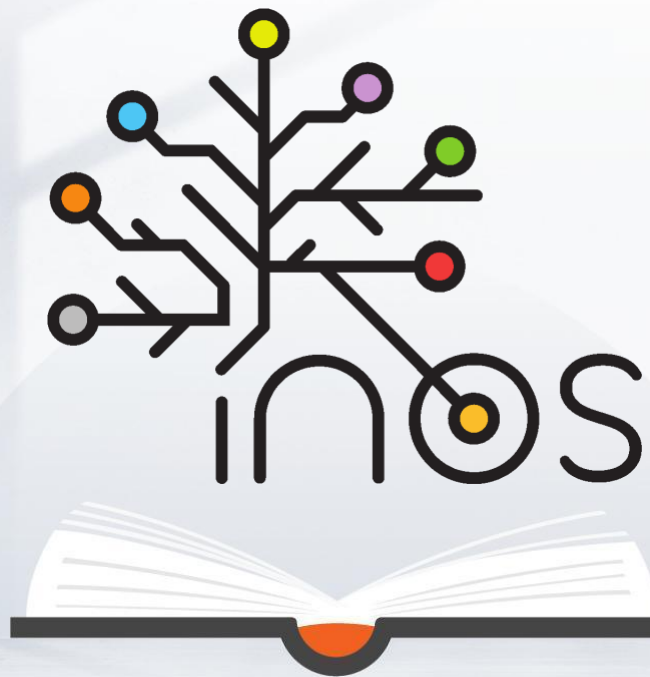INTEGRATING OPEN AND CITIZEN SCIENCE INTO
ACTIVE LEARNING APPROACHES IN HIGHER EDUCATION

A 10-step roadmap to building open and citizen science capacity at your university and library

Roadmap for Capacity Building on Open Science and Citizen Science for Research Libraries

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Abstract: This document corresponds to Intellectual Output 6 of the INOS project. It contains concrete steps to build capacity on open and citizen science in Higher Education Institutions and Research Libraries based on the discussions with stakeholders held during the project duration. The steps are broken into thematic clusters: 1) resources to support capacity building; 2) targeted OS communication to foster capacity building; 3) implementation of structured capacity building.

Keyword list: Open Science, Citizen Science; Capacity-Building; Skills

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Consortium

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1	Aalborg University	AAU	Denmark
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3	Web2Learn	W2L	Greece
4	University of Oulu	UO	Finland
5	University of Bordeaux	UBx	France
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List of Abbreviations

The following table presents the acronyms used in the deliverable.

Abbreviations	Description
OS	Open Science
CS	Citizen Science
HE	Higher Education
ICT	Information and Communication Technology
HR	Human Resources
RDM	Research Data Management

Executive Summary

The advancement of open science is no easy task. The many challenges to the implementation of open science (OS) policies in Higher Education (HE) institutions include lack of understanding, access, motivation, resources, and skills. Research libraries, being ideally positioned to serve as focal points for many OS initiatives, including citizen science (SC) projects, are no exception when it comes to the need for capacity development in the field of OS.

Building on the expertise and experience of the research libraries' community, this document represents a 10-step roadmap for capacity building on OS and CS for research libraries. The steps are thematically divided to address three major gaps that have been identified: resources, targeted communication, and structured training. The steps proposed in this roadmap can be adopted in their entirety or broken down to include only the relevant ones.

The conceptualisation of these steps relied heavily on interaction with all the project's intellectual outputs. Further attempts towards mapping the concepts developed within this roadmap were made through two highly interactive vision-building workshops in which a variety of stakeholders took part. The final discussion of these steps took place in the form of a co-creation workshop for the research libraries' community, LIBER CS Working group and CS practitioners.

This roadmap has been created to assist research libraries in developing their capacity to advance OS and adapt to changing environments and cultural shifts. The term 'research library' is used here to include all libraries containing primary and secondary sources and various materials on diverse topics. HE institutions were chosen as a focus within the INOS project and are thus also the focus of this roadmap.

INTRODUCTION

The movement towards the advancement of open science (OS) and citizen science (CS) across various higher education (HE) institutions and research libraries in Europe is undeniable. OS aims at making the results of research available to everyone who wants to learn and/or build upon its results. The movement towards an OS cultural change is widely supported throughout the European Union (EU), including such stakeholders and structures as the European Commission, research-performing organisations (RPOs), research (including academic libraries) and other types of libraries, research infrastructures (RIs)[1], and research funders among others. However, the speed at which progress is made differs across the continent.

