



Usage of institutional repositories in Zimbabwe's public universities

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Background: The concept of institutional repositories (IRs) has gained traction across the globe; Zimbabwe's public universities have established IRs to capture, store, archive and widely disseminate their institutional intellectual capital. However, research output from the repositories remains obscure, hence the motivation to explore the use of IRs in the universities to ascertain if they are getting a return on their investment in IR technologies.

Objectives: The objectives of this study were to establish the range of items contained in the repositories; establish the growth of the repositories and determine the software platforms being used.

Method: A mixed methods approach was used, with methodological triangulation. Study participants included eight public universities, library directors, assistant or IR librarians; complete enumeration was done. Data were collected through questionnaires, interviews and bibliometric analysis of IRs, policy documents, Directory of Open Access Repositories and Registry of Open Access Repositories. Qualitative data were analysed thematically; Statistical Package for the Social Sciences was adopted to analyse quantitative data and generate tables.

Results: The IRs largely contain peer-reviewed content, while the DSpace software is popularly used. Most of the repositories are searchable on the Internet. The biggest repository has acquired 2520 items in 10 years, while the smallest one has 46 items in 7 years. The population of the IRs is slow because of various challenges.

Conclusion: The repositories have not been successful because populating them is a challenge. This could partly be because of libraries being too selective about content going into the IRs. Adopting the DSpace software by the universities points to long-term preservation plans for their intellectual output stored in the repositories for posterity.

Keywords: Institutional repositories; public universities; academic libraries; self-archiving; public university libraries; Zimbabwe.

Introduction

The traditional scholarly communication landscape has experienced exponential transformation because of technological advancements (Ocholla 2011; Philips 2010) to include open access (OA) journals and institutional repositories (IRs) as alternative channels for disseminating and communicating research findings. Knowledge generated through research is only meaningful when it is shared, disseminated, easily findable and accessible to a wider audience for the benefit of a country's population. Institutional repositories are fast becoming significant players in the provision of scholarship, as well as information resources. As a result, universities worldwide have adopted these new ways of accessing and communicating research results developed by their academic staff, to remain competitive by enabling access to current research (Frankland & Ray 2017). Open access enables access at no cost to research online or to anyone with access to the Internet; therefore, these advancements have lowered costs and widened access to information on the worldwide web (Frankland & Ray 2017).

Where OA has been adopted and used, the volume of scholarly publication has experienced exponential growth and also increased the value of knowledge to society (Boissy & Schartz 2011; Fitzpatrick 2012; Pandita & Ramesha 2013). Fitzpatrick (2012:350) postulates that 'the more influence that scholarship can produce, the better'. However, this cannot be said of Africa, which has not been successful in acquisition and exploitation of knowledge for development (Moahi 2010). Africa's research output performance is less than 1% of global research output (World Bank/Elsevier 2014); furthermore, there is a very low research output from Southern Africa and its published works are barely visible (Abrahams, Burke & Mouton 2010). This leads to the misguided notion that little

research of substance is emanating from the Global South and that researchers rely on information donations from the Global North (Chan, Kirsop & Arunachalam 2011).

Most of Africa's research outputs are not indexed in international citation indexes, such as the Science Citation Index, as they are scattered in diverse outlets (Rotich 2011). As such, African universities need to devise communication and dissemination strategies to enable a wider reach and increased visibility in research output. Abrahams et al. (2008) advocated for universities in Southern Africa to adopt OA strategies for knowledge production, publishing and dissemination. As a result, university libraries in the region, including Zimbabwe, established repositories to promote, disseminate and ensure long-term preservation of their scholars' and institution's scientific works (Rizor & Holley 2014). Therefore, adoption of IRs by Zimbabwe's public universities not only expands readership and visibility of their research output, but also results in greater impact when it reaches 'government, industry and civil society personnel who can leverage it for development' (Trotter et al. 2014:1).

