Co-creation in practice: from bottom up to top down

Margaret Gold [a,*], Thomas Kaarsted [b,*], Rosy Mondardini [c,*]

[a] *Leiden University | LEI · Citizen Science Lab*
   Rapenburg 70, 2311 EZ Leiden, The Netherlands

[b] *University of Southern Denmark*
   Campusvej 55, 5230 Odense M, Denmark

[c] *Citizen Science Center Zurich*
   University of Zurich and ETH Zurich
   Kurvenstrasse 17, 8006 Zurich, Switzerland

   E-mails: thk@bib.sdu.dk   m.gold@biology.leidenuniv.nl

   maria.mondardini@uzh.ch

Co-created citizen science projects are considered to enhance active, inclusive, and wide participation, and significantly improve the quality of public participation. However, fully co-created projects are still rare in citizen science (CS), where many projects aim primarily at overcoming the capacity of current research structures and involve participants only for the collection, and sometimes the analysis, of large-scale data. In addition, in many research areas professional researchers are used to having full control of their methodology and processes; in the majority of cases, they consider CS late in the process, when they already have a clear and well-defined idea of their research plans and needs, with little or no space left for the contribution of citizens. How can the citizen science community of practitioners better encourage and support real co-creation?

This paper discusses a workshop at the Engaging Citizen Science Conference 2022 in which the authors shared their experiences of co-created CS projects from three existing CS centers: the Citizen Science Center in Zürich (Mondardini, Director), the Citizen Science Lab in Leiden (Gold, Coordinator) and the Citizen Science Knowledge Center at Southern Denmark University in Odense (Kaarsted, Deputy Library Director).

---

[*]Speaker

1.   Introduction

Citizen science (CS in the following) as an interdisciplinary field holds promise for boosting scientific research while increasing public participation and empowering citizens in their everyday life with new knowledge and skills. In practice though, this can be hard to achieve. In recent years, several CS Centers have opened in Europe to facilitate public engagement with science and participation in research. Their ambition is to increasingly include in the scientific research process the perspective of the citizen, widening and deepening the breadth of research collaborations for the benefit of all involved.

To find effective ways to collaborate between researchers and other stakeholders, CS initiatives increasingly adopt techniques and methodologies from a wide variety of disciplines and practices [1]. This includes co-creation, an approach that originated in the design sphere [2] and that emphasizes the value of the collaboration between various stakeholders with diverse knowledge, background, and stakes. To make research and scientific knowledge production more inclusive, co-creative processes aim at involving citizens in all stages of the research process, from research question formulation to the sharing of outcomes (i.e., develop the research question and set objectives, choose the study design and data collection methods, collect data, analyse data, disseminate finding, evaluate results and process).

Co-creation can be understood in different ways (as a method, a process, or a service) and applied in both public and private sectors, as its value resides in the collaboration between different stakeholders and their involvement in different innovation processes [3]. Co-created projects are considered to enhance active, inclusive, and wide participation and evidence suggests that research results can be significantly shaped by the degree and quality of public participation in project design [4, 5]. At the same time, they elicit a wider social impact and affect the cognitive, affective, social, behavioural, and motivational dimensions of participants [6].

However, several challenges emerge when trying to apply co-creation methodologies in CS projects, including balancing social and scientific interests, varying levels of negotiation skill or strength of voice among the participants (and therefore the need for facilitators), as well as the need for accessible and open tools and platforms to support the co-creation process [7]. These are some of the reasons why fully co-created projects are still rare in CS, where many projects aim primarily at overcoming the capacity challenges of current research structures and involve participants only for the collection, and sometimes the analysis, of large-scale data [8].

