National Library of Medicine

Shaping an NLM Roadmap for Crowdsourcing and Citizen Science

Spring 2020 Associate Fellowship Project

Han, Sharon (NIH/NLM) [C]
7-31-2020

Project Sponsor:
Aimee Gogan (NIH/NLM/LO/Office of Engagement and Training)

Contents

Abstract

Objective

The project focuses on developing a plan for NLM staff to use Crowdsourcing and Citizen Science (CCS) methodologies to meet their programmatic goals and serve user audiences. Through various information gathering strategies, the project identified resources, opportunities, and concerns to consider when building CCS opportunities at NLM.

Methods

The project involved a wide array of information gathering strategies across several audiences. Environmental scans, literature reviews, and interviews were conducted to learn more about perspectives and approaches to CCS from non-NLM experts. NLM staff perspectives on CCS were sought out through interviews. Staff from the Network of the National Library of Medicine were surveyed to understand their capacity for facilitating opportunities within the Network.

Results

Results found that CCS activities can be highly collaborative across a variety of STEM subjects. CCS practitioners actively discuss addressing issues related to data quality, promotion and recruitment, and educational opportunities. NLM staff say that leadership and logistical support are necessary to begin planning for CCS opportunities. NNLM staff offer promotion, engagement, and training expertise to support CCS facilitation, but more conversations are needed between NLM and NNLM staff to identify appropriate audiences to engage.

Conclusion

OET and the contractor group are working to design a framework guiding NLM staff through the CCS ideation process using our findings. This framework will then be tested and refined through a workshop with NLM staff interested in exploring CCS opportunities for their program areas.

Introduction

The purpose of the project is to develop a roadmap guiding Crowdsourcing and Citizen Science (CCS) opportunities using NLM data and resources. The project assesses the capacity to formalize the CCS project development for any NLM program area. This report highlights project objectives and specific activities I conducted throughout the process.

Crowdsourcing and Citizen Science can be defined in a variety of ways, but usually with an emphasis on public participation and scientific research. For the purposes of this project, we broadened our definition of CCS to include development as well, as not all NLM activities fall under the traditional definition of research. During this project, CCS is defined as any project involving non-staff to support NLM activities.

Previous and Current CCS Activities at NLM

NLM and the Network of the National Library of Medicine (NNLM) are involved in several CCS-related activities. The NLM Strategic Plan 2017-2027 cites Citizen Science as an opportunity to help "build a workforce for data-driven research and health." Current NLM examples of CCS activity include crowdsourced metadata and image tagging at Lister Hill intramural research programs to help train machine learning algorithms. NLM web products, such as PubMed, have also used crowdsourced A/B Testing to improve web design. The NNLM currently supports CCS programming through educating members on CCS opportunities with our partnership with SciStarter, a Citizen Science project discovery platform from University of Arizona. OET and the Network facilitate CCS activities such as the #citeNLM Wikipedia Edit-a-thons, events in which participants are trained to use NLM and NIH resources to create, review, and update Wikipedia articles on health science topics. As these examples show some NLM program areas have successfully implemented CCS in their work, this project hopes to expand opportunities to adopt CCS in other program areas if it fulfills their project goals.

Methods

The overall project process towards our goal is illustrated in **Figure 1.** During Part 1, project activities include an environmental scan, literature review, and interviews with external CCS researchers and thought leaders to identify general impact and challenges involved in CCS projects. I supplemented the environmental scan and literature review by focusing particularly on CCS opportunities in K-12 education and public learning environments (e.g. museums, libraries). As NLM staff would oversee potential CCS projects, we conducted pre-interviews and structured interviews with select staff who either have experience or may be involved in future CCS activities. We discussed with them their perspectives on CCS, needed supports, and potential opportunities. We also engaged with the NNLM staff through a survey to share their experiences and thoughts on CCS at regional and local levels. A more detailed breakdown of information gathering activities can be found in **Table 1**. Input from all audiences inform the current stage of the process, Parts 2 and 3, wherein we are working to develop and facilitate a workshop for NLM staff to test our prototyped framework guiding CCS project development.