Statement of the problem and research questions

Academic and research institutions in Zimbabwe have established IRs to showcase their research and facilitate wider distribution of their output in the global arena (Lagzian, Abrizah & Wee 2015). Despite establishing IRs, content for these repositories is obscure on the web (Kocken & Wical 2013). This is because finding articles in the repositories is still a challenge, as indexing and discoverability of existing articles are not yet perfect (Rizor & Holley 2014). Many institutions have been disappointed by the returns on investment in information technologies because of low usage of installed systems (Venkatesh & Davis 2000). The value of an IR's services could be underestimated if their significance is not quite understood and results in waning organisational support which is crucial to IR survival and growth (Lagzian et al. 2015).

Universities in the Global South should benefit from IR use because their capacity to provide access to literature to further the research efforts of their scholars is hampered by crippling expensive and unaffordable journal subscriptions. Through IRs, universities can expand the reach and visibility of their research output, contribute to global academic discourse and significantly contribute to the achievement of the Sustainable Development Goals (SDGs) by 2030. Therefore, this study explored the state of IRs in Zimbabwe's public universities through establishing the categories of documents in the repositories, establishing the number of items in the repositories and identifying the software being used to host the IRs.

Literature review

The concept of IRs has gained traction, with many academic and research institutions worldwide adopting and

establishing repositories. The concept involves authors not only publishing in a traditional subscription-based journal but also self-archiving pre-prints or post-prints of their works in an IR, subject repository or personal website, on expiry of the embargo period (Zhang & Watson 2017). An IR is:

... [a] set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members. (Lynch 2003:2)

Academic and research institutions invest in research and development; however, they lose control of their research output to commercial journal publishers who, after institutions have surrendered the research for publication, charge them exorbitant and unsustainable subscription fees to access their research. This militates against progress in furthering research, knowledge sharing and development. According to Trotter et al. (2014:66), 'the proliferation of repositories worldwide offers new possibilities for universities to take greater control of their scholarly communication destinies'.

Benefits and impact of repositories have been proffered by several scholars. Institutional repositories centralise, preserve and enable access to institutions' intellectual capital, but simultaneously they can be a part of a global system of distributed, interoperable repositories (Islam & Chowdhury 2011). Open access repositories follow the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) which enables web search engines like Google to index the contents of the repositories, thus making them interoperable. Interoperability means that audiences in different geographical settings across the globe can remotely search sparsely located repositories and archives (Yiotis 2005). Therefore, depositing in a local repository is 'equivalent to depositing centrally in one global, seamlessly searchable Open Archive' (Harnad 2010:87). Scholars become visible to the international research network scene and their works can be found (Islam & Chowdhury 2011; Van Schalkwyk 2014).

In addition, institutions that are active in research gain higher visibility, usage and impact of their intellectual output, with regard to citations, social return and funding (Swan, Willmers & King 2014). Visibility refers to digital accessibility: metadata of a scholarly object is profiled in a way that makes it easily findable by search engines and databases (Trotter et al. 2014). Research has established that articles in OA IRs have a huge citation advantage over other types of OA models (Archambault et al. 2014; Zhang & Watson 2017), thus making them the preferred route to OA. In addition, IRs can be used by institutions as management information tools for monitoring and analysing their research activities.

However, establishment and maintenance of the repository requires financial and staff resources, while advocacy for establishing its authority and value in the university is also important; thus, the value of the repository can best be demonstrated by populating it quickly (Giesecke 2011).

The level of content submission by content creators (academics) versus the number of scholars in the institution is used as a measure of success of an institution's repository. Kocken and Wical (2013) and Mercer, Rosenblum and Emmett (2007) add that the number of searches and downloads of items in the repository also reflect IR success. Content deposit is attributed to awareness of the IR by the scholars (Kocken & Wical 2013) and knowledge of its value in academic discourse.