2.   The Workshops

Citizens can participate in co-creation in different ways and with different processes [9]. In this workshop, representatives from three existing CS Centers initially shared their experience with encouraging and supporting the implementation of co-created CS projects in their own institutions, and then facilitated three parallel table discussions. The tables were conceived as co-design spaces, where participants tackled the same issue with three different hands-on participatory dynamics, one per table, depending on the leading lab (details in the sections below). Two rounds, with facilitators changing tables in between, allowed each group to work with two

different dynamics. In both rounds, sticky notes were used to allow capturing and sharing participants thoughts. The whole process was facilitated by the organizers, who guided the activities, challenged and motivated the participants, and encouraged them to share their thoughts and ideas. This served also to demonstrate the type of facilitation that is often used in CS co-creation activities, which have been shown to generate a creative and cooperative environment [10]. The tables were originally planned as small-group interactions; however, due to the high participation and the size of the room, there was a need to adapt to a big group dynamic, where parts of the discussion were performed within small "adjacent-people" groups. Additionally, one of the representatives was attending the event virtually, which proved to be a significant challenge in effectively facilitating the discussion. The tables where this representative was assigned; therefore, held an unfacilitated open conversation with each other on the topics under discussion, with the facilitator available to answer any questions that arose.

The workshop was attended by approximately 60 participants from different fields and with different experience/roles, including researchers, research support staff, librarians, NGOs, and more. Participants shared experience and thoughts based on projects in different countries, with different methodologies, and with various degrees of co-creation.

2.1 Citizen Science Center Zurich

The Competence Center – Citizen Science, better known as CS Center Zurich, was established in 2017 as a joint initiative of ETH Zurich and the University of Zurich. It is a unique one-stop-shop supporting CS in Zurich and beyond, providing resources, expertise and technical know-how to develop, set up, and run CS projects. The Center is striving to support co-created activities that maximize the collaboration between citizens and scientists in all phases of the research process, and projects that apply established CS processes and standards to ensure the production of academic-quality data and results.

The support provided by the Center is available to all practitioners, including academics, civil society organizations, NGOs, and citizens at large. In practice though, as the Center is the effort of two academic institutions, in its 5 years of experience the team has served mainly researchers, meaning that CS projects have often been proposed by professional scientists. A trait of professional researchers is that they are, more than any other CS practitioner, used to having full control of their methodology and processes; in the majority of cases, they come with a pretty clear and well-defined idea of their research plans and needs. They think of CS as an easy way to optimize time and resources and seek for the Center's support with "getting the citizens". One could say that in this case co-creation is off the table, as a big part of the project's ideation and design is already done.

Accordingly, the conversation led by the Center focused on the specific aspect of "Is co-creation possible when it's essentially an afterthought?" At the table, participants were tasked to work with a hypothetical scenario: a researcher studying climate was coming to their "CS Hub" with a pre-defined idea for a CS project. She wanted to focus on the decrease of snow coverage in the Alps, and engage people in the analysis of thousands of photos, evaluating and reporting snow depth. Their task was to imagine (discussing among them) how they would go about convincing the researcher to embrace co-creation.

General considerations included the following:

- It is not too late to apply co-creation when researchers come with a precise idea. In fact, it is quite natural to have an "initiator" that proposes the idea for a project, while it is rare to come up with it collectively, as an ideal co-creation would suggest.

  What we do in this case is to present, nevertheless, the benefit of co-creation and guide the initiator in the process of involving and welcoming more stakeholders, and be ready to adjust the original idea to additional inputs and interests to the benefit of all parties involved.

- CS projects are an iterative process, which start with a certain goal, methods and design and evolve over time through phases of optimization, when all components—from research question to protocol design and data management—are refined. Usually, just an initial "pilot" of the implementation is sufficient to reveal questions and issues—not least the aspect of (missing) participation and engagement. Adding additional stakeholders, usually early-stage participants, as soon as possible in the optimization process comes naturally, and it is so immediately useful and enriching that rarely initiators have further doubts about the benefits of co-creation. Sharing ownership, evaluating diverse ideas, interests, and stakes, and ultimately adapting and tailoring the project to additional needs only helps the success of the project, to the benefit of all involved.

