The missing link: the capacity development for academic librarians to sustain citizen science at university libraries

Modiehi Winnie Rammutloa

*Department of Information Science, University of South Africa,
Pretoria, South Africa*

Abstract

Purpose – This paper reports on research into the skills and services required to ensure the sustainability of citizen science as a service in university libraries.

Design/methodology/approach – A quantitative research design was adopted to collect data from academic librarians. A questionnaire was administered, and data were analysed using Statistical Package for the Social Sciences (SPSS).

Findings – More than 90% of responses indicated that to support citizen science activities, it is important for academic librarians to acquire information literacy, data literacy and an understanding of open science. The study found that citizen science activities require a dedicated team and continuous capacity development of team members. Findings also indicated that though academic librarians do not have knowledge of citizen science, they are willing to embrace and embed it in their services and products. Capacity shortage was listed as a challenge for academic librarians to promote and support citizen science activities.

Originality/value – This study is unique as it reports on the possible involvement of academic librarians in the field of citizen science. The link between academic librarians and the field of citizen science which is predominant in the natural sciences has a positive contribution to the body of scholarship as it promotes interdisciplinarity.

Keywords Academic librarians, Capacity development, Citizen science, Continuing professional development, Crowdsourcing, Public participation in research

Paper type Research paper

1. Introduction and background to the problem

The rapid changes in research impact universities across the globe. By extension, university libraries are also affected by the evolution of parent institutions and need to adapt their services to meet the demands necessitated by changes in research. Citizen science is a research change that challenges how university libraries support and promote research. Citizen science is a research activity that encourages community members to engage and participate in scientific research. The phenomenon of citizen science was first coined in the 1990s by authors such as Irwin (1995) to describe the involvement of community members in conversations about matters within their environment. The strength of citizen science hinges on the participation of untrained community members dedicating their time and knowledge to contribute to scientific discoveries (Bonney *et al.,* 2016).

Participation in citizen science is based on a typology of projects which ranges from contractual, where citizen scientists initiate projects with the assistance of seasoned

researchers; contributory projects, where citizen scientists assist in data collection; collaborative projects involving citizen scientists in all project-related activities ranging from the development of data collection methods; co-created projects where citizen scientists get involved in the initial planning of the project such as question formulation process and lastly collegial projects where citizen scientists conduct research independently from researchers (Sauermann *et al.,* 2020). SciStarter, which is the biggest database housing citizen science projects, recorded over 3,000 citizen science projects to date with over 100,000 registered citizen scientists (SciStarter, 2022).

Citizen science is more prevalent and widely reported in the natural sciences (Kullenberg and Kasperowski, 2016). In recent years, there has also been a move to report on citizen science in the social sciences (Tauginienė *et al.*, 2020). The social sciences uptake on citizen science has opened an opportunity for universities to get involved in citizen science activities. Though citizen science is popular in project-based settings, this paper reports on the social aspects of citizen science, exploring the role of academic librarians in citizen science activities.

The ever-changing landscape in research compels universities to re-imagine their roles and involvement in research initiatives such as citizen science. University libraries, as sub-components of the university system, can actualise this reality by providing services and products to stay versed in research, particularly in citizen science research. The development also dictates this assertion in research for university libraries which necessitates an evolution in services and products to align with the changes (Muhammad and Anwar, 2019; Huang *et al.*, 2021). This begs the question, why should university libraries be involved in citizen science? Previously, traditional libraries focused on the magnitude of their collections (Dempsey and Malpas, 2018). That notion gradually diminishes as university libraries focus on supporting data-driven research (Tzanova, 2020).

University libraries have the skills and expertise to assist researchers with their research needs and therefore need to keep up with the changing knowledge space (Bieraugel and Neill, 2017; Sewell and Kingsley, 2017). The research needs also include navigating citizen science research data. This emerging role could expand academic librarians' responsibilities to accommodate citizen science (Nitecki and Davis, 2019). The problem, however, is the lack of awareness, skills and knowledge of citizen science in university libraries. The absence of a skilled workforce to perform citizen science activities could hinder the uptake of citizen science by academic librarians. An opportunity, therefore, exists for academic librarians as knowledge hubs to support and promote citizen science, provided they possess relevant skills and expertise.

2. Purpose and objective of the study
The paper aims to investigate the skills required by academic librarians to actualise citizen science in university libraries. The specific objective of this paper is, therefore, to investigate whether the skill set academic librarians possess or have developed over the years is sufficient to perform citizen science activities.