However, the issue of content composition of IRs has generated much concern among scholars and they seem to have failed to reach a consensus on the functions of an IR (Ruiz-Condo & Calderon-Martinez 2014). According to Foster and Gibbons (2005), the success of an IR hinges on it containing scholarly content of enduring value which is searched and cited. Content includes peer-reviewed journal articles and conference proceedings, datasets (such as diagrams, video and audio files), spreadsheets, photographs, charts and artwork representations. Lynch (2003) believed that:

A mature and fully realised institutional repository will contain the intellectual works of faculty and students – both research and teaching materials – and also documentation of the activities of the institution itself in the form of records of events and performance and of the ongoing intellectual life of the institution. It will also house experimental and observational data captured by members of the institution that support their scholarly activities. (p. 328)

However, Kocken and Wical (2013) and Connell (2011) opine that academic libraries can be overly selective of the content to include in the repository, and their policies may be vague, causing confusion and thus weakening efforts to get other units to participate in populating the IR.

Another factor crucial to IR success is the capability of the software platform on which the repository is hosted. Because of costs associated with purchase, maintenance and rigidity of proprietary software, most institutions have adopted open-source IR software (Xia & Opperman 2010). Besides being open, flexible and adaptable, open-source software is associated with speedy reaction to problem-solving (Reddy & Kumar 2013). Witten et al. (2005) proffer that the DSpace platform is popular because it is flexible for customisation, followed by Bepress, Digital Commons and Eprints. Apparently, Greenstone is as prominent as DSpace, though they differ in their goals, strengths and environments in which they were designed to operate. DSpace was designed to operate in an institutional setting, allows faculty members to self-archive and it visualises communities (departments, schools, faculties and so forth) building digital collections. Therefore, the DSpace 'software is ideal for planning, building and managing digital repositories for large institutions' (Ravikumar & Ramanan 2014:80). On the contrary, Greenstone was designed for lay users 'to produce single, individualised, collections' (Witten et al. 2005). Because of these features, Greenstone is 'highly suitable to

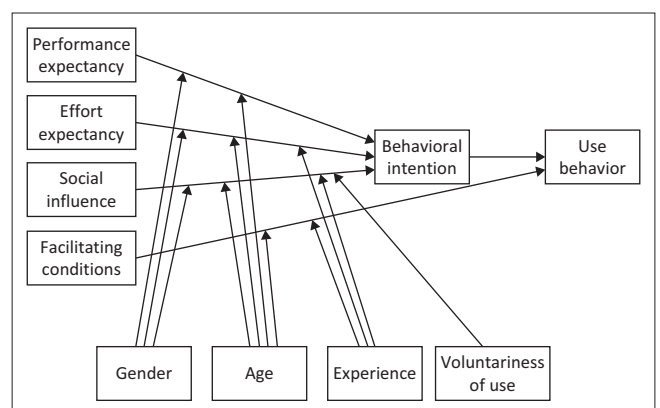
preserve digitised collections like dissertations/theses, manuscripts, rare materials, past examination papers, and other in-house documents' (Ravikumar & Ramanan 2014:80).

The Fedora Commons software has been adopted by well-known institutions such as the Public Library of Science, the Library of Congress and OhioLINK (Little 2012). The Digital Commons application in Bepress is another software platform ideal for hosting journals as part of the IR content, 'presumably for its journal publishing strengths' (Xia & Opperman 2010:12). Small institutions unable to maintain their repositories have found Bepress of good service to them because technical assistance is directly provided by the service provider because it is a commercial IR software and not an open-source IR software (Bankier & Perciali 2008; Xia & Opperman 2010). Librarians face a daunting task in selecting appropriate software platforms.

Theoretical framework

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was adopted because it is concerned with how people accept and adapt to the use of technology (Oye, A.Iahad & Ab.Rahim 2012) (Figure 1).

