Making citizen science tools discoverable and accessible

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At SciStarter, we aim to make it easy to find and join meaningful citizen science projects. Choose a location, activity, or topic to find appropriate adventures and learn more about the project and what tools (sensors, digital scales, rain gauges, etc) are needed to participate. But, for many projects and would-be participants, there are challenges to accessing the right tools for the job. (We define "tools" as equipment not usually found at home.) So, we took the follow steps to find a solution and are ready for your help to populate a new database of citizen science tools.

Step One: We interviewed 110 people about their citizen science tool needs.

Through participation in the National Science Foundation's Innovation Corps for Learning program, a collaboration of researchers between SciStarter and Arizona State University's School for the Future of Innovation in Society and ASU's School of Engineering adapted lean launch methods to explore and develop a better understanding of the ecosystem of stakeholders around citizen science tools.

This team included SciStarter founder Darlene Cavalier, ASU Assistant Professor of Engineering Dr. Micah Lande, graduate student Brianne Fisher, PhD student David Sittenfeld and me. We used "customer discovery" practices to interview more than 110 people, focusing on identifying key "pain points" for the "customer segments" of citizen science volunteers and project organizers. This approach delivered

significant insights applicable to the larger citizen science community. We discovered our "value propositions:" 1) to save time and effort by connecting people, projects and vetted turnkey project-tool bundles to collect a lot more quality data, and 2) to increase confidence when making decisions on quality instruments, protocols, instructions and additional citizen science resources from a trusted source.

As we explored this problem space, lack of awareness and access of appropriate tools became more clear. Project owners and researchers may not be aware of accessibility concerns and/or they struggle to find the right tools for their projects. Manufacturers and Makers need to make their instruments more discoverable to those who need them. Many universities and government-supported projects cannot recommend, promote, or sell instruments. And project volunteers frequently spend too much time and money in search of the tools.

These guiding principles are shaping the development and deployment of new approaches starting with one for the NASA's GLOBE Program's El Nino protocols, thanks to generous support from Dixon Butler and the Youth Learning as Citizen Environmental Scientists Foundation (YLACES). YLACES and NASA contracted SciStarter to recruit, train and equip volunteers to ground-truth satellite data by monitoring soil moisture levels, surface temperature, precipitation and more. We provide instruments including a digital scale, infrared thermometer, rain gauge and heat lamps. We created prototype kits and we started testing a Build, Borrow, Buy vision of the SciStarter tools database. We quickly sold these kits and learned a good deal about acceptable price points, cost of goods sold, etc. We will continue exploring the Buy and Borrow functions through additional research.

We also partnered with a handful of libraries and museums located near El Nino volunteers. A handful of university and public libraries and museums are cataloging the kits and making them available for loan so

we can explore how lending kits may be improved. We will explore what characteristics of projects and tools align with the capacities and interests of libraries and museums in order to scale this up!

We summarized our iCORPS insights (https://vimeo.com/179928931) and lessons learned (https://vimeo.com/179474536).

Step Two: We asked project owners about their tools.

We surveyed project owners to help inform the types of tools required for their citizen science projects. What we learned from this survey shaped the Beta SciStarter Tools Database. More than 50 responses provided key information used to inform an early taxonomy (a standardized language) to help us organize the emerging database.

Step Three: We organized a central repository of Citizen Science Tools linked to SciStarter's Citizen Science Projects.

The partnership between SciStarter and Arizona State University lead to an NSF EAGER grant to ASU's School of Engineering, to fast-track a taxonomy to describe citizen science tools and to further develop features of the SciStarter Tools Database including a Consumer Reports-style review feature. Our goal is to help project owners discover the right tools for their projects and for all tool users to share their experiences via a rating/review system. This social proofing will help people understand the pros and cons of the tools for different scenarios.

We will assemble an expert advisory panel to test and review the tools. Communicating important requirements to the users is critical for many reasons, some of which are articulated in this recent article: "Sensor manufacturers sometimes provide limited information on these low-cost

sensors, and it is very easy to use the devices improperly. This is because they are designed to work under very controlled conditions – for example, at fixed temperatures or with limited wind movement – and these requirements often are not communicated to consumers. "Professional organizations (including the American Geological Union and IEEE) and engineering schools are well-positioned to test and review these tools. We're excited about the possibilities here! If you are interested in providing support for this feature and/or joining the expert advisory committee, please email me at erica@scistarter.com .

The Woodrow Wilson International Center for Scholars is also helping us build the taxonomy. This fall, we joined forces to leverage the Wilson Center's success in convening experts to inform and document standardized, scalable approaches. The Wilson Center is also interested in understanding how the data collected through these tools can be linked to emerging, global data repositories. In turn, by partnering with SciStarter and ASU, the Wilson Center is able to apply scholarly research to real-world solutions through the SciStarter platform.

Twenty citizen science researchers and practitioners, makers, and metadata experts participated in a workshop hosted by the Wilson Center, SciStarter, and ASU as a preamble to the first Citizen Science Maker Summit at ASU on October 26, 2016. The alpha database infrastructure I worked on was one key resource used at the workshop. The other was a report and survey of more than 100 low cost citizen science tools (commissioned by the EPA and authored by Margaret MacDonnell/Argonne National Laboratory). This workshop tested the use cases of key database fields through personas and it helped validate several key hypotheses. Armed with a draft of database fields, case studies of database use, and examples of tools that could populate the database, the participants went to work refining which fields would be most important to database users.

At the ASU Citizen Science Maker Summit 2016, an initial draft of the Tools database was shared for peer feedback during a session titled, "Making Tools Discoverable." During this larger session, more than 80 Summit attendees assumed one of four personas (librarian, citizen scientist, maker/manufacturer, and project owner) and provided feedback on the most important database fields and provided additional suggestions for improvement.

We compiled feedback and developed a Beta version of the SciStarter Tools Database that's ready for "trial by fire" and refinement by tool makers, lenders, and manufacturers who are invited to add their tools to the database.

Step Four: We're inviting people to add Citizen Science Tools to the beta database!

We are ready to test the [beta version of the SciStarter Tools Database!](link) Do you use a particular tool for your [citizen science project](link)? Have you designed a tool that you think could be of use to [citizen science](link)? Do you offer tools for loan or for sale? Please [add it](link) to the beta version of the SciStarter Tools Database. (Note: You will need a SciStarter account to add a [tool](link) to the [database](link).)

Thank you for interest and we look forward to keeping you posted on this collaboration!

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