Open Science Practices among Universities in Kenya: Opportunities and Challenges

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Abstract

Science is data-driven however access to scientific data often possess a challenge to scientist. Scientific data is often subject to legal and privacy regulations, restrictive institutional policies, in addition to weak incentives for researchers to share data. There have been concerted efforts to promote openness in research through encouraging open science among researchers. This chapter analyses open science practices, opportunities and challenges among universities in Kenya. The study on which this chapter is based employed a descriptive survey research design using an online questionnaire through Google forms to collect data from researchers in universities in Kenya. Data was collected from 34 universities. A majority of the respondents 55% were familiar with some aspects of open science such as open access, open source software and open data, most of them were not aware of open peer review and open notebook concepts. Over 70% of the respondents are involved in open access publishing while only a few are involved in other forms of open science. The benefits of open science include sharing knowledge, enabling collaboration and wider dissemination of research outputs. Therefore, Open science practices should be encouraged as a panacea to scholarly crisis and publishing channels needs to be encouraged among researchers. Recommendations made in this chapter may be helpful to all stakeholders in the research workflow to develop open science practices among universities in Kenya.

Keywords: *Open Access, Open Data, Open Peer Review, Open science, Open Source.*

1 Introduction

Open science is changing the way in which scientific research processes are conducted and the data/knowledge is produced thereof accessed and utilised by researchers. Science is usually a data-driven and expensive activity however on access to scientific data is subject to administrative, legal and privacy regulations, ICT infrastructure requisites, restrictive institutional policies and practices in addition to weak incentives for researchers to share data. Therefore, open science is gaining momentum as a new and alternative way for researchers to conduct, publish and disseminate their research.

Open science as a term is attributed to Paul David who defined the phenomenon in 2003 (David, 2008), and can be taken to refer to efforts made to provide the outputs of a research in digital formats for wider accessibility to the scientific community and the society at large. Information and communication technologies (ICTs) have reshaped the scientific research process by creating opportunities to collect, organise and publish the outputs (OECD, 2015). Open science is about increased rigour, accountability, and reproducibility for research. It is based on the principles of inclusion, fairness, equity, and sharing. Open science ultimately seeks to change the way research is done, who is involved and how it is valued. It aims to make research more open to participation, review/refutation, and improvement and (re)use for the world to benefit. Research in many fields are facing reputation crisis due to what Kohler (2018) calls failure of replication attempts. He adds that the major reason for this lack of reproducibility is questionable research practices that might invalidate the research outputs. Open science has been touted to improve such a situation.

Open science has the potential impact research workflow; how researchers conduct their research; how they share and discuss research findings; how they publish articles; how research findings are disseminated to academics and civil society; and how research findings are evaluated using new metrics to assess their impact. There is however no known scholarly study undertaken to explore how researchers practise open science. Much research has been concentrated on the explanation of the concept (Frieske, Widenmayer, Gassmann & Schildhauer, 2015; Kisjes, 2015) and a few on its impact on researchers' career progression (McKiernan *et al.*, 2016). This chapter analyses open science practices, the opportunities and challenges in universities in Kenya.

2 Open Science Practices in the Research Workflow

Open science embodies an approach to research that is collaborative, transparent and accessible. There is a wide range of activities that come under the umbrella of open science that include open access publishing, open data, open peer review and open research. It also includes citizen science, or more broadly, stakeholder engagement, where non-specialists engage directly in research (European Commission, 2017). Open science in itself is not a new initiative but has been practised in various approaches as early as 1990s with open access movement. It started with the development of open access journals (1993), open archives (1999) and open access policies (2003) (Laakso *et al.*, 2011). These initiatives led to an increased availability of open online publications. However, this practice focused more on the publications phase in the research

workflow. Other initiatives of open science started developing in early 2000 but with slow adoption rates (Kisjes, 2015). These initiatives included open data, open educational resources, open peer review, open source, and open methodology.

Researchers all over the world, to some extent, practise open science. More and more researchers do so by publishing in open access journals, sharing research data, or including other researchers into the research process (Friesike *et al.*, 2015). The increased requirement for implementation of Open science practices can be attributed to a push by funders, publishers and institutions requiring researchers to work in an open science manner. There is an increased recognition and adoption of open science practices, including new policies that increase public access to the academic literature (open access) (Björk *et al.*, 2014; Swan *et al.*, 2015) and encourage sharing of data (open data) (Heimstädt, Saunderson & Heath, 2014; Michener, 2015; Stodden *et al.*, 2013), and code (open source; Stodden *et al.*, 2013; Shamir et al., 2013).