The UTAUT model proffers that behavioural intention to use technology is determined by four constructs that include performance expectancy, effort expectancy, social influence and facilitating conditions. These determinants of technology usage behaviour are moderated by age, gender, experience and voluntariness. Performance expectancy is concerned with the extent to which users (academics and researchers) of an installed system believe that they will realise gains in work performance when they use the technology. It is moderated by gender and age. Effort expectancy is concerned with the degree of ease of use of the system and is moderated by gender, age and experience. Social influence is concerned with the degree to which a person believes that members of a reference group (e.g. workmates or the academic community) believe they should use the new system. It is moderated by gender, age, experience and voluntariness. Lastly, the



Source: Venkatesh, V., Morris, M.G., Davis, G.B. & Davis, F.D., 2003, 'User acceptance of information technology: Toward a unified view', *MIS Quarterly* 27(3), 425–478, viewed 01 March 2014, from <http://www.jstor.org/stable/30036540>.

FIGURE 1: Unified Theory of Acceptance and Use of Technology.

construct 'facilitating conditions' is concerned with the degree to which a person believes that an organisational and technical infrastructure exists to support the use of the system. Its influence on usage of a system is moderated by age and experience constructs (Venkatesh et al. 2003).

Research methods and design

The study was pragmatist in its approach, using mixed methods research to gain deeper insight into the state of the repositories. Mixing quantitative and qualitative methods increases the quality of the study as limitations of one method are counterbalanced by others (Fidel 2008:265). Simultaneous methodological triangulation was done with limited interaction between the methods during data collection. The findings would then complement each other at the stage of data interpretation (Johnson, Onwuegbuzie & Turner 2007).

Zimbabwe has 18 universities: 12 are public and six are private. This study focussed on public universities and only eight public universities were studied, namely, Bindura University of Science Education (BUSE), Chinhoyi University of Technology (CUT), Great Zimbabwe University (GZU), Harare Institute of Technology (HIT), Lupane State University (LSU), Midlands State University (MSU), National University of Science and Technology (NUST) and the Zimbabwe Open University (ZOU). The University of Zimbabwe (UZ) refused to participate in the study, while Gwanda State University (GSU), Manicaland State University of Applied Sciences and Marondera University of Agricultural Science and Technology were excluded because they were under the tutelage of NUST, MSU and UZ, respectively.

The study population comprised eight directors of libraries, 40 assistant librarians and nine IR librarians because they are responsible for the establishment, maintenance of IRs and gatekeepers of content. The nine IRs of these institutions were also included in the study. Given the small size of the population, complete enumeration was done. Self-administered questionnaires were distributed to assistant or IR librarians, interviews were held with library directors, policy documents were analysed, literature was reviewed and bibliometric analysis of IRs including the Directory of Open Access Repositories (OpenDOAR) and the Registry of Open Access Repositories (ROAR) was done. The instruments were pilot tested using staff at the University of KwaZulu-Natal, Pietermaritzburg Library. A thematic content analysis technique was used for qualitative data analysis, while Statistical Package for the Social Sciences was used on quantitative data to generate tables.

Ethical consideration

Ethical clearance was sought from the University of KwaZulu-Natal's Humanities and Social Sciences Research Ethics Committee. Full approval was granted (protocol reference number HSS/0941/014D). Clearance to conduct studies in the public universities was sought from the universities and permission was granted. Study participants

were shown the permission letters, including a letter explaining the purpose of the study, and signed the informed consent form before participation. The University of Zimbabwe is the leading university and it was the first to establish an institutional repository in the country; therefore, its refusal to participate was a drawback to the study.

Results

Response rate

Twenty-five questionnaires out of 40 were returned by librarians, giving a response rate of 62.5%. All eight library directors were interviewed, giving a 100% response rate. Six OA IR policy documents from six universities were scrutinised; policies of two universities were still at the draft stage, so they were not available for scrutiny. The universities' websites were also visited to obtain IR data, while OpenDOAR and ROAR were also used.

Institutional repository establishment in the universities

Library directors were asked to state the number of repositories they had within the university. Their responses showed that 87.5% (seven) of the universities had two repositories each, one for the public domain and one for internal use by the local university community. One (14.3%) of the seven universities had both IRs in the public domain. Only one (12.5%) university had one IR, which was in the public domain. Thus, nine IRs were in the public domain; of these, two (22.2%) were established between 2007 and 2009, so they were 8–10 years old, and seven (77.8%) IRs were established between 2010 and 2012, so they were 5–7 years old. Institutional repository or faculty librarians corroborated the responses of their directors.