3. Literature review
Capacity development in university libraries emanates from the changes due to technology and the requirement for academic librarians to function in a data-driven space (Corrall and Jolly, 2019). In addition, academic librarians need to be prepared to accommodate new user needs. Academic librarians have recently acquired skills in bibliometric analysis, data mining and digital curation (Auckland, 2012). These skills may need to be re-examined if performed by academic librarians. This is because there are insufficient staff and resources to perform functions such as data management and data curation in university libraries (Giarlo, 2013).

The lack of skills and knowledge in research data services may pose a barrier for academic librarians to perform research data services functions (Tenopir *et al.*, 2019). Some university libraries may not have the resources to hire new staff to perform these functions; the option is, therefore, to re-skill. Therefore, the technical skills for the optimum functioning of academic librarians in a techno and data-driven environment need to be examined. Though academic librarians have been working with research data for years, their readiness to promote and support citizen science activities needs to be discovered. To realise the citizen science drive and close knowledge gaps, academic librarians in South Africa could consider training and re-skilling as an option through appropriate infrastructure, standards and best practices. For university libraries to be active partners in citizen science, they need to have or develop infrastructure to support the initiative (Ignat *et al.*, 2018).

The assertion is prompted by the need for academic librarians to re-skill to serve a new breed of scientifically literate clients. If this opportunity passes, there is a possibility of limiting the involvement of community members in citizen science activities in favour of using seasoned researchers (Weingart and Meyer, 2021). This could lead to the detriment of citizen science; however, the active involvement and participation of academic librarians in research data-intensive roles could change the narrative.

The role of academic librarians in data-intensive roles is three-fold: introducing data librarianship in Library and Information Science (LIS), creating and increasing awareness among researchers and providing research data archiving and preservation services (Corrall, 2020). These are all research support services, and the involvement of academic librarians should not be a challenge because this is also an opportunity to expand their roles. Fuhr (2019) suggests that to bridge the skills gap; academic librarians should identify the services currently being offered or planned by their institutions and participate in training that requires expertise. Inevitably, gaining the skills and necessary qualifications is compulsory for modern academic librarians to provide new or reviewed services.

4. Research methodology
The paper adopted a positivist paradigm centered around quantitative research design to measure the opinions of academic librarians on citizen science. Data were collected through a survey where a structured questionnaire was administered to 185 academic librarians. A questionnaire was distributed via email to academic librarians aligned with the Library and Information Association of South Africa (LIASA). A census sampling was used, and all eligible members of the LIASA belonging to the Higher Education Library Interest Group (HELIG) were invited to respond. The decision to use the census sampling method was based on the small population of 185 academic librarians. The response rate was 34%, as most academic librarians did not possess the tools of the trade to work from home. The questionnaire was conducted during the hard lockdown restrictions in South Africa, which negatively impacted the responses to the survey. Secondly, some academic librarians were alternating to report for duty due to strict Covid-19 rules imposed. The focus for the targeted academic librarians was, therefore, on their work commitments when they reported for duty. Informed consent was obtained from respondents and ethical considerations were followed. The responses from the questionnaire were downloaded on a spreadsheet for coding, and data analysis was conducted using the Statistical Package for the Social Sciences (SPSS).

5. Findings and discussions
The following areas to establish the capacity of academic librarians to sustain citizen science activities were explored.

5.1 Perceptions of citizen science

The respondents were provided with three similar and correct definitions of citizen science to choose the one that aligns with how they see and perceive it to be. This was by no measure a test of the respondents' understanding of citizen science but their perception of the phenomenon. Table 1 shows the responses provided by academic librarians on what they perceive citizen science to be.

The results show that the majority (32) selected that citizen science is a collaboration between scientists and volunteers with the sole aim of conducting scientific research. The second definition that received (25) responses was that citizen science is a scientific work involving community members working together with trained scientists. The last definition states that citizen science is a component of extramural knowledge production that encompasses crowdsourcing, amateur science, indigenous knowledge and commercial science, which received fewer responses (16). The results are by no means a measure of how academic librarians understand citizen science but a definition they resonate with.