3 Methodology

The purpose of this chapter is to explore open science practices in universities in Kenya. The objectives of the study which yielded this chapter were to analyse open science practices among universities in Kenya; and examine the opportunities and challenges in open science.

The study adopted a descriptive survey research design. According to Salaria (2012), descriptive survey concerns itself with the present phenomena in terms of conditions, practices beliefs, processes, relationships or trends. Creswell (2014) adds that descriptive research design is devoted to the gathering of information about prevailing conditions or situations for the purpose of description and interpretation. This study describes how the universities in Kenya practise open science and explores the opportunities and challenges they face. Therefore, a descriptive survey research design was found to be appropriate. An online questionnaire was formulated with three (3) sets of questions. The first part of the questions captured background information about the respondents' institution and gender. The second set of questions assessed the respondents' understanding and level of awareness of the concept of open science practices. The third set of questions, meant for respondents who had practiced open science, sought to establish the extent of this practice in terms of length of time, the specific open science practised and the opportunities and challenges experienced. The questions in the third set of questions provided for an open-ended response where the respondents were to give additional information in regard to the issue under study.

The target population was 71 universities accredited by Commission for University Education in Kenya as at July 2018. The study sampled 68 universities ranked by Webometric in July 2018 (Cybermetrics Lab - CSIC, 2018). The methodology for webometrics ranking heavily relies on the quantity and quality of research outputs. This is the basis of the assumption that open science practices contribute a great deal to the rank attained. Virtual snowball sampling technique was used. Respondents-driven sampling where the university librarian in each institution was the first contact and was used to identify eligible participants for inclusion in the study and share the research instrument through virtual social networks.

A questionnaire survey mounted on an online survey tool 'Google form' was used to collect data. The questionnaire was sent to email addresses of the university librarians with a message to share with the researchers in their institutions. The questionnaire remained online for three (3) weeks. The data was analysed manually and presented in form of charts, graphs, and percentages.

To ensure generalisability of the study, 'Proximal Similarity Model' proposed by Donald T. Campbell was used. This model is an appropriate approach to ensure external validity where the context (people, place, setting, and time) of the study are more or less similar (Trochim, 2006). Open science practices and research process are the key variables in this study and they are more proximally similar, and hence generalisation of the results of this study is possible.

4 Results and Discussion

A total of 36 responses from 34 universities were received by the end of the survey period. This composed of 24 females, 8 males while 4 did not provide their gender. This represents a 50% response rate.

4.1 Level of understanding of open science concept

Open science being a new concept, it was necessary to establish the level of understanding. 9% (3) of the respondents rated their level of understanding as "very well"; 47% (16) rating their understanding as "well" and 20% (7) as "moderately well", while 15% (5) rated their understanding as "a little" and 9% (3) did not answer this question. A study conducted among European researchers in May 2017 reported otherwise. It reported that the concept of open science was unknown to a majority of researchers (European Commission, 2017). Fuente (2016) highlighted the non-realisation of the concept of open science despite the developments in information and communication technology which propels the practice. In Kenya, deliberate efforts have been made to mainstream open science practices through trainings, workshops and sensitisation forums for different practitioners, ranging from researchers, librarians to policy makers (Sturdy & Wykstra, 2016). Such kind of efforts can be said to have contributed to the high level of understanding of the concept of open science among researchers in Kenya. Figure 1 presents these findings.