Library directors were asked to state the period it took them to have the IRs functional from the time they conceived the idea. Four (50%) took 6 months to a year and they did not face any resistance from management. Three (37.5%) said they conceived the idea around 2005 and 2006, but it took a long time for them to establish the IRs, citing internal resistance as having contributed to delays in establishing their IRs; according to one library director, stakeholders lacked interest and were sceptical of the innovation. However, through persistence and perseverance, they finally won the support of management and things began to take shape.

Another institution took 5 years to establish their IR; the director cited lack of IT expertise to assist with the technical challenges associated with the Greenstone software they had adopted during the time of Database of African Theses and Dissertations (DATAD) in 2005 as having contributed to the delay. Another institution took almost 2 years having conceived the IR concept in 2009 on joining the Zimbabwe University Libraries Consortium (ZULC), where dialogue and training on the concept among members were ongoing, but they started around 2010/2011. Knowledge of the period

the IRs had been operational was necessary to determine their success.

Software choice

Data on the software platform in use were gathered from library directors, OA IR policy documents, OpenDOAR and ROAR. The findings revealed that all the universities used the DSpace open-source software; four (50%) institutions initially used the Greenstone software but over time, two (25%) discontinued using the software after experiencing difficulties, while two (25%) universities were still using it for their local repositories. One library director indicated that the software was not user-friendly as their staff experienced technical problems, poor speed and ease of use. They decided to adopt the DSpace software because of its popularity with fellow institutions.

Content type

Through IR analysis, OpenDOAR analysis, interviews with library directors, questionnaires for IR or faculty librarians and OA IR policy documents, diversity of content hosted on the IRs was established (Table 1).

Library directors of two (25%) universities said they only uploaded peer-reviewed content and localised material in the public domain repository but housed them in the local repository. Six (75%) universities upload first class undergraduate dissertations and postgraduate theses on the public domain IR. One (12.5%) only uploaded PhD theses in the public domain repository, while another (12.5%) university excluded undergraduate dissertations from the OA IR and only included postgraduate theses. All the universities housed past examination papers, undergraduate dissertations and, in one case, master's dissertations. All these repositories are multi-discipline oriented; the faculties, schools, institutes or centres within a university constitute the communities, while departments or sections form the

sub-groups called sub-units on the DSpace platform. Content contributors comprised scholars, researchers, non-teaching staff and students. According to one (12.5%) university's IR policy, affiliate external researchers can deposit content in the IR at the time of publication.

Size of the repositories

The study sought to compare content deposit with the number of scholars in the institution as a measure of success of the IRs. Faculty or IR librarians were asked to state the number of items in their repositories, OpenDOAR and ROAR were checked for statistics of records held in the repositories, while researcher requested the statistics of academic staff establishments from the registrars of the institutions (Table 2).

To assess the content deposit levels, it was important to establish the staff complements of the universities and their categories. Table 2 shows that seven (87.5%) universities had an academic staff complement exceeding 200, while one (12.5%) had fewer than 80 scholars. A majority of the staff were lecturers (1879), with only 44 associate professors and 38 professors.

The results in Table 3 showed the biggest repository with 2520 records having been established in 2009 and the smallest

TABLE 2: Academic staff establishments at the universities.

Institution	Professors	Associate professors	Lecturers	RFs, TAs, SDFs	Total
1	8	3	192	16	219
2	7	5	215	47	274
3	3	4	303	20	330
4	2	0	222	23	247
5	0	0	70	4	74
6	7	9	391	57	464
7	4	9	304	96	413
8	7	14	182	2	205
Total	38	44	1879	265	2226

RF, research fellow; TA, teaching assistant; SDF, staff development fellow.

TABLE 1: Content type in the institutional repositories.