2.2   Citizen Science Lab, Leiden University

The Citizen Science Lab at Leiden University (the CS Lab) was founded in 2018 by researchers in the Leiden Observatory and Science Communication & Society group in order to consolidate and build on the knowledge they had gained in practice from the planning and execution of a range of CS projects, and emerging CS expertise in other faculties. The mission of the CS Lab is to connect scientists and other citizens to co-create research projects that address urgent scientific and/or societal issues that can only be solved by actively involving volunteers in the scientific process. In order to achieve this, the CS Lab acts as an Incubator to co-create new sustainable CS projects that connect society with science, and as a Knowledge Hub to build a collaborative CS knowledge-sharing network across the Netherlands.

The very first activity of the CS Lab was to organise an international workshop at Leiden University with 55 scientists and non-scientists to co-create breakthrough CS projects for measuring, understanding, and mitigating air pollution, which led to new collaborations and funding proposals. Deliberate attention was paid to bringing a diverse stakeholder group together, both inside and outside academia, but this approach still had quite a top-down orientation and voices from the local residential communities were missing from these discussions—exactly the people who experience the greatest impacts from air pollution. To take a bigger step towards co-creation across the entire research journey, the CS Lab took advantage of the occasion of the 444th anniversary of the University in 2019 to pioneer a "radical co-creation" approach that could encompass the entire city of Leiden and its residents. This

approach resulted in the launch of two winning projects—Plastic Spotter and Psychology Lab on Wheels—out of 55 CS ideas submitted by citizens and academics of Leiden and Den Haag. Local funding for this project allowed the CS Lab to cover the cost of a part-time Community Manager within the CS Lab to manage the project, who has now gone on to start a PhD on the topic of CS approaches for addressing plastic pollution. The project has continued to evolve in response to the needs and expectations of the participants, becoming much more activist in both removing and studying macro plastic pollution in the urban waterways of Leiden, and in realising policy and city planning impacts.

This "radical co-creation" approach was therefore the focus of the conversation led by the CS Lab at the workshop, focusing on how to start co-creation efforts with very large groups of people, such as the residents of a city. However, the CS Lab was the presenter in virtual attendance, and therefore the emphasis was placed on explaining how they ran this particular initiative, sharing their experiences from using this approach, and inviting those at the table to share any similar experiences, and speculate on opportunities they might have to trial such an approach and how they might overcome some of the unique challenges. These were difficult to record remotely, so here are presented some of the experiences shared by the CS Lab to initiate the workshop discussion.

Drawing on the typology of co-creation for reaching a crowd of people, (sometimes referred to as Crowdsourcing), where the goal is to engage large numbers of people, but the need is therefore to have very low barriers to participation, the CS Lab framed the call for research ideas as a competition. The dual advantages of a competition approach are that it offers an additional incentive to participate, but also zooms in quickly on a short-list of options for further development, accelerating the process towards a deeper collaborative engagement in the final design phase. The largest take-away from this experiment has been that co-creation at different scales yields participation of different depths—large numbers of people proposing research questions, and engaging with researchers at public events to share their thoughts at a table with posters and maps and idea boards, engage at a much "lighter-touch" level than the small number of very active participants who are continuing to shape how the Plastic Spotter initiative (now De Grachtwacht Clean-up) evolves.

Similarly, the wider reach for engagement across the city took a lot more communication effort and played out over a longer period of time, whereas the deeper engagement with regular volunteers takes a lot more active effort in the field, but for short bursts of more intense activity together. But interestingly, the two are connected—as observed above, the wide invitation for research questions has funnelled down into a very targeted activity with a highly engaged small group of participants.

2.3   SDU CS Knowledge Center

The SDU CS Knowledge Center provides infrastructure, cross-disciplinary workshops, project development, management, communication, community building and data management support. The Center works with a number of media partners and in close dialogue with SDU-researchers in bridging the gap with the public.