In some countries, the ministries of education drive OS advancement. However, most of such groundwork falls on HE (Including academic staff and research libraries) in most of Europe.[2] For some HE Institutions, OS is built into their strategic priorities for the years to come, with special teams created among academic and research library staff to advance OS and CS projects, create awareness, and provide coordination and assistance. They do so through:

- contributing to, implementing, and raising awareness on OS policies,
- developing resources,[3] and

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[1] The term 'research infrastructures' is used in this document in accordance with the European Commission's definition as 'facilities that provide resources and services for research communities to conduct research and foster innovation. They can be used beyond research e.g. for education or public services and they may be single-sited, distributed, or virtual'. Retrieved from https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/european-research-infrastructures_en

[2] Kalaitzi, V., Yankelevich, T., Buunk, I. (2021). *Co-Creating a Shared Vision for Citizen Science in Higher Education: Pitfalls and Recommendations. Report on two Vision-Building Workshops*. Kalaitzi, V. (Ed.). INOS Consortium. Retrieved from: https://inos-project.eu/

[3] Ayris, P.; Bernal, I.; Cavalli, V.; Dorch, B.; Frey, J.; Hallik, M.; Hormia-Poutanen, K.; Labastida, I.; MacColl, J. Ponsati Obiols, A.; Sacchi, S.; Scholze, F.; Schmidt, B.; Smit, A.; Sofronijevic, A.; Stojanovski, J.; Svoboda,

- sharing best practices through central offices for open access, research data management and CS topics;
- EU-funded and other types of funded CS projects;
- specialised courses within the curriculum or free training offer.[4]

In other HE institutions, however, the advancement of OS falls on the shoulders of a few practitioners within academic and research library staff.

Current efforts are not enough when it comes to ensuring that the future of research is open. With unequal attention and funds for OS development across Europe, more concrete strategic foci and steps towards their implementation are needed. This roadmap focuses on concrete steps for capacity-building on OS and CS in research libraries, which are uniquely positioned to coordinate the efforts for OS advancement within HE institutions. Because of differences across the EU and within EU member states, these steps can be followed completely or with a 'pick and choose' strategy to adapt to the local context.

M.; Tsakonas, G.; van Otegem, M.; Verheusen, A.; Vilks, A.; Widmark, W.; Horstmann, W. (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x

[4] Kalaitzi, V., Yankelevich, T., Buunk, I. (2021). *Co-Creating a Shared Vision for Citizen Science in Higher Education: Pitfalls and Recommendations. Report on two Vision-Building Workshops*. Kalaitzi, V. (Ed.). INOS Consortium. Retrieved from: https://inos-project.eu/

RESOURCES TO SUPPORT CAPACITY BUILDING

STEP 1: Include OS as a priority within the institutional strategy

OS practitioners often discuss whether top-down or bottom-up approaches are more relevant to the advancement of OS. Everyone agrees, however, that the easiest way to achieve a cultural shift towards OS (including CS) is to ensure that it is part of the institution's long-term priorities and that scientific and research practices and guidelines are designed accordingly. While the process relies on the involvement of all stakeholders in policy-making discussions, the practices should also focus on providing incentives and rewards to researchers and other relevant stakeholders for engaging in OS and CS activities, such as appraisals and promotion frameworks. Researchers can also be motivated if open science or citizen science is integrated into the research itself. Open science and citizen science can indeed have added value and are often a funding requirement for the research projects, with data collection and processing as obvious examples. Quality assurance procedures and research data management (RDM) should be integrated properly to represent the overall goal, OS advancement, and implementation as a strategic priority.

Research libraries play a major role in advocating for the inclusion of OS in strategic priorities of HE institutions and building trust with researchers by representing their interests in such policy discussions.

STEP 2: Establish OS collaborations across the HE institutions and research libraries

Working in diverse multidisciplinary teams is crucial when it comes to OS and CS. Not without its challenges, building strong and trusting relationships with all stakeholders within the HE institution, be they librarians, researchers, administrative staff, or anyone else, is the only way to move forward when implementing OS and CS goals in the organisation. Such collaborations could mean teaming up with various non-research and/or research support departments, such as information and communication technologies (ICT), administration and human resources (HR), grants & projects Office, among others, with the common goal of supporting OS and CS initiatives and finding effective ways of reaching out to relevant stakeholders. These

joint ventures also mean acknowledgement of the roles and values of each actor involved in the process to ensure their investment and buy-in from the very start.