5.2 Identification of citizen science projects

To further explore the respondents' perceptions, they were requested to identify citizen science projects they are familiar with. The question intended to gauge whether academic librarians know of any active citizen science projects whether locally or abroad. The respondents were presented with a list of projects which are mostly reported in the literature. Most respondents (60%) had not heard of any of the projects presented. The results further show that (24%) know the South African Bird Atlas Project (SABAP1), 14%, Cape Citizens, (11%), The South African Frog Atlas Project, E-bird project (10%), Galaxy Zoo (10%), Milky way project (8%), iNaturalist (8%), SciStarter (5%), SABAP2 (2%) and Nature's Valley Trust (2%). Table 2 presents the various citizen science projects selected.

What does the term "citizen science" refer to? Select the definition/s that makes sense to you Definition of citizen science	Responses
The collaboration between scientists and volunteers with the sole aim of conducting scientific research	32
Scientific work involving community members working together with trained scientists	25
A component of extramural knowledge production that encompasses crowdsourcing, amateur science, indigenous knowledge, and commercial science, to name a few	16
Source(s): Table by author	

Table 1. Definition of citizen science

Project/Activity	Frequency	Percentage
I have not heard of any citizen science projects/activities listed above	38	60%
South African Bird Atlas Project (SABAP1)	15	24%
Cape Citizen Science	9	14%
South African Frog Atlas Project (SAFAP)	7	11%
E-bird project	6	10%
Galaxy Zoo	6	10%
iNaturalist	5	8%
Milky way project	5	8%
Scistarter	3	5%
Nature's Valley Trust	1	2%
SABAP 2	1	2%
Source(s): Table by author		

Table 2. Citizen science projects

The findings depicted a limited knowledge of citizen science projects, whether locally or internationally. The findings could suggest that academic librarians need to be involved in citizen science activities even in their communities. This will assist in expanding their knowledge of citizen science projects.

5.3 Reliability of citizen science data
Respondents were asked to comment on how they view the reliability of citizen science data collected by citizen scientists as compared to data collected by researchers. Results from Table 3 show that 87.3% of respondents view citizen data as reliable as data collected by researchers, whereas 4.8% perceive the data as more reliable and 4.8% as unreliable.

The results show that academic librarians perceive citizen science data to be reliable. This is despite the previous question about their limited knowledge of citizen science projects. The limited knowledge of the projects did not influence the respondents' perception of the reliability of citizen science data. The results further suggest that there is some level of trust in citizen science data as it is seen as reliable by academic librarians.

5.4 Knowledge and skills required to perform citizen science activities
Respondents were asked to establish the knowledge and skills required for academic librarians to assist with citizen science activities in the ever-changing university library landscape. A three-point Likert scale was used to analyse the responses. On a scale of 1–3, ranging from 1 being "No opinion" and 3 being "Agree", respondents were asked to rate the skills required to be involved in citizen science activities. The results presented in Table 4 depict the fact that knowledge and numerous skills were required for citizen science activities in university libraries and information literacy skills (Agree = 61), data literacy skills (Agree = 59), understanding of open science (57), understanding of data quality (54), Data collection skills (53), Digital content management skills (53), Data management plan creation skills (51) and Knowledge of the creative commons licenses (51) were particularly identified by the respondents to assist with citizen science activities.

The result further revealed generally low levels of agreement and no opinions for the mentioned knowledge and skills required for academic librarians to possess. Therefore, less priority must be given to the aspect of knowledge and skills ranked low or where respondents do not have an opinion.

5.5 Additional knowledge and skills to assist academic librarians
An open-ended question was asked on additional knowledge and skills required for academic librarians. This ensured that all views on the knowledge and relevant skills were covered. The results presented in Table 5 were grouped into five (5) core ideas and seventeen (17) categories of additional knowledge and skills in citizen science activities. The core ideas were labelled as Domain one to five. Data management and digitisation skills (31.6%), research skills (26.3%) and communication and people management skills (21.1%) emerged as the top three additional knowledge and skills to be considered by academic librarians.

In your view, how reliable is data collected by citizen scientists?	Frequency	Percent
As reliable as data collected by researchers	55	87.3
More reliable than data collected by researchers	3	4.8
Not reliable at all	3	4.8
Total	63	100
Source(s): Table by author		

Table 3.
Reliability of citizen science data

What knowledge and skills (to observe, infer, predict and understand collected data) do you think academic librarians need to assist with citizen science activities?