The project team involved in these activities include Aimee Gogan and Laura Bartlett from OET and a team from a contracting group, ICF Next. The contractors and the OET/NLM team worked on specific tasks for each activity, further described in Table 1.
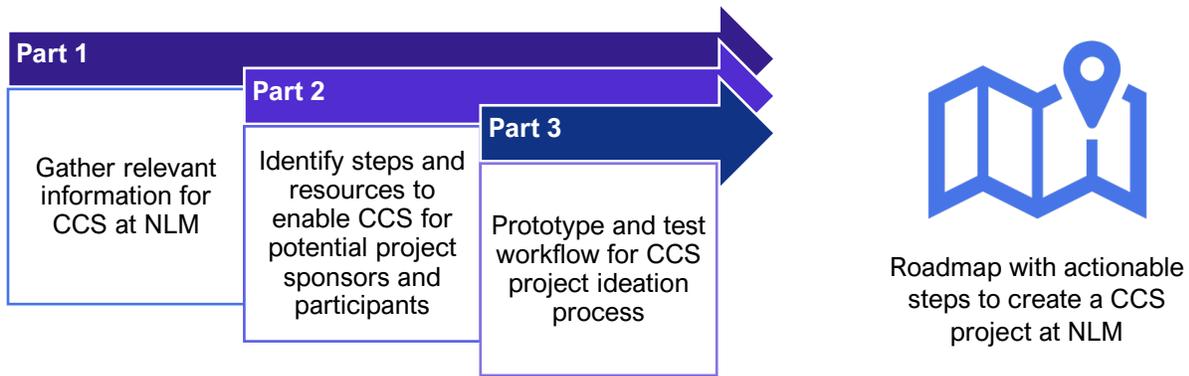
Figure 1. Project Process in Three Parts

Part 1
Gather relevant information for CCS at NLM

Part 2
Identify steps and resources to enable CCS for potential project sponsors and participants

Part 3
Prototype and test workflow for CCS project ideation process

Roadmap with actionable steps to create a CCS project at NLM

Table 1. Project Activities by Group

Activity	Contractors	OET/Associate Fellow
Environmental Scan	Examine publicly and federally funded/facilitated CCS projects	Collect and analyze CCS projects involving K-12, education, museums, and libraries
Thought Leader Identification	Use Environmental Scan to identify active promoters of CCS	Selected thought leaders from environmental scan to contact for structured interviews—activity paused in April 2020 due to COVID-19
Literature review	Identifying and summarizing peer-reviewed literature on citizen science and crowdsourcing efforts	Summarizing a mix of peer-reviewed and grey literature (blogs, videos, reports) on citizen science and crowdsourcing; focus on education and addressing some concerns identified in contractor review, such as data quality and promotion
Interviews	Interview NLM staff and CCS thought leaders on opportunities, barriers, and considerations for implementing CCS	Conducted pre-interviews with NLM staff to provide project context, answer general questions, and invite them to participate in formal interview
Survey	--	Survey NNLM staff on previous CCS activities and what they anticipated need for in future opportunities with network members
Roadmap Workshop	Plan and facilitate workshop with NLM staff to test roadmap and CCS project development	Plan and facilitate workshop with NLM staff to test roadmap and CCS project development

| Participation in federal CCS working groups | --- | Attend meetings and webinars on CCS activities; present at 6/9 NIH Working Group Meeting (Aimee) |

Results

The results will focus on my work, referencing ICF's work as needed.

Environmental scan

The Associate environmental scan included a total of 27 projects that involve museums, educational centers, and/or K-12 audiences. Similar to ICF's environmental scan of general CCS projects, projects for educational audiences tended to focus on environmental science and ecology. Projects involving learning environments tended to be collaborative efforts with government agencies, universities, and/or non-profits. While I first thought there would be explicit evidence of these institutions facilitating outreach and public engagement to recruit participants, such efforts were not obvious in the scan, reviewing mostly online websites. However, this task did show that public STEM educational institutions are contributing to CCS efforts in some capacity. A more detailed summary of reviewed CCS projects can be found in **Appendix I.**

Literature Review

ICF reviewed over 20 peer-reviewed publications on Citizen Science projects and methodology. Complementing their review, I conducted a follow-up review focused on K-12 education, as well as addressing any gaps mentioned in their review. In addition to peer-reviewed literature, I also reviewed grey literature on CCS. The results highlight discourse in three areas: Data Quality, Promotion and Engagement, and Education. Research on data quality and promotion were done in response to interviews where quality assurance was identified as a major concern to address.

Grey literature used in this review were primarily found through websites of Citizen Science organizations such as the Citizen Science Association (CSA) and SciStarter. References in found sources were also used to find other relevant resources.