While research libraries are perfectly placed to establish such collaborations, their staff often lack the broader picture of how this could benefit the advancement of the OS agenda. Building capacity in such social interoperability[5] of library staff is essential to ensure such close partnerships across institutional departments are established.

STEP 3: Build on the position of research libraries as key stakeholders in achieving CS goals

Research Libraries are pioneers in advancing open science[6] and undeniable have an important role to play in the advancement of CS within HE institutions. Firstly, they have a direct link to researchers and different departments within the institution and are often the trusted partners for various research projects. Secondly, their connection to the institution's staff and citizens is fundamental when developing and implementing CS project ideas. Research libraries are also well-positioned to offer space for collaboration, have the knowledge, and provide the necessary support to researchers for the advancement of OS and CS. By serving as hubs or points of contact for all stakeholders (researchers, IT, admin, etc.), research libraries can help develop rapport and provide essential expertise. They are best placed to collect, maintain, and share knowledge about OS and CS as they support the sustainability of research outputs.[7] Also, while research

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[5] Bryant, R.; Dortmund, A.; Lavoie, B. (2020) *Social Interoperability in Research Support: Cross-Campus Partnerships and the University Research Enterprise*. *Dublin, OH: OCLC Research.* Retrieved from https://doi.org/10.25333/wyrd-n586

[6] Ayris, P.; Bernal, I.; Cavalli, V.; Dorch, B.; Frey, J.; Hallik, M.; Hormia-Poutanen, K.; Labastida, I.; MacColl, J. Ponsati Obiols, A.; Sacchi, S.; Scholze, F.; Schmidt, B.; Smit, A.; Sofronijevic, A.; Stojanovski, J.; Svoboda, M.; Tsakonas, G.; van Otegem, M.; Verheusen, A.; Vilks, A.; Widmark, W.; Horstmann, W. (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x

[7] Ayris, P.; Bernal, I.; Cavalli, V.; Dorch, B.; Frey, J.; Hallik, M.; Hormia-Poutanen, K.; Labastida, I.; MacColl, J. Ponsati Obiols, A.; Sacchi, S.; Scholze, F.; Schmidt, B.; Smit, A.; Sofronijevic, A.; Stojanovski, J.; Svoboda,

libraries often serve as such hubs, they are not the owners of the knowledge but instead focus on ensuring others can access it. As such, they are key stakeholders in building and maintaining communities around OS/CS.

However, to succeed in their mission, research libraries need to be further involved in the policy-making process to provide a clear understanding of how they can help and be given a mandate to support and advance HE institution OS goals and their implementation.

Figure 1: Results of the Google Jamboard discussion on the strategic objectives for research libraries for capacity0-building on OS and CS

STEP 4: Be actively involved in establishing support programmes for researchers in HE institutions and research libraries.

M.; Tsakonas, G.; van Otegem, M.; Verheusen, A.; Vilks, A.; Widmark, W.; Horstmann, W. (2018) *LIBER Open Science Map*. Retrieved from: https://zenodo.org/record/1303002#.YSeIkY77Q2x

One of the key steps in ensuring the implementation of the OS agenda at HE institutions is supporting researchers with expertise, funding, and infrastructure, so they are interested in working on OS and do not need to start from scratch. Research support staff within research libraries are the key mechanism within the institution to :

- Identify the existing/emerging level of knowledge and existing/emerging needs among researchers when it comes to OS (e.g. in terms of RDM, Copyright, etc.);
- Introduce the main concepts, benefits, policies, and best practices of OS to researchers and explain how open science can bring new opportunities for researchers and support excellence in science;
- Provide support in the implementation of OS and FAIR principles;
- Continue to provide support and guidance throughout the whole research process;
- Build trust and rapport to ensure the success of OS implementation.

STEP 5: Share information on the existing financial support for OS and CS initiatives

While often overlooked in the 'OS as a strategic priority' discussion, availability of funding for OS and CS initiatives makes a fundamental difference between engagement and the lack of it. Established funding structures need to exist to ensure the OS agenda advances across Europe, regardless of how much funding is generally available for research in any given European university. These could be:

- Allocation of HE institution standard research budget for OS and CS activities through diminishing financial resource allocation for non-OS activities;
- Investments in open access (OA) publishing and relevant shared and interoperable infrastructure (e.g. those supported through SCOSS);
- Development of proposals targeting EU and other types of funding for the implementation of OS and CS projects;
- Active participation of research libraries in the design and implementation of such projects.