Statement	No opinion (1)	Disagree (2)	Agree (3)
Information literacy skills	2(3.2)		61(96.8)
Data literacy skills	4(6.3)		59(96.7)
Understanding of open science	3(4.8)	3(4.8)	57(90.5)
Understanding of data quality	7(11.1)	2(3.2)	54(85.7)
Data collection skills	4(6.3)	6(9.5)	53(84.1)
Digital content management skills	6(9.5)	4(6.3)	53(84.1)
Data management plan creation skills	8(12.7)	4(6.3)	51(81.0)
Knowledge of the creative commons licenses	7(11.1)	5(7.9)	51(81.0)
Understanding of findability, applicability, interoperability and reusability (FAIR) of data	12(19.0)	2(3.2)	49(77.8)
Data cleaning skills	10(15.9)	5(7.9)	48(76.2)
Data publishing skills	10(15.1)	6(9.5)	47(74.6)
Knowledge of scientific metadata schemas	14(22.2)	3(4.8)	46(73.0)
Science literacy skills	14 (22.2)	5(7.9)	44(69.8)
Data visualisation skills	13(20.6)	7(11.1)	43(68.3)
Discipline-specific scientific data	11(17.5)	12(19.0)	40(63.5)
Data citation skills	6(40.0)	3(20.0)	6(40.0)

Source(s): Table by author

Table 4.
Knowledge and skills

What else should be added to the knowledge and skills that academic librarians already possess to assist them with citizen science activities?

Domains (core ideas)	Categories	Frequency	Percent
Data management and digitisation skills (*n* = 6, 31.6%)	Data privacy protection	2	33.3%
	Digital literacy skills	2	33.3%
	Data curation skills	1	16.7%
	Digitisation	1	16.7%
	Total	6	100.0%
Research skills (*n* = 5, 26.3%)	Advanced research skills	1	20.0%
	Knowledge of measuring research impact	1	20.0%
	Open Science Open publishing	1	20.0%
	Open science skills	1	20.0%
	Statistical, coding and programming skills	1	20.0%
	Total	5	100.0%
Communication and people management skills (*n* = 4, 21.1%)	Communication skills	3	75.0%
	Community or People Management skills	1	25.0%
	Total	4	100.0%
Ethics skills (*n* = 2, 10.5%)	Cyber ethics	1	33.3%
	Ethical handling of data	1	33.3%
	Sound knowledge of ethical considerations related to the research topic	1	33.3%
	Total	3	100.0%
Knowledge (*n* = 2, 10.5%)	Knowledge of the creative commons licenses	1	33.3%
	Knowledge of various languages spoken in various communities	1	33.3%
	Knowledge of which groups/disciplines are involved in citizen science, to keep the group members abreast of developments	1	33.3%
	Total	3	100.0%

Table 5.
Additional knowledge and skills

Source(s): Table by author

In contrast, the respondents considered ethics skills (10.5%) and knowledge of creative commons licence, various spoken languages and groups or disciplines involved in citizen science (10.5%) the least.

(1) *Domain 1*: Data management and digitisation skills ($n = 6$, 31.6%) with four categories.

(2) *Domain 2*: Research skills ($n = 5$, 26.3%) with five categories.

(3) *Domain 3:* Communication and people management skills ($n = 4$, 21.1%) with two categories.

(4) *Domain 4:* Ethics skills ($n = 2$, 10.5%) with three categories.

(5) *Domain 5:* Knowledge ($n = 10.5\%$) with three categories.

The categories that generated the highest responses from the respondents are communication skills (75%), data privacy protection (33.3%), and data literacy skills (33.3%). The results suggest that in addition to the core ideas, these three categories are necessary for promoting citizen science activities and the capacity development of academic librarians and should therefore be considered.

5.6 Positions or roles to perform citizen science activities

After establishing the knowledge and skills to assist academic librarians in performing citizen science-related activities, it was important to identify the key roles to carry out the responsibilities. The results in Figure 1 revealed that Research data specialist (86%), Institutional repository librarian (75%), Metadata specialist (71%), Subject/information/search/personal (70%) and data curator (67%) were ranked higher than all the other positions or roles.

This finding could suggest that these roles or positions are key to achieving the objectives of citizen science activities in university libraries. The respondents also viewed Training librarians (56%) and Information and communication specialists (51%) as roles or positions to be considered, however Research Commons Coordinator, Marketing Specialists, Cataloguers, Copyright Specialists, any other staff members such as Statisticians, Collection Management assistants/Shelvers, Community outreach and advocacy Liaisons and Library Management were not viewed as important for the success of citizen science and they were ranked very low at below 50%.