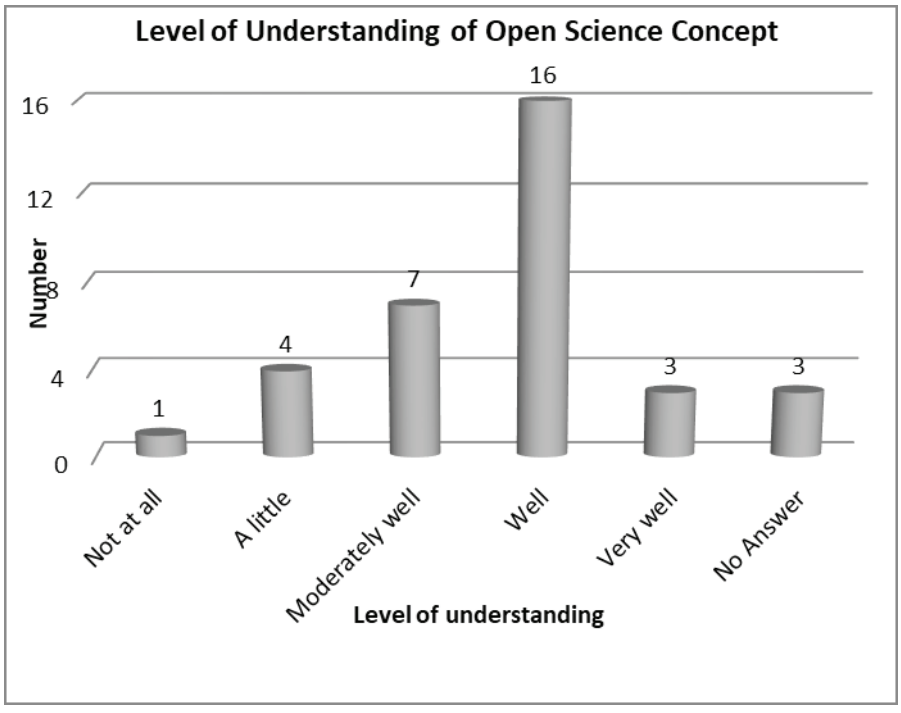

Figure 1: Levels of understanding of open science concept

4.2 Open science practices

There are various practices which are regarded as contributing to open science and are employed in different stages in the research workflow. This study sought to establish the practices researchers in Kenya were aware of and engaged in. The open science practices were extracted from literature to include open access, open software, open data, open notebook, open peer review, and open science evaluation and open lab notes. Figure 2 shows that the majority of the respondents, 91% (31), are aware of open access, 73% (25) open software, 70% (24) open educational resources; while 11% (4) open notebook and open science evaluation and 2% (1) for open lab notes.

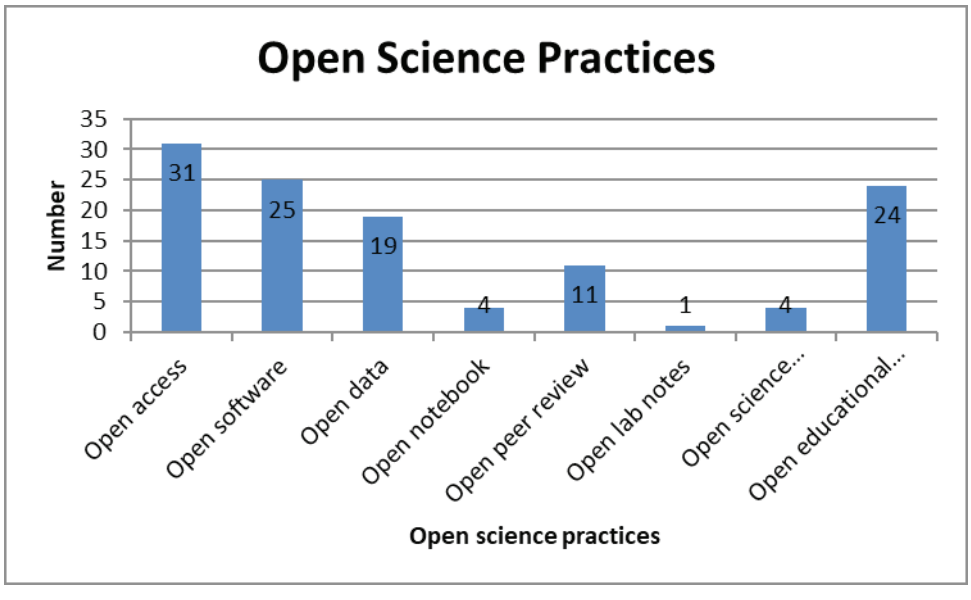

Figure 2: Open science practices

Open access publishing is the most known open science practice and on the contrary, open lab notes, open science evaluation and open notebooks are less known. Similar findings were reported by European Commission (2017) where it was found that open access publishing was known by three out of four researchers while open notebook and open peer review was not known at all. A search for literature on open science in Kenya showed that many international organisations and partners have organised trainings and forums advocating for open access publishing, open source software and open data, with little or no mention of the other forms of open science. Additionally, open access publishing is the oldest form of open science practice having begun in 2000 (Appel *et al.*, 2017), while open notebook

in 2006 (Bradley, 2007) and open peer review in early 2010 (Ross-Hellauer, 2017). The emphasis given to open access publishing and the adoption time may have contributed to these findings.