Data Quality

Concerns for data quality and management have been identified in both literature review and interviews with NLM staff/CCS thought leaders. To mitigate these concerns, it is important to be aware of current practices and considerations made when handling publicly-submitted data. Common characteristics of CCS data include anonymous sources, exclusively online activities, and differing levels of comfort with data and collection skills (Wiggins 2013). Active members in CCS activities are also aware of data quality concerns and help mitigate these issues through curating and sharing resources (Data Quality Resources).

Much of the literature identified intentional planning of data collecting, validation, and analysis to build data credibility. Strategies were given at all stages of the data life cycle, and often pointed to institutions for data management policies and guidance (Wiggins 2013; Citizen Science Manual). Both Wiggins and the Manual also suggest doing pilot tests of the data collection process to ensure the appropriateness of the steps and identifying points of training and technology support. Data quality strategies include a variety of players such as technology,

volunteer "experts," and project staff (Freitag 2016). Increased engagement between staff and volunteers can also help improve quality of data, as they can exchange feedback on data collection and adjust training as necessary. Other studies on data quality in CCS include findability and ease of access of publicly-generated data, but is not explored in this review because it is out of scope (Schade 2016).

Promotion, Coordination, and Engagement

Many resources found on promoting CCS activities emphasized understanding volunteer motivations as a key component in recruitment and long-term engagement. Recruitment efforts are especially effective if you highlight the areas that fit the needs of the researchers, the volunteers, and the organization itself. In a CSA webinar, project leaders from University of Minnesota pointed out that not all volunteers will be interested in the entire project. In certain cases, volunteers will participate in training and educational opportunities, but will leave the project after, as the education may have been their primary motivation.

Experienced Citizen Science project coordinators encourage use of multimedia tools such as video and social media to broaden audience reach. Short videos can be used to quickly grab viewers' attention and emphasize their potential impact in an authentic way (Gabe 2019). While these recommendations were made specifically for video formats, these same strategies could be applied to other promotion formats, both in print and online.

There are also factors to consider that measure the frequency and intensity with which the public participates. Participant backgrounds may provide some insight into participant expectations. For example, volunteers with higher education levels are often more likely to continue participating in CCS efforts long-term, and levels of knowledge also produce similar effects (Haklay 2018). Different levels of knowledge and engagement can be more or less conducive to different CCS projects; meaning every project does not always need to strive for a group of highly knowledgeable and engaged participants. For example, a CCS task requiring low levels of knowledge and engagement may allow for outreach to a wider audience and higher numbers of participants (Haklay 2018).

CCS in Education

In 2018, the National Academies of Sciences, Engineering, and Medicine released an in-depth report on CCS and learning opportunities in educational environments (NASEM 2018). This document supports continued discourse on the link between science and learning for communities often excluded from the original research process. The report identifies design learning as a methodology to create and implement CCS projects that achieve specific objectives for both project coordinators and participants, which overlaps with general CCS project design. This report cautions readers to also consider issues of equity and power in CCS projects, especially when it comes to coordinator-participant dynamics and engaging diverse audiences. Underrepresented communities identified as potential collaborators in CCS projects mirror the same communities often underrepresented in the sciences, such as communities of color and women. As the report focuses on education, it also highlights opportunities to engage youth and provide early exposure to scientific practice. CCS is seen as an opportunity for youth to develop specific literacies in science, technology, and data, especially for topics that interest them (Informal Science 2017).

In building more inclusive CCS opportunities, coordinators may also want to leverage partnerships with experts in education, both formal and informal. Schools and museums can provide CCS projects opportunities to connect with intended audiences that may not be readily available in research labs or non-profit offices. Depending on intended audiences and learning environments (formal vs informal), museums or schools may be the more appropriate partner for a project. Educational spaces can also help navigate particular challenges in public engagement such as the increasingly negative adult opinions of science (Staveloz 2015). Libraries can also serve as potential partners to help design and facilitate CCS opportunities for patrons, from science kits to events (Cavalier et al. 2019).

Literature review references can be found in **Appendix II.**

Pre-Interviews

When I joined the project, the pre-interviews to select NLM staff for structured interviews were underway. These pre-interviews were hour-long conversations with NLM staff selected for their experience or interest in CCS or possible contributions to future CCS activities. The latter category included staff in the Office of Computer and Communications Systems (OCCS), as they manage much of NLM's online infrastructure and could help manage data access. These pre-interviews were an opportunity for project members to explain our goals and invite them to participate in the structured interviews with ICF staff. During the pre-interviews, we found that those who had already done CCS before were comfortable with figuring out a workflow that works best for them. Participants who had not used CCS in their program areas before, however, were interested in having more guidance and support for developing such opportunities. Some wanted to make sure that leadership supported such efforts, both strategically and financially, before proceeding with planning. Other resources mentioned include technical support, promotion and engagement, and recruitment expertise. As much of staff time is already dedicated to program support and development, they were also concerned about having access to the necessary resources to create CCS opportunities without duplication of other NLM activities.