Item	Institution							
	1	2	3	4	5	6	7	8
Post-print articles	*	*	*	*	*	*	*	*
Pre-print articles	*	-	*	*	*	*	-	*
Conference or workshop presentations	*	*	*	*	*	-	*	-
Books or book chapter or book review	*	-	*	-	-	*	*	-
Journal of the university	*	-	*	-	-	*	-	-
Conferences hosted by the university	-	-	*	-	-	*	*	*
Theses and dissertations	*	*	*	-	*	*	-	*
Multimedia or audio-visual materials	-	-	-	-	*	*	-	*
University annual reports or speeches	-	-	-	-	*	*	-	-
Datasets	-	-	-	-	*	-	-	*
Inaugural or public lectures	-	-	-	-	*	-	-	-
Technical reports	-	-	-	*	-	-	-	*
Lecture notes or courseware	-	-	-	-	*	-	-	-
Newspaper clippings	-	-	-	-	*	-	-	-
Grey literature or unpublished works	-	-	-	*	*	-	-	-
Working papers	-	-	-	*	-	-	-	-
Reports for industrial design and technology innovation	-	-	-	*	-	-	-	-

*, Indicator of content in institution's repository.

TABLE 3: Official institutional repositories of eight public universities.

Institution	Date established	Registry	Number of records	Last updated	Software	Internet availability
1	2010	OpenDOAR or ROARMap†	394	April 2015	DSpace	Searchable
2	2011	OpenDOAR	46	July 2017	DSpace	Searchable
3	2012	None	50	2014	DSpace	Unsearchable
4	2011	OpenDOAR or ROAR	236	May 2018	DSpace	Searchable
5	2012	OpenDOAR	279	May 2018	DSpace	Searchable
6	2009	OpenDOAR or ROARMap	2520	May 2018	DSpace	Searchable
7	2007	OpenDOAR	121	November 2013	Greenstone	Searchable
	2010	OpenDOAR, ROAR	689	May 2018	DSpace	Searchable
8	2012	OpenDOAR, ROAR	314	May 2018	DSpace	Searchable

†, Registry of open access repository mandates and policies.

repository had 46 records having been established in 2011. One library director lamented the lack of statistical tally between IR content and the research output of the scholars, for example, around 200–200 publications had been produced but there were as little as 100 items in the repository. The IR or faculty librarians said the content was current as they constantly updated it. This was corroborated by data in OpenDOAR, which showed five IRs having been last updated in May 2018 and one in July 2017; however, three were not current as they had been last updated between 2013 and 2015.

Library directors and IR or faculty librarians were asked if their repositories were searchable on the Internet. Searches of the repositories were also done on the Internet. The results showed that seven (87.5%) universities' repositories were searchable on the Internet with only one (12.5%) unsearchable. Seven (87.5%) universities had registered their repositories with OpenDOAR and, of these, three (42.9%) were registered with ROAR. Analysis of the ROAR database showed inactivity by the universities because the records lacked daily deposit activity and the number of items held in the repositories was unknown. In 2016, two (25%) universities had registered their IR policies with ROARMap but were no longer listed in the database in 2018. The study further probed IR or faculty librarians and searched the university repositories to find out if the IRs were user-friendly. Ninety-six per cent (24) IR or faculty librarians said 'Yes' and 4% (one) said 'No'. The researchers also found it easy to navigate through the repositories. The interfaces of the IRs enabled easy navigation through various access points such as the author, title, discipline or community and so forth.

Discussion

Institutional repository establishment in the universities

In correspondence with the findings of a study by Kuchma and Rosenblum (2010) where 15% of participating institutions maintained more than one digital repository, Zimbabwe's eight public universities followed a similar system, but the second IR was for internal or local use and not for public consumption. In a study of repository development in developing and transition countries involving 49 repositories, Kuchma and Rosenblum (2010) found 15% of participating institutions maintained more than one digital repository.