4.3 Involvement in open science activities

Upon establishing awareness of the open science practices, the author explored how the researchers were involved in open science. The respondents were asked to indicate the open science activities they were involved in. The activities were derived from literature review to include: publishing in open access, communication/sharing research works through social media, using open licenses, sharing research data, sharing software code, sharing notebooks, using open peer review, sharing pre-prints, using shared reference libraries and sharing (grant) proposals. This question also allowed the respondents to add any other activity they undertake and consider it to be open science. Figure 3 presents the results.

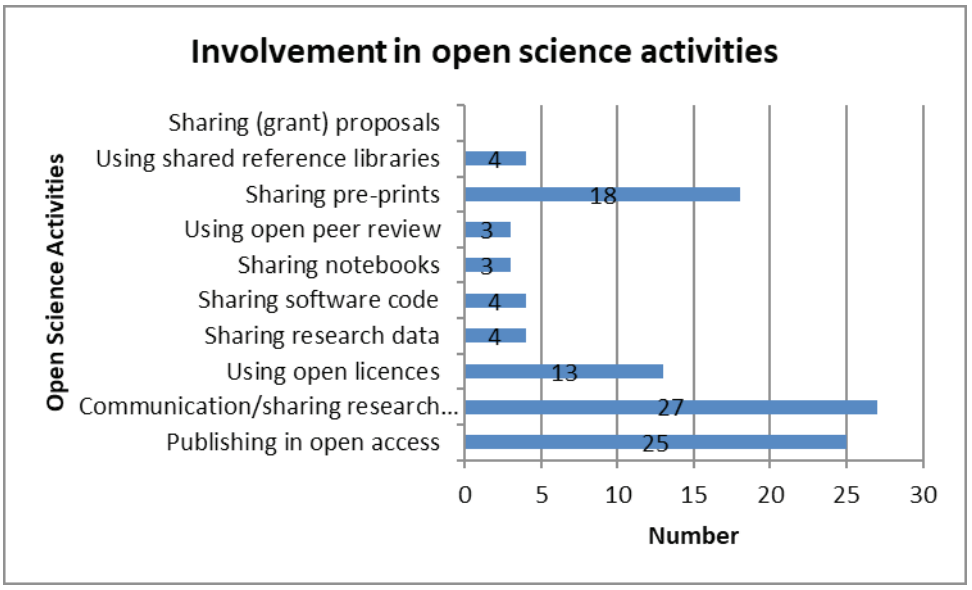

Figure 3: Involvement in open science activities

It was found that the majority 79% (28) and 73% (26) of the respondents were sharing their research work through social media networks and publishing in open access respectively. This corroborates what was reported in Figure 2 where open access publishing was the most known practice. Similar results show that many researchers are publishing their research work in open access journals and self-archiving in their institutional repositories or personal websites (Laakso *et al.*, 2011; Whyte & Pryor, 2011). Opening research work including has been touted to lead to an increase in research impact (McKiernan *et al.*, 2016) and hence the reason why many researchers are involved in open access. There has been a debate on the evaluation metrics for research work and a number of authors have proposed new strategies of communicating research work and especially through social media networks for wider impact (Arza & Fressoli, 2018; McKiernan *et al.*, 2016; Whyte & Pryor, 2011). This explains why 79% of the respondents in this study were involved in sharing their work through social media. Literature search on the other open science activities revealed that no scholarly research has been done, except non-scholarly reports such as blogs and wikis. Therefore, this can explain why not many researchers are aware and involved in such activities.

4.4 Opportunities and challenges offered by open science

One of the objectives of this study was to establish the opportunities and challenges offered by open science to researchers in Kenya. The following were the opportunities identified in order precedence:

1. Enables collaboration in research 27(79%);
2. Sharing of knowledge 27(79%);
3. Wider dissemination of research work 26(76%);
4. Greater access to research outputs 25(73%);
5. Makes research more transparent and trustworthy 24(70%);
6. Allow use and re-use of research 20(58%);
7. Minimise research duplication 2(5%); and
8. Give more visibility, more citation and more accessibility 1(2%).