NNLM Survey

In early summer, I developed a survey with Aimee and Laura asking NNLM staff to report on their previous CCS activities, what they think Network members need to facilitate CCS programming, and what they can do as staff to facilitate these programs. Laura then published this survey through SurveyMonkey, and Aimee distributed the survey to all NNLM staff via email. In about 1.5 weeks, we received 23 total submissions, and 9 submissions included more in-depth details about their perspectives on CCS in their region. At least 6 of the 8 total RML regions were represented in this dataset.

8 respondents said that they conducted CCS activities within the past few years, including participating in Citizen Science Month, training members through webinars, partnering with SciStarter, reading clubs, and Wikipedia Edit-a-thons. Based on this experience, staff assessed that Network members are somewhat to moderately interested in CCS projects both in general and directly from NLM. Respondents identified technical assistance, funding, pre-made activities, and promotion as support they can provide for Network members in facilitating CCS programming. Academic and K-12 students, staff, and librarians were identified as potential

audiences of interest for NLM-specific activities. In light of the COVID-19 pandemic, NNLM staff also expressed the need for making CCS opportunities accessible and engaging through digital environments to reduce the need for social gathering. A more detailed summary of survey results can be found in **Appendix II**.

Discussion

Benefits and Concerns

The environmental scan and literature review revealed several benefits of conducting CCS. Benefits include scaling research scope, broader data collection, and increasing public engagement and awareness with research. In our pre-interviews, similar suggestions were made when we asked staff how their programs might benefit from implementing CCS. As many NLM staff also oversee our products and offerings, some suggested that crowdsourcing could help garner more feedback on their resources and suggestions for improvement as well. Staff also showed interest in using CCS to increase awareness about NLM resources.

In addition to benefits, stakeholders also noted that developing new CCS opportunities may require additional labor, which could impact the day-to-day work. Staff wanted a better understanding of what work and costs are involved in CCS projects, especially if they needed to conduct new tasks that require training. It is important for us to hear these concerns, as they will play a critical role in determining if pursuing a CCS opportunity is realistically feasible for different program areas.

Determining an Audience

"Citizen" in Citizen Science is meant to reflect that anyone can and should be able to participate in scientific research. However, it became abundantly clear throughout the environmental scan and subsequent literature review that not every CCS project is suitable for all audiences. Depending on the task and content, some projects were more conducive to broader or narrower audiences. For example, training participants to take pictures of birds and submit them to Cornell's Lab of Ornithology [eBird](#) platform may be more streamlined than training participants to read and transcribe digitized historical documents on Library of Congress's [By the People](#) platform due to the variation in documents. Structured interviews with NLM staff identified that they are particularly concerned about appropriate participant recruitment and training because of their impact on data quality. Desiring specific traits could indicate that NLM staff would be more comfortable working with specific communities trained and/or interested in such tasks, such as library science students. Who NLM wants, however, does not seem to overlap so clearly with who our NNLM staff think would be interested in participating across the Network. From our NNLM survey, respondents indicated that they think K-12 and academic audiences would be most interested in participating in Citizen Science activities. The dissonance between NLM staff's ideal CCS audience and NNLM's perceived audiences of interest in CCS suggests that more conversations will be needed between potential project supervisors and facilitators to find optimal opportunities for recruitment and participation.

Identifying Resources

While the environmental scan and literature gave us an idea of what can be done, directly speaking with NLM and NNLM staff helped us understand what tools we already have and what other support is needed. Before starting, NLM staff want to first know that leadership support

using resources for these efforts. Once support is manifested strategically and financially, NLM program areas can then use their subject matter expertise and project goals to ideate opportunities. From there, staff will need assistance with setting up CCS workflows and promoting opportunities to the public. NNLM can support promotion and engagement with CCS projects to the Network but may need some initial training and "ready-to-use" activities to facilitate. If CCS projects involve several collaborators within NLM, NNLM, and the public, it may also be useful to have a hub to help staff connect with the appropriate resources.