This suggests that the universities were mindful of what others in scholarly circles would say about their institution and the quality of their research output. Therefore, they made sure what they exposed for public consumption met acceptable standards because scholarly communication values quality and trustworthiness of platforms on which research is communicated and shared (Drott 2006; Kennan & Cecez-Kecmanovic 2007; Kennan & Kautz 2007; Kling & McKim 1999). Thus, the 'social influence' construct of the UTAUT model influenced decision-making by the libraries.

Four (50%) of the universities had difficulty convincing management to support the IR initiative, while the other half had no such issues. There was scepticism over the concept of OA even though the Southern African Regional Universities Association (SARUA) – of which Zimbabwe's universities are members – had held a leadership summit in November 2007 to inform university leadership on the OA concept. That is why half of the universities' administrators and managers were quick to respond and support the initiative. Thus, the 'performance expectancy' construct of the UTAUT significantly influenced the decision to adopt OA IR technologies to increase access to research output and visibility on the global sphere.

However, it is worth noting that 'setting up a repository is a major undertaking for an institution' (Cullen & Chawner 2011:462) requiring financial and human resources for establishing and maintaining the repository. The universities were operating under a hyperinflationary and economically constrained environment when the IR initiative was introduced. It was crucial for the universities to think through this issue before plunging themselves into a project they would not be able to sustain in the long run. Lynch (2003:334) said that 'stewardship is easy and inexpensive to claim; it is expensive and difficult to honour, and perhaps it will prove to be all too easy to later abdicate'. This could have been the reason for lack of skilled IT staff to offer technical support for the initiative. As a result, the establishment of IRs in the country's universities lagged behind. In this case, the UTAUT construct 'facilitating conditions' significantly influenced the behaviour of university management towards adoption of IR technologies. The study findings showed that the concept of IRs in Zimbabwe's public universities was still in its infancy as evidenced by 77.8% IRs having been operational for only 3–6 years since their establishment in 2010–2012.

Software choice

All the universities used DSpace open-source software to host their IRs, with two (25%) of them continuing to also use Greenstone software for their local repositories despite others having abandoned it. In Kuchma and Rosenblum's (2010) study, 57% of the participating institutions preferred DSpace software, while 19% used other software packages which included Greenstone. OpenDOAR statistics as of 09 August 2018 showed that 43.9% of the repositories are hosted on DSpace software, thus confirming Masrek and Hakimjavadi's (2012) and Xia and Opperman's (2010) assertion that most universities prefer the DSpace platform because of its flexibility for customisation. In addition, the software was designed to operate in an institutional setting, allows self-archiving by faculty members and uses communities (departments, schools, faculties and so forth) to build digital collections. The universities adopted the software because their colleagues in the ZULC were using it, so they knew they could get support from colleagues in the event of challenges. Therefore, the UTAUT construct 'social influence' significantly influenced behavioural intention to adopt the DSpace software. However, the small universities could have pooled their resources to build a shared IR as a consortium (Xia & Opperman 2010). The universities that continued to use Greenstone could have been attracted by the fact that the software is highly suitable for preserving 'digitised collections like dissertations/theses, manuscripts, rare materials, past examination papers, and other in-house documents' (Ravikumar & Ramanan 2014:80).

All the universities' repositories were multi-disciplinary and made use of the facility of communities within DSpace to categorise their items, a factor that makes it easy for users of the repositories to place and find works in the repositories. The 'performance expectancy' construct influenced adoption of Greenstone by the two universities; they did not mind that others had given up on the software because of its challenges which they were determined to overcome to get the desired results.

Content type

The librarians concurred on post-prints, pre-prints, conference and workshop papers, and theses or dissertations, but differed significantly on the level of theses or dissertations; some included first class undergraduate dissertations in addition to postgraduate theses or dissertations. Others considered postgraduate theses or dissertations only, thus limiting access to the totality of institutional research output. These variations in preferences demonstrate lack of consensus among librarians in Zimbabwe's public universities on the content to be held in the repositories. This confirms Ruiz-Condo and Calderon-Martinez's (2014) assertion that there is lack of consensus on the functions of repositories and debate rages on the type of materials that should be stored in IRs. In concurrence with Connell (2011) and Kocken and Wical (2013), the university librarians were being overly selective about the kind of

content to be included in the repository, thereby weakening their efforts to get campus participation in the IR.