While traditional models of research recognition are not applicable to researchers involved in OS practices, specifically CS, new recognition models need to be developed to address this niche. The Responsible

Research and Innovation (RRI)[8] approach, developed by the European Commission, aims at fostering the design of sustainable and inclusive research innovation by predicting potential implications and societal expectations in relation to research and innovation. This approach could serve as the basis for the development of new appraisal structures and incentives for researchers to engage in OS.

While it is often out of research libraries' control what type of funding becomes available, research libraries are perfectly positioned to provide access to and promote information about the funding that is available for OS initiatives.

TARGETED OS COMMUNICATION TO FOSTER CAPACITY BUILDING

STEP 6: Support establishing easily available knowledge transfer procedures within HE institutions

One would argue that knowledge transfer is one of the cornerstones of ensuring that HE institutions embed OS practices. Achieving effective knowledge transfer is, however, not always easy. Researchers can be willing to advance the OS goals set by their HE institution, the infrastructure might be there, but without knowledge, experience, appropriate training, and expertise, any initiative is doomed to fail. The following steps could be used to create a diverse and comprehensive approach to training on OS:

- Develop reusable training resources for the researchers;
- Continuously invest in research library personnel capacity through a train-the-trainer approach, providing regular training on OS practices, so that the research library staff can, in turn, provide high-quality training to other HE staff and researchers;

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[8] The term "responsible research and innovation" is used here in accordance with the European Commission definition as "an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation." Retrieved from https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation

- Provide training to HR and other relevant departments in order to be able to work closely with researchers;
- Ensure that staff has the necessary technical skills and the knowledge about infrastructure to be used in implementing OS principles in research, but also during CS projects
- Create aggregated channels of knowledge transfer from advanced to beginner researchers and citizens.

Such research libraries' support and initiative in establishing such knowledge transfer procedures, as well as storing the necessary knowledge, is crucial for the advancement of the OS practices.

Figure 2: Results of the Google Jamboard discussion on the skills necessary for research libraries to advance OS and CS
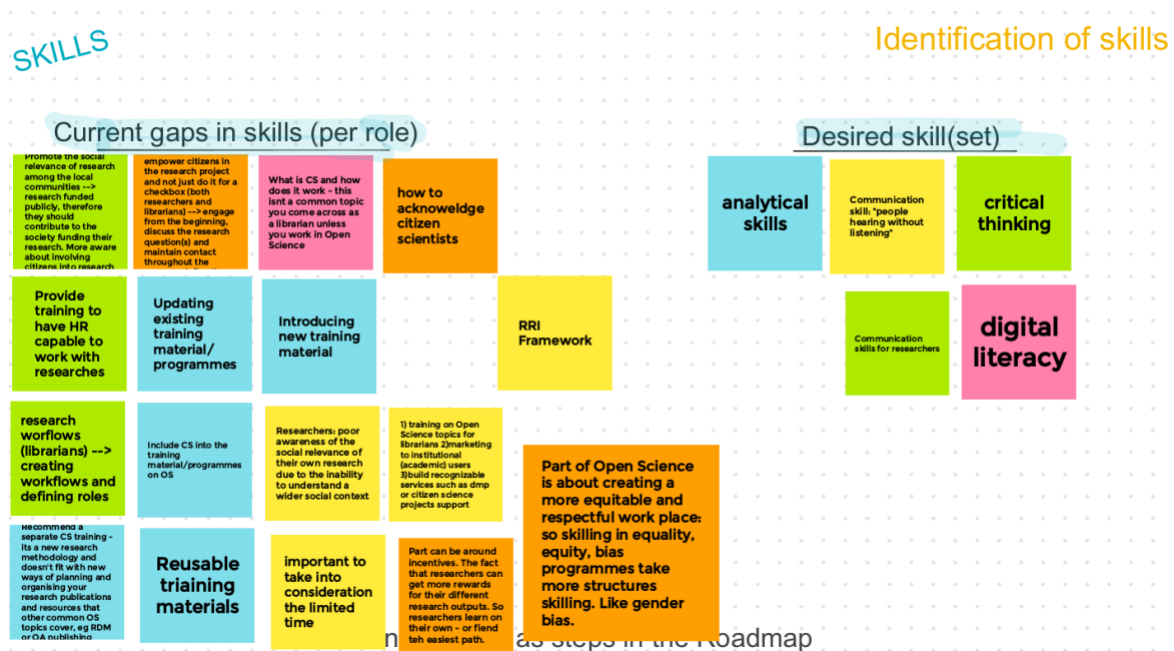
STEP 7: Focus OS-related communication and strategic marketing efforts on the benefits of OS for researchers