Next Steps

Using the information found in the first part of the project process, team members are analyzing and curating information necessary for NLM staff to ideate CCS opportunities. This information will be organized into a framework, which will then be tested during a workshop with NLM staff. The workshop, scheduled tentatively for this fall, will enable staff from various program areas to ideate a CCS project proposal that fits their area's goals. The workshop will not only provide space for collaboration and design, but also help the project better understand what information and resources staff need in the development process.

Reflection

I was initially interested in this project due to my experience with outreach and engagement in science education environments. Citizen Science seems like an engaging and authentic tool to create opportunities for the public to learn about science first-hand and make an impact. What was interesting about this project is that it aimed to address Crowdsourcing and Citizen Science for all of NLM rather than a specific program area. As a result, the project group often had to juggle competing priorities and needs of stakeholders to develop a framework that involves all necessary groups. Aiming to be comprehensive has resulted in a large corpus of information we can now use to analyze and curate a deliverable that adequately addresses the needs and considerations of those involved in developing CCS opportunities.

This project also demanded flexibility and a willingness to explore various topics that may or may not inform the final deliverable. For example, while I did a lot of research on CCS opportunities with youth audiences, our interviews with NLM staff revealed that their project goals may not be conducive for youth audiences due to necessary technical and subject expertise. This example is also good evidence for consistent engagement with involved stakeholders to ensure that priorities and understand of needs are aligned. The eventual workshop for this fall is another example of garnering staff feedback to ensure the project team creates a program that supports NLM staff and goals.

As OET continues to develop ways to connect user audiences with NLM tools, I am interested to see what role they will play in leveraging CCS as an asset for research and development.

Conclusion

This exploratory project offers an opportunity for collaboration at NLM within program areas, divisions, with the Network, and other partners. NLM and NNLM staff already have an extensive array of roles and responsibilities, and simply tacking on CCS as another task for everyone to do is not sustainable. CCS will provide more value to staff if it is presented as a tool to help achieve programmatic goals, whether accelerating research, engaging public audiences, or gathering feedback for resources. Through in-depth background research, OET continues to identify

resources and tools necessary to actualize CCS projects to public audiences through our Network. Moving forward, these efforts aim to provide more opportunities to connect users with NLM resources and develop resources that meet community priorities.

Acknowledgements

Appendix I: Environmental Scan of CCS Activities in Museums and Educational Centers, K-12 focus
[Original Data](#)

Methods

The Associate used a variety of online sources and prior knowledge to identify Crowdsourcing and Citizen Science projects that involve museums, educational centers, and/or K-12 audiences. Information about funded CCS projects, as well as general descriptions, were found using National Science Foundation, Institute for Museum and Library Services, and the Association of Science and Technology Centers' websites. Articles from science communication publications such as Science Friday were also explored to identify projects. The Associate also looked through ongoing projects on CCS platforms, SciStarter and Zooniverse, to identify projects that fit the scope of this environmental scan.

Dataset

This dataset includes 27 different projects. These projects were grouped into Education, Museums, and Public, depending on the primary investigating institution(s). The Associate identified 9 projects for each category.

CCS Topics

Project topics varied broadly in scope, with a particular emphasis on ecology, environmental science, and atmospheric science. There were two projects with a disciplinary focus on medicine (Monkey Health Explorer; Dream Catchers), as well as a couple about history (Freedman's Bureau; Living with Machines).

Funders and Investigators

Over a third of the projects found were the result of collaborations among a multitude of institutions, including museums, archives, universities, non-profit organizations, and consortia. Funding for projects came from both public and private funders, although the Associate was unable to identify funders for 6 projects. It was also not always clear if funding was continuous, or if funding came from one source to start, and then projects may have moved to different funding models.

Participants

Nearly all projects were advertised for the general public, which aligns with the purpose of citizen science. Three projects were particularly interested in recruiting student participants, with one (Never Home Alone) focused on students at their home institution (NCSU). The Reef Check program recruits specifically those with scuba diving certifications, as it is a required activity to contribute to their project. No other project identified specific requisite skills needed prior to participating in the project, suggesting that training is provided after recruitment.

Tasks

The majority of participant tasks include documenting observations about a particular subject (organisms, birds, snow, plants, constellations, etc) and submitting collected data to a larger database. Documentation often includes location data. Two projects require participants to collect soil samples and submit geographic or testing data. Several projects involve review of images and/or text for annotation or transcription. The Marine Debris project included an

experimental component wherein participants would throw plywood drift cards along one coastal location and then recover other drift cards to track the cards' travel routes. Many of these projects allow for participation multiple times for an indeterminant period of time. The Canine Behavioral Assessment only asks for one survey response, where participants submit information about their own dog's behavior.

