding access to these data?

   8.2. (**If No to Q8**) are there plans to accept data deposit in the future?

9. What challenges do you envisage in trying to support data storage through the IR?

10. Please is there any other information/opinion you will like to share with me?

Interview guide for senior official at University of Ghana Computing System (UGCS)

1. Can you please describe briefly what your role at the ICT Directorate is?

2. Please describe how the University of Ghana Computing System (UGCS) currently supports the research process at UG.

3. How does the current IT infrastructure of the university support collaborative research? (*If response does not make reference to RDM, ask follow up question*)

   3.1. What about providing support for the data generated by researchers? How adequate and secure is the current IT infrastructure (e.g. network bandwidth, storage) to support active data storage, regular and automatic backing up and syncing of data as well as facilitating data sharing?

4. Would you consider the current IT infrastructure robust and resilient enough to cope with an increase in demand for data storage space?

5. Does the UGCS have any data management platform or applications to assist researchers to manage their data effectively (including data storage and sharing)?

   5.1. (**If No to Q5**) Is the University/UGCS considering developing a research data management platform for UG?

6. Is the University/UGCS also considering providing data storage service for researchers in the future?

7. Do you consider some of the UGCS staff to be knowledgeable about research data management and could support researchers in that regard?

8. Would you consider it necessary for the University to support researchers in the management of their research data (including data storage, sharing and archiving)? And do you think it can be done sustainably?

9. Can the university's IR support data deposit? And what will be required to make research data storage in the IR possible and sustainable?

10. Please is there any other information/opinion you will like to share with me?

Interview guide for senior official at Office of Research, Innovation and Development (ORID)

1. Can you please describe briefly what your role here at the Office of Research, Innovation and Development (*ORID*) is?

2. Can you please describe how ORID support researchers and research activities here at the University of Ghana?

3. What is the attitude of the University towards RDM? And how is the University enabling good data management practices at UG?

4. Is the University conversant with existing research data assets available within the University (their location and volume) and risk associated with poorly managing these research data? How are these data assets managed?

5. How do you determine which data are of long-term value and should be preserved or shared if possible?

6. How long do you expect researchers to keep their research data and how are you ensuring compliance?

7. How does the University address the governance of data access and re-use? To what extent do you promote open sharing of research data and not just the research findings?

8. How is the ORID ensuring that existing policies and guidelines on research and RDM are well communicated to the research community of UG and that they are adhered to?

9. The UG research policy states on page 6 "The University shall put in place a system for [among other things] managing research data/ material" and "the University will create a meta-database of research materials/ data repositories". Has the University succeeded in putting in place these systems and how has this been done?

    9.1. (**If No**) what is hindering the setting up of these systems? What challenges have been encountered?

10. Would you consider it necessary for the University to provide support for researchers in terms of how they manage and share or in preserving their research data? And do you think it can be done sustainably?

11. Is there any sort of training, support service or guidance (such as materials, workshops, audio or videos etc.) that is provided for researchers in terms of how to manage or share their research data? (*If no support for RDM, ask follow up question*)

    11.1. Is the University considering providing support for researchers in the management of their research data in the future? How does the university plan to do this and what areas will be considered?

12. Are researchers (both faculty and students) here required to write data management plans (whether as part of funding requirement or the research process) and how is the University supporting this requirement?

13. In your opinion, do you consider that some staff here at the ORID may be knowledgeable in aspects of RDM (e.g. providing training and guidance on data management)? And if there are, are they known to researchers in the university community and are they consulted for assistance?

14. Does the University have any resource allocations (including funding) to facilitate RDM support/ development in the near future?

15. Please is there any other information/opinion you will like to share with me?

Interview guide for researchers

1. Can you please describe your role at the University of Ghana? How long have you been in this capacity, and what your discipline and area of research focus are?

2. What types of research data do you often generate in your research activities? How do you manage, store and preserve your research data during and after any research activity?

3. In terms of your research outputs, what contents are most important to you (e.g. research findings, article, data)?

4. Are you aware of existing institutional policies on research and specifically on research data management? Where and how do you assess these policies?

5. How long do you keep your research data before disposing it?

6. How do you share your research data? And how do you determine what data has long term value? What role does the university play in this regard?

7. Does the University of Ghana (through its IT services or library) offer secure storage and backup services for your research data? Have you used such a service before?

    7.1. (**If No to Q7**) do you consider such services or support as appropriate for you as a researcher?

8. How confident are you about existing IT infrastructure within the University to be able to support the growing volumes of institutional research data and storage needs?

9. Do you get external funding for your research? And have you been required at any time to write a data management plan – outlining how the data will be collected, managed and stored – as an addendum to the proposal for funding?

10. How does the University of Ghana (through the library, research office or any support unit) support you in writing data management plans, if you have had the need to write one?

11. Have you ever received any support from the university support services (such as the library, IT services or research office) in the form of training, workshops, audio or video materials specifically on issues of proper management of research data and good research practices?

    11.1. (**If No to Q11**) do you consider such services or support appropriate for you as a researcher?

12. Do you think it is important for the University to support researchers in the stewardship – continuous management, sharing, archiving and preserving – of their research data? And do you think it can be done sustainably?

13. Are you aware of the potential risks associated with poor research data management? And what kind of institutional systems and support are available to you here at the University of Ghana in curtailing such risks?

14. Please is there any other information/opinion you will like to share with me?