In many ways the knowledge center is a Broad Engagement in Science, Point of Contact (BESPOC) [11] that functions as the hub of CS. The BESPOC model outlines a number of services, templates, partnership models and communication tools that enables researchers and the public to work together and maintain an open dialogue. The hub is in the university library, to highlight how SDU puts a strong emphasis on cross-disciplinary research. Among the tasks of the facilitators at the hub, a frequent one, is to engage researchers and participants in analyzing their potential stakeholders (partners and communities) in order to include participants from civil society, legislators, schools/learning and the private sector. The aim is to achieve the level of co-design appropriate to the specific project or community [12].

The participants at the Aarhus workshop used the approach from the Golumbic [13] to emphasize inclusion, contribution and reciprocity. They analysed their own projects focusing on the role of citizens, their contribution, and discussed how they could potentially be empowered to further shape and enrich the projects. This approach ensures that scientists and project managers explore the relationship between the way that CS is defined and presented in the literature, and the ideas that researchers who engage in the project have about what CS is, what it could be, and how to include participants in a dialogue. In addition, in the workshop, participants applied a stakeholder matrix for engaging citizens and communities. Building on Skarlatidou [14] the facilitator discussed with participants potential partners from civil society, education, government, and industry, a take on the quadruple helix model for innovation. The matrix is used at SDU in the modules of co-design of the Talent programme. Although stakeholder involvement in CS can be diverse, a structured approach and thinking about partners and their role can nevertheless add significant value and contribute to the co-creation or co-constructed process. Several benefits of stakeholder involvement have been identified including impact, data, communication, and access to new audiences.

This created a lot of 1-to-1 and group dialogue while discussing projects as diverse as earthquake detection, the library as a CS hub, co-creation within Citizens Humanities, water quality, astronomy, engaging high schools and public schools.

3. Conclusions

The following general observations are based on the organizers personal experience and on the interaction with participants at the Aarhus workshop, and could be useful to CS practitioners venturing into co-creation activities within science:

1) CS seems to be diversifying, both in terms of scientific and social domains, and in terms of roles and actors. Several actors were represented at the workshop, including researchers, project managers and facilitators, revealing an increasingly professional and structured way to handle projects.

2) As CS is not a one size fits all methodology, co-creation is by no means a requirement or panacea for success. Hearing the experience of participants, it was clear how many approaches exist that are very different but equally successful in approaching citizens and research. Depending on the project, going a long way to

engage citizens in the definition of the research questions and design of the projects (bottom-up) can be as effective as a top-down "please help us" approach.

3) As described above, co-creation at different scales yields participation of different depths.

4) Building alone on the dialogue from the workshop, the BESPOC-model seems to hold promise as a baseline for creating hubs for CS in research institutions. These hubs can be placed and governed in alignment with institutional strategy and focus, and libraries seem suited for this role:

- Libraries are familiar with providing research support services and infrastructure.
- Libraries and their staff have a number of transferable skills (advocacy, communication, project management and coordination, community management, doing events, evaluation, etc.) that are suited for CS projects.
- CS projects are seen as multi-disciplinary making the library a "neutral" hub for researchers. This also seems true for universities where one Faculty or Institute might take ownership of a CS hub and thus potentially and unconsciously push away other research disciplines.

5) There seems to be a huge potential in further supporting and empowering the sharing of approaches and tools. Participants' contributions revealed the existence of novel ideas for stakeholder involvement and communication, as well as innovative ideas to structure and carry on projects.

In conclusion, considering also the high attendance of the workshop and the positive feedback received by the participants, we feel a pressing need in the community to further explore and support co-creation, empowerment and inclusiveness within all fields and areas of CS.

References

[1] E. Senabre Hidalgo, J. Perelló, F. Becker, I. Bonhoure, M. Legris, A. Cigarini, Participation and Co-creation in Citizen Science, in:*The Science of Citizen Science* , eds. K. Vohland et al., Springer, Cham (2021). https://doi.org/10.1007/978-3-030-58278-4_11

[2] E. B. N. Sanders & P. J. Stappers, Probes, toolkits and prototypes: Three approaches to making in codesigning.*CoDesign* **10**, 1 (2014) 5–14.