Arza and Fressoli (2018) identified collaboration among researchers as the engine for production of interconnected knowledge. Research funders, governments and individual institutions have developed policies motivated by ethical,

moral and utilitarian arguments that the public has a right to access literature arising from publicly funded research (Suber, 2012; Willinsky, 2006). Publishing in open access has been evidenced to have the advantage of higher citation (Gargouri *et al.*, 2010; Hitchcock, 2016). Open research gives visibility to the activities undertaken and hence ensuring transparency and reproducibility and dispels replication failures (Kohler, 2018). Fuente (2016) notes that one of the key benefits of open science is efficiency which is achieved through providing greater access to scientific outputs, reducing research duplication, and allowing more research from the same data. The values and benefits of open science are not constrained to researchers but extend to the whole society.

The challenges identified as bedevilling open science among researchers in Kenya are:

1. Lack of standards for sharing research 15(44%);
2. Cultural/institutional constraints 15(44%);
3. Difficulties in guaranteeing data privacy 14(41%);
4. Ineffective policy guidelines 14(41%);
5. Lack of legal clarity 12(35%);
6. Fear of free-riding 10(29%);
7. Need to invest more time and effort 8(23%);
8. Trouble with digital tools for research 7(20%);
9. Financial aspects of openness 7(20%);
10. Reluctance to share code/data 5(14%); and
11. Evaluation criteria impede openness 4(11%).

Fuente (2016) explains that there are still concerns about open science which need to be tackled so as to realise the full potential of openness. Fuente (2016) grouped the challenges as socio-cultural, technological, political, organisational, economical and legal. Socio-cultural concerns range from lack of awareness of the benefits and potential of open science (Whyte & Pryor, 2011); reluctance to change the current research practices (Arza & Fressoli, 2018); diverse approaches to research; to researchers considering open science as a time and effort-consuming activity (Appel *et al.*, 2017). The technological issues identified were the need to improve the e-infrastructure to support transition to open science and the wide variety of technologies available (Fuente, 2016). A true open science landscape should happen from an international level and be supported at national level. The political and organisational issues raised included lack of political commitment to promote and integrate open science in the government agenda (Fuente, 2016); and lack of policy framework to guide open science practices at both national and institutional level (McKiernan *et al.*, 2016). Although open science has been praised to lead to better use of resources, there is need for significant investments in order to develop the technical and organisational ecosystem (Appel *et al.*, 2017). Legal issues identified as the major concerns range from data privacy to lack of clarity of appropriate laws. Fuente (2016) stresses the concern of absence of legislative frameworks at international and national levels while Appel *et al.* (2018) found that lack of set rules for disclosure of data and other inputs of research and protecting the privacy of the contributors was impeding the uptake of open access. To realise the potential of open science, the stakeholders in the research workflow need to be abreast with the challenges raised in this study.

5 Conclusion

The findings of this study indicate that researchers in Kenya understand the concept of open science and are aware of the open science practices. The high level of awareness can be attributed to advocacy programmes conducted by various international agencies like Centre for Open Science, Innovations for Poverty Action (IPA) among others. Despite the high level of awareness, it was found that open science practices in which the researchers were involved were limited to open access, open source software and open data. There was minimal involvement in open peer review/evaluation and open notebook/lab. To optimise the benefits offered by open science, the author recommends the following:

1. To foster a change of attitude towards open science, there is need for incentives and rewards for researchers practicing open science by university management.
2. There is also a need for trainings and awareness creation on all open science practices to be given a balanced attention by librarians and international bodies and partners involved in open science advocacy.
3. Create support structures for open science. These structures may include technical, legal, professional and implementation support from institutions. This can be at organisational or national level. For organisational level, the management should be responsible, while national level the government.
4. Develop and implement open science policy. To mainstream open science, a policy is important to ensure compatibility tools and elements of research to open science. Such a policy will provide clarity to all stakeholders in regard to open science. Librarians should guide in the development and implementation of the open science policy.

6 References

American Library Association. (2012). Why librarians don't share code. Retrieved June 23, 2018, from https://americanlibrariesmagazine.org/blogs/the-scoop/why-librarians-dont-share-code/

Appel, A. L., Albagli, S., & Maciel, M. L. (2017). Open scientific journals: Emerging practices and approaches. *Information Services & Use*, *37*(4), 475–488.

Appel, A., Lujano, I., & Albagli, S. (2018). Open science practices adopted by Latin American & Caribbean open access journals. *ELPUB*, *4*(1), 191–210.