According to the participants of the co-creation meeting, 'Co-Creating a Roadmap for Capacity Building on Open Science and Citizen Science for Research Libraries', OS advancement is often stunted by unclear communication practices that focus on the aspects of "why OS" that do not appeal to the conservative audience of researchers who are used to and/or trained to perform research in a certain way and do not have institutional incentives to prioritise OS practices within their heavy workload. The central point of these recommendations is on how best to focus communication and marketing approaches to reach the right audience—researchers—and motivate them to engage in OS:

- Create a clear goal for all your communication efforts on OS;
- Know your audience: target your messages to how OS practices would benefit researchers and why they should, select a few powerful arguments and stick to them;
- Make sure your messages are small but regular, make them part of researchers' regular training;
- Explain the process step by step—make sure researchers know what to expect across disciplines;
- Focus special attention on the disciplines particularly reluctant to engage in OS practices;
- Provide ample examples from your and other HE institutions, with a specific focus on success stories in diverse disciplines. Make sure to choose the relevant examples;
- Should such be available, collect examples from your HE institution and provide access to researchers whose examples are used as experts;
- Build recognisable services such as data management platforms or CS project support.

IMPLEMENTATION OF STRUCTURED CAPACITY BUILDING

Very often, researchers themselves have limited awareness of the relevance of their research, particularly to the wider social context. It is precisely the fact that the results of OS and CS hold significant value to the communities where research takes place that may motivate the researchers to pursue it. Such understanding and the skills associated with it need to be the focus of OS and CS training. Research libraries play a central role when it comes to developing capacity for researchers in this regard. Below are several steps research libraries can take towards shaping a more skilled and encouraged research community centred around creating value for the communities they serve.

STEP 8: Make targeted CS training a part of the general OS training

In order to advance OS, training on it should be standard and mandatory for researchers and library staff. While such training can include anything from the philosophy and practices pertaining to OS, including open access and RDM, special attention needs to be paid to CS as a new research methodology.

STEP 9: Focus training on a diverse range of stakeholders

Since collaboration is the cornerstone of OS, training should focus not only on researchers but also on a diverse group of stakeholders, including library staff, ICT, HR, and research administration, among others. Below are the recommendations on what to include and how to approach such training programmes for both researchers and librarians.

- Regularly updating existing training materials and/or programmes;
- Creating new (reusable) training materials on OS and CS as part of OS;
- Separate CS training to include:
  - what CS is and how it works;
  - CS needs that have to be addressed: communication, logistics, project management, infrastructure needs. Refer to general research skills related to methodology, research data management, quality assurance procedures;

- ways to empower citizens to engage in research projects (such as engagement from the stage of shaping the research project, discussing research question(s), defining roles, maintaining contact throughout the process, etc.);
- Separate training that focuses on recognising biases (e.g. gender bias) and aiming at increasing quality and equity at the workplace;

- Invest in training the trainers and especially the research support staff under the research libraries.

All OS and CS training programmes should focus on a specific skill set necessary to advance OS goals and topics, such as metrics and rewards, FAIR data, scholarly publishing, research integrity, and CS[9]. More specifically, the skillset development should focus on:

- Analytical skills
- Critical thinking
- Digital literacy
- Information and data literacy FAIR data
- Digital content creation
- Communication and collaboration[10]