[3] J . Eckhardt, C. Kaletka, D. Krüger, K. Maldonado-Mariscal and A. C. Schulz, Ecosystems of Co-Creation.*Front.Sociol.* **6** (2021) 642289. doi: 10.3389/fsoc.2021.642289

[4] J. Shirk, H. Ballard, C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, et al., *Public participation in scientific research: A framework for deliberate design, Ecology and Society* **17**, 2 (2012) 29. https://doi.org/10.5751/ES-04705-170229.

[5]   G. Hickey, T. Richards, & J. Sheehy, Co-production from proposal to paper. *Nature*
        562 (2018) 29–31.

[6]   T. B. Phillips, H. L. Ballard, B. V. Lewenstein, & R. Bonney, Engagement in science
        through citizen science: Moving beyond data collection, *Science Education* 103, 3
        (2019) 665–690.

[7]   E. S. Hidalgo, J. Perelló, F. Becker, I. Bonhoure, M. Legris, and A. Cigarini,
        Participation and Co-creation in Citizen Science, in: *The Science of Citizen Science*,
        eds. K. Vohland et al., Springer, Cham (2021).
        https://link.springer.com/chapter/10.1007/978-3-030-58278-4_11

[8]   C. Kullenberg, D. & Kasperowski, D., What is citizen science?—A scientometric
        meta-analysis, *PLoS One* **11**, 1 (2016) e0147152.
        https://doi.org/10.1371/journal.pone.0147152.

[9]   W. H. Voorberg, V. J. M. Bekkers, and L. G. Tummers, A Systematic Review of Co-Creations
        and Co-Production: embarking on the social innovation journey, *Publ. Manag.*
        Rev. **17** (2014) 1333. doi:10.1080/14719037.2014.930505

[10]   B. Guasch, M. González, and S. Cortiñas, S., Enhancing Scientific Knowledge Transfer through
        Design Methodologies: A Graphene-centered Case Study, *The International Journal of Design in*
        Society **13**, 2 (2019) 63–85. https://doi.org/10.18848/2325-1328/cgp/v13i02/63-85.

[11]   Tiberius Ignat and Paul Ayris, Built to Last! Embedding Open Science Principles and Practice
        into European Universities, *Insights* **33**, 1 (2020) 9. DOI: http://doi.org/10.1629/uksg.501

[12]   M. Haklay, M. Participatory citizen science, in: *Citizen Science: Innovation in Open Science,*
        Society and Policy , eds. Hecker et al., UCL Press, London (2018).
        https://www.jstor.org/stable/j.ctv550cf2

[13]   Y. N. Golumbic, D. Orr, A. Baram-Tsabari, and B. Fishbain, B., Between Vision and Reality: A
        Study of Scientists' Views on Citizen Science, *Citizen Science: Theory and Practice* **2**, 1
        (2017) DOI: http://doi.org/10.5334/cstp.53

[14]   A. Skarlatidou, M. Suškevičs, C. Göbel, B. Prūse, L. Tauginienė, A. Mascarenhas, M.
        Mazzonetto, Sheppard, J. Barrett, A. Haklay, A. Baruch, E.-A. Moraitopoulou, K. Austen, I. Baïz,
        A. Berditchevskaia, E. Berényi, S. Hoyte, L. Kleijssen, G. Kragh, M. Legris, A.Mansilla-Sanchez,
        C. Nold, M.Vitos, and P. Wyszomirski, The Value of Stakeholder Mapping to Enhance Co-
        Creation in Citizen Science Initiatives, *Citizen Science: Theory and Practice*   **4**, 1 (2019) 24.
        DOI: http://doi.org/10.5334/cstp.226