5.7 Training interventions required to capacitate academic librarians

Respondents were asked to identify training interventions that could be offered to capacitate academic librarians. On this question, a multiple-response rating was used where respondents could select as many options as possible. As depicted in Figure 2, the respondents identified workshops (90%), continuous professional development (CPD) courses (83%), short courses (76%), peer learning from other librarians (73%) and conference attendance (71%) as the top training interventions required to capacitate academic librarians to assist with citizen science activities. Unfortunately, repository training by vendors and webinars are the least training interventions needed by academic librarians to assist with citizen science activities, with a rating of (2%).

This result suggests that the top training interventions (workshops, CPD courses, short courses, conference attendance and peer learning) recommended by the academic librarians to assist with citizen science in the study area should be given urgent attention. In contrast, vendor repository training and webinars deserve little consideration by university libraries. The low response could be that academic librarians do not consider vendor repository
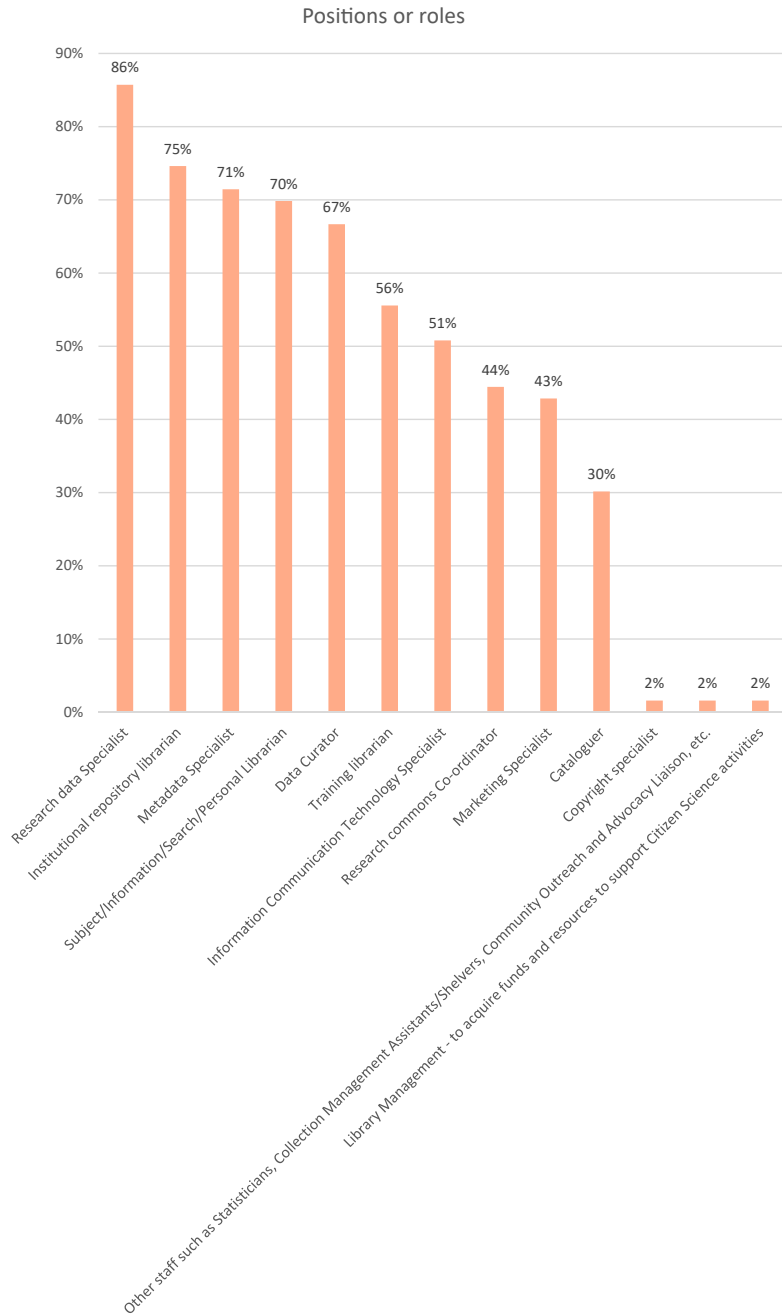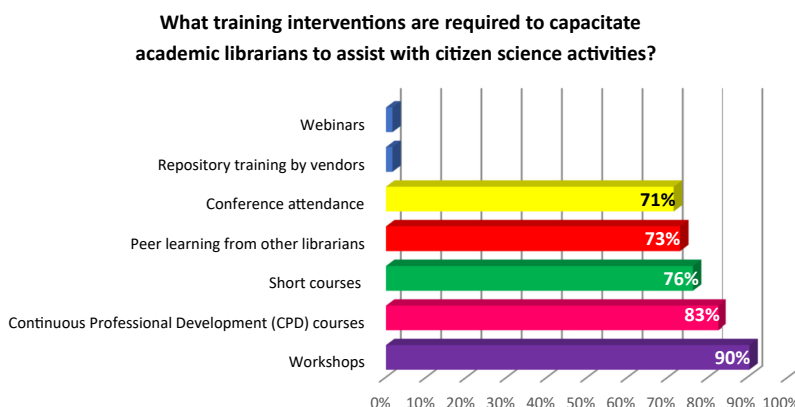
Figure 1.
Library roles in
performing citizen
science activities