STEP 10: Create and/or contribute to workflows that help define the process and define roles within the HE institution, with the involvement of its library
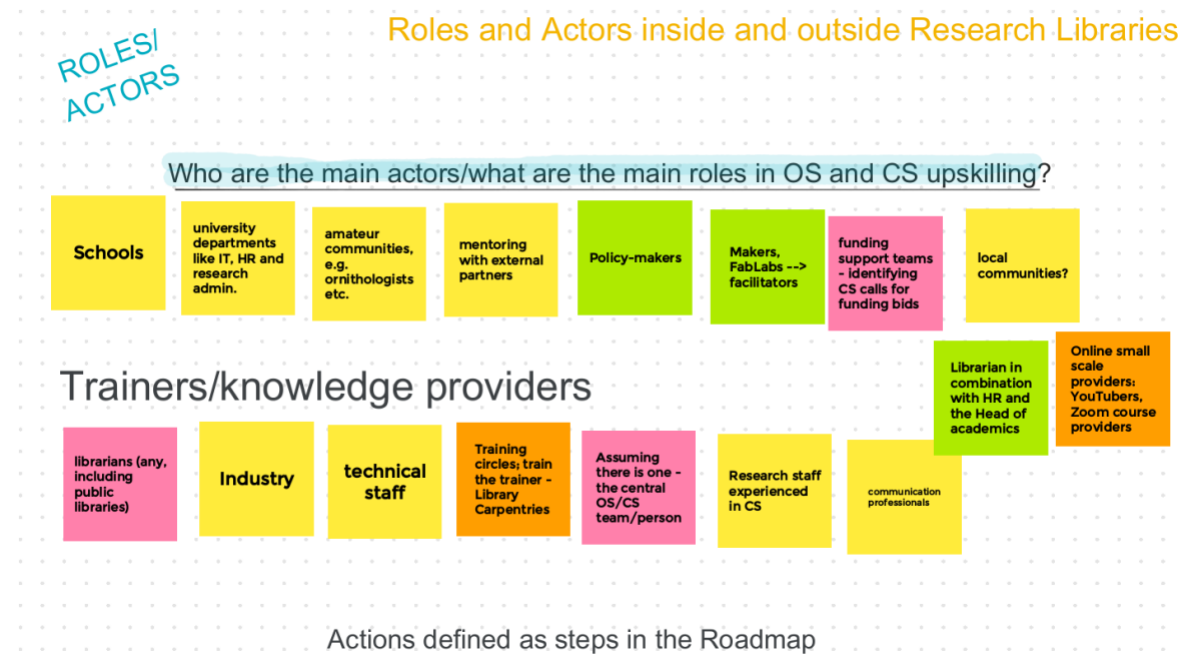
Although research libraries have an established role in supporting the implementation of and raising awareness of OS in general, their position and involvement might be different when it comes to CS. Sufficient time is always a challenge for researchers. To simplify their work processes and promote OS and CS, adjustable workflows need to be created where roles of all potential stakeholders are clearly defined. Involvement of library staff in the creation of such workflows is essential, whichever form it might take. Such

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[9] McCaffrey, C.; Meyer, T.; Riera Quintero, C.; Swiatek, C.; Marcerou-Ramel, N.; Gillén, C.; Clavel, K.; Wojciechowska, A.; Brinken, H.; Prevoo, M.; Egerton, F. (LIBER Digital Skills for Library Staff and Researchers Working Group, 2019). *Open Science Skills Visualisation.* https://zenodo.org/record/3702401#.YSYTjIj7Q2w
[10] Ibid.

involvement could take the shape of libraries being in the centre of the process by facilitating coordination, libraries being one of the involved parties supporting the process, and many others.

Figure 3: Results of the Google Jamboard discussion on the specific goals and actors involved in OS and CS advancement at research libraries

Roles and Actors inside and outside Research Libraries

ROLES/ ACTORS

Who are the main actors/what are the main roles in OS and CS upskilling?

Schools | university departments like IT, HR and research admin. | amateur communities, e.g. ornithologists etc. | mentoring with external partners | Policy-makers | Makers, FabLabs --> facilitators | funding support teams - identifying CS calls for funding bids | local communities?

Trainers/knowledge providers

librarians (any, including public libraries) | Industry | technical staff | Training circles; train the trainer - Library Carpentries | Assuming there is one - the central OS/CS team/person | Research staff experienced in CS | communication professionals | Librarian in combination with HR and the Head of academics | Online small scale providers: YouTubers, Zoom course providers

Actions defined as steps in the Roadmap

Conclusion

While advancing the OS agenda in HE institutions remains a challenge, this roadmap provides practitioner- and stakeholder-based advice on how to approach the process of upskilling to achieve the cultural shift in practical terms. Addressing resource gaps, targeting communication on the right audience, and tailoring messages in the right way, and providing structured training to all involved are the main steps to be taken to achieve the level of capacity of the research library staff necessary for their inspired leadership in ensuring open and citizen science practices are not only adopted by the researchers but rather become an integral part of any HE institution research and policy.

In their unique position as trusted hubs, go-to specialists in RDM, connectors of researchers with other relevant stakeholders within HE institution and the society, and the broader vision of their research impact, research libraries serve an essential function in moving research practices towards open and citizen science. The 10 steps described in this roadmap can and should be adapted to the local context and the level of capacity already present in the research library that takes on upskilling to achieve a culture shift towards OS.

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