Growth of the repositories

The success of an academic IR is measured by the proportion of items held in the repository to the number of scholars, and by the number of searches and downloads of archived items by others (Kocken & Wical 2013; Mercer et al. 2007). However, for this study, statistics of searches and downloads were excluded because the information could not be availed at the time of the study. In terms of the number of items deposited since establishment of the IRs, they reflect very low levels of content deposit if the number of items held in the repository are compared to the duration of IR functionality, the number of academics (Tables 2 and 3) including students (because they contribute theses or dissertations) and projected research output per year (if each scholar were to publish one research article per year) for each institution. Given the high number (1879 lecturers) of research-active scholars seeking promotion, statistics of research publications by scholars did not match the amount of content held in the repository. One would expect the lecturers to be highly motivated to use the IR as it facilitates visibility of and increased access to their works, thus could improve their articles' impact factor. The finding confirms Kocken and Wical's (2013) position that most universities struggle to acquire content for their IRs. A similar observation was made by Harnad (2011) that most universities' IRs are 85% empty and deposit levels languish at 15% or below. The 'Build it and they will come' approach was used, but the content was not flowing in at a satisfactory pace. Therefore, better strategies, such as offering monetary incentives for authors who deposit their works in the IR, should be developed to increase content deposit.

Interoperability of the repositories

Most (88.9%) IRs were discoverable on the Internet, while one (11.1%) IR was unsearchable. This is a positive development in that the country's research output is now highly visible and discoverable in the international arena and its impact could increase, thereby contributing to sustainable development, potentially attracting collaborative research and more funding from research funders. The research knowledge can be used by a broader readership of scholars working within and outside academia (Fitzpatrick 2012), including government, industry and civil society for development programmes (Trotter et al. 2014).

Most (88.9%) repositories were registered with OpenDOAR and ROAR (37.5%). Registration of an IR with OpenDOAR and ROAR increases visibility and discoverability of the repository content because these databases enable users to find content by location or particular groupings such as content type (Jisc 2019). However, evidence of inactivity by the institutions on ROAR is worrisome as it indicates lack of inflow of content for the repository. However, the interfaces of the IRs are user-friendly as they enable easy navigation through various access points such as the author, title,

discipline or community and so forth. The lack of interoperability of one university's IR is against the ethos of OA and the thrust of the SARUA, which motivated for universities in the Southern African region to adopt OA platforms to impact the global sphere and increase visibility of the institutional research and the scholars (Abrahams et al. 2008). The university should speed up the efforts to enable the searchability of the repository. It is, therefore, recommended that at the ZULC level, spirited efforts to encourage universities to have functional IRs which are searchable through various Internet search engines should continue, while all IRs should be registered in the ROAR for increased visibility of research output, expanded readership and impact of the research for sustainable development.

Conclusion

Although content deposit in the universities' repositories remains low, the research output is now increasingly accessible, searchable, harvestable and useable by a broad readership globally and should contribute towards sustainable development. Visibility of the universities' intellectual capital would contribute to their global rating. Because the repositories are interoperable, the country's goal to establish a functional national repository will be realised. By adopting the DSpace software, the institutions have demonstrated that they have long-term preservation plans for their intellectual capital now stored in the repositories for posterity. However, the libraries are being too selective of the content composition of the IRs; therefore, consensus needs to be arrived at on this issue to gain the trust of content creators and depositors to ultimately increase deposits. Currently, the universities have the formidable task of fill their repositories to obtain a return on investment in IR technologies; the repositories have not been successful thus far. Therefore, it remains to establish the reasons behind low content deposit levels and identify strategies that can be used to increase acceptance and use of the repositories.

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Competing interests

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Authors' contributions

M.M.T. carried out the research for her PhD study; R.G.H. supervised the PhD research.

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