Source(s): Figure by author

**What training interventions are required to capacitate
academic librarians to assist with citizen science activities?**

Source(s): Figure by author

Figure 2.
Training interventions

training as a key intervention to capacitate academic librarians in citizen science activities as it is more relevant to product suppliers than librarians' responsibilities.

5.8 Provision for citizen science data management training
A question was asked to establish if university libraries provide some form of citizen science data management training. The results show that (65.1%) do not provide data management training, 33.1% are not sure, and 1.6% responded affirmatively. The result depicted in Table 6 suggests the apparent need for university libraries in South Africa to provide citizen science data management training. The success of citizen science activities is anchored on a trained workforce, particularly in data management.

These results suggest that there are no efforts from the academic librarians to provide training in citizen science data management which could provide an understanding of citizen science and its activities. The finding revealed a barrier to the uptake of citizen science in university libraries.

6. Recommendations
Possession of knowledge and skills are primary requirements for the success of citizen science in university libraries. Knowledge and skills deficiency are reported in this research which can potentially hamper the positioning of citizen science. Academic librarians need to repurpose their current skills or acquire new skills to accommodate citizen science. University libraries need to provide the necessary support and capacity development to prepare academic librarians for the new role, as they are expected to train citizen scientists. It is, therefore, prudent that stakeholders such as the LIASA, the Network of Data and Information Curation and Library and Information Science Schools introduce CPD programmes to offer skills development and training.

Does your university library provide citizen science data management training?	Respondents
No	65.1%
I am not sure	33.3%
Yes	1.6%
Source(s): Table by author	

Table 6.
Citizen science data
management training

The study recommends that citizen science be incorporated into all the library's activities. University libraries should leverage existing relationships with academic departments to develop programmes for capacity building. In addition, citizen science could be added to the curriculum of the field of information science to train students in science literacy and the importance of science conducted by non-science persons. Academic librarians have been at the forefront of information literacy training; an introductory course to citizen science could be added as part of information literacy training. This way, citizen science will not be elevated as a stand-alone course but an addition to what is already in existence.

Regarding roles and responsibilities, a dedicated team should be appointed to manage and streamline all related processes. Staff members with strong research data backgrounds or pure interest in innovation in research data should be identified to spearhead the initiative. Capacity development should not be limited to academic librarians but to library clients as the biggest stakeholders in university libraries and by extension, citizen scientists.

7. Conclusion

Citizen science is an old field, however new to academic libraries, which warrants a suitable introduction. Its introduction to academic libraries could result in additional expenses in the form of human resources. It might, therefore, not be practical due to the unavailability of staff to perform citizen science activities. A staggered and phased approach by academic libraries might be a solution to this challenge. This will reduce pressure on university libraries and academic librarians to manage added responsibilities. The benefits of involvement outweigh the challenges, as the profiles of academic librarians would be raised once they engage in citizen science activities.

In this paper, the changes in universities and university libraries regarding research data were discussed. Citizen science as a form of research data and a service in university libraries has presented both opportunities but rather more challenges to academic librarians. For academic librarians to support and promote citizen science, there is an urgent need to re-invent their roles, services and products to engage in citizen science activities. The adverse effect of skills shortage and time constraints were illustrated as major barriers to the success of citizen science in university libraries. In mitigating, academic librarians require capacity development with multiple interventions such as CPD, conference attendance, mentoring and peer learning. Furthermore, a dedicated team needs to be assigned the responsibility of providing a service for citizen science. The findings of this paper have implications for the profession as it introduced a new body of knowledge in the field of LIS by merging university libraries and citizen science.

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Corresponding author
Modiehi Winnie Rammutloa can be contacted at: rammumw@unisa.ac.za