Arza, V., & Fressoli, M. (2018). Systematizing benefits of open science practices. *Information Services & Use*, *37*(4), 463–474.

Bradley, J.C. (2007). Open notebook science using blogs and wikis. *Nature Precedings*.

Cybermetrics Lab - CSIC (2018). Ranking Web of Universities. Retrieved July 30, 2018 from http://www.webometrics.info/en/Africa/Kenya%20

David, P. A. (2008). The historical origins of 'Open Science': An essay on patronage, reputation and common agency contracting in the scientific revolution. *Capitalism and Society*, 3(2), 1-103.

European Commission. (2017). Open science report: How to provide the skills researchers need?. Retrieved June 23, 2018, from https://www.zbw-mediatalk.eu/2017/08/report-wie-bekommen-forschende-die-qualifikationen-fur-open-science/

Friesike, S., Widenmayer, B., Gassmann, B., Schildhauer, B. (2015). Opening science: Towards an agenda of open science in academia and industry. *The Journal of Technology Transfer*, *40*, 581–601.

Fuente, G. B. (2016). Challenges and strategies for the success of Open Science. Retrieved June 23, 2018, from https://www.fosteropenscience.eu/content/challenges-and-strategies-success-open-science

Gargouri, Y., Hajjem, C., Larivie` re V, Gingras, Y., Carr, L., Brody, T., & Harnad, S. (2010). Self-selected or mandated, open access increases citation impact for higher quality research. *PLoS One*, 5, e13636.

Heimstadt, M., Saunderson, F., & Heath, T. (2014). From toddler to teen: Growth of an open data ecosystem. *eJournal of eDemocracy & Open Government,* 6, 123–135.

Hitchcock, S. (2016). The effect of open access and downloads ('hits') on citation impact: Abibliography of studies. Retrieved June 18, 2018 from http://opcit.eprints.org/oacitation- biblio.html

Kisjes, I. (2015). The evolution of open science: How digitization is transforming research. Retrieved June 7, 2018, from https://www.elsevier.com/connect/the-evolution-of-open-science-how-digitization-is-transforming-research

Kohler, A. (2018). Open science for transparent research practice. Retrieved June 7, 2018, from https://www.uni-frankfurt.de/70839918/Open-Science-for-Transparent-Research-Practice.pdf

Laakso, M., Welling, P., Bukvova, H., Nyman, L., Björk, B.-C., & Hedlund, T. (2011). The development of open access journal publishing from 1993 to 2009. *PLoS ONE*, *6*(6), e20961

McKiernan, E. C., Bourne, P. E., Brown, C. T., Buck, S., Kenall, A., Lin, J., ... Yarkoni, T. (2016). How open science helps researchers succeed. *eLife*, *5*.

Michener, W.K. (2015). Ecological data sharing. *Ecological Informatics*, 29, 33–44.

OECD. (2015). Making open science a reality. Retrieved from http://wiki.lib.sun.ac.za/images/0/02/Open-science-oecd.pdf

Ross-Hellauer, T. (2017). What is open peer review? A systematic review. *F1000Research*, *6*, 588.

Shamir, L., Wallin, J.F., Allen, A., Berriman, B., Teuben, P., Nemiroff, R.J., Mink, J., Hanisch, R.J., & DuPrie, K. (2013). Practices in source code sharing in astrophysics. *Astronomy and Computing*, 1,54–58.

Stodden, V., Guo, P., & Ma, Z. (2013). Toward reproducible computational research: An empirical analysis of data and code policy adoption by journals. *PLoS One*, 8, e67111.

Sturdy, J. & Wykstra, S. (2016). Training for open science in Kenya. Retrieved June23, 2018, from https://www.poverty-action.org/blog/training-open-science-kenya

Suber, P. (2012). Open access. MIT Press. Retrieved June 21, 2018, from http://bit.ly/ oa-book.

Swan, A., Gargouri, Y., Hunt, M., & Harnad, S. (2015). Open access policy: Numbers, analysis, effectiveness. arXiv:1504.02261

Trochim, W. M. K. (2006). Social research methods. Retrieved June 23, 2018, from https://socialresearchmethods.net/kb/external.php

Whyte, A., & Pryor, G. (2011). Open science in practice: Researcher perspectives and participation. *The International Journal of Digital Curation*, *6*(1), 199–213.

Willinsky, J. (2006). The access principle: The case for open access to research and scholarship. MIT Press.

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