Promotion

Most projects advertise and recruit for their work using online methods, including social media, blog posts, and e-newsletters. Wicked Hot Boston was able to engage a variety of community members through hosting a public forum in which groups of people attended presentations and did workshops. Projects also receive promotion through being readily available on CCS activity platforms such as SciStarter and Zooniverse. While evidence of attempted promotion and engagement were evident, the Associate did not look for measures of engagement with their intended audiences (how many followers, attendees, etc.).

Outcomes

The projects that involve submission of observations/data often make the data publicly available online. Projects such as eBird have also developed mobile applications to streamline uploading and searching data. Projects that involve identification have also resulted in new discoveries, such as the identification of new dwarf plants in Backyard Worlds. Transcription projects have resulted in readily available materials for future use. Several projects have also presented and published articles on the projects or research findings derived from the crowdsourced data. Few projects have also collected data on project participants, although it is not clear about how projects will apply this information in the future.

Appendix II: Literature Review References

Data Quality Resources

Citizen Science Association. (2019). Data Quality Resources for Citizen and Community
    Science. [Google Sheet]. Last accessed 16 June, 2020:
    https://docs.google.com/spreadsheets/d/1C7k_IIHDjxSc56l6ajPydyrdWFzvO8ZOauJe1U
    DoIzQ/edit#gid=0
- Also organized resources by Data Life Cycle Stage

Freitag, Amy, Ryan Meyer, and Liz Whiteman. (2016). Strategies employed by citizen science
    programs to increase the credibility of their data. *Citizen Science: Theory and Practice*
    1:1, p.2. http://doi.org/10.5334/cstp.6

Schade, S. and Tsinaraki, C. (2016). Survey report: data management in Citizen Science
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Wiggins, A., Bonney, R., Graham, E., Henderson, S., Kelling, S., Littauer, R., LeBuhn, G., Lotts,
    K., Michener, W., Newman, G., Russell, E., Stevenson, R. & Weltzin, J. (2013). Data
    Management Guide for Public Participation in Scientific Research. DataONE:
    Albuquerque, NM. (PDF)

Emmett Environmental Law & Policy Clinic. (2019). The Citizen Science Manual: A Guide for
    Starting or Participating in Data Collection and Environmental Monitoring Projects.
    Harvard Law School. (PDF)
- Emphasis on Section 5: Information Generation- Design of Sample Collection,
Sample Analysis, and Data Interpretation Methodologies

Promotion Resources

Citizen Science Association. (2020, April 14). Engaging Volunteers Online [Blog Post]. Retrieved
    from https://www.citizenscience.org/2020/04/14/engaging-volunteers-online/.

Citizen Science Association. (2019, June 11). *CSA WEBINAR: Wide Angle Lens of Volunteer*
    Engagement with UMN Extension [Video file]. Retrieved from
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Haklay, Muki. (2018). "Participatory Citizen Science." *Citizen Science: Innovation in Open Science,*
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    Citizen Science [PDF File]. Retrieved from https://s3-us-west-
    2.amazonaws.com/orrerymedia/misc/CitSci_Librarians_Guide_02_22_r1.pdf

National Academies of Sciences, Engineering, and Medicine. (2018). Learning Through

Citizen Science: Enhancing Opportunities by Design. Washington, DC: The National Academies Press. https://doi.org/10.17226/25183.

Staveloz, W. (2015). Embracing the Vision of Citizen Science: An Historic Opportunity for Science Centers [PDF File]. *InformalScience*. Retrieved from https://www.informalscience.org/embracing-vision-citizen-science-historic-opportunity-science-centers.

Appendix III: Review of NNLM Survey

Active Dates: June 8 to 17, 2020

- Survey Respondents: 23
  - 9 responded on behalf of ROC
  - 14 responded on behalf of themselves
- Number of Completed Survey Responses: usually between 7 and 9 on average

Q1: Has your NNLM group conducted any Crowdsourcing and Citizen Science (CCS) activities during Year 3 or Year 4 of the funding cycle? This includes trainings, exhibits, programming, etc.
- Response Rate: 92% (11 of 23)
- 8 responded Yes to conducting CCS activities in Year 3/4

Q2: Has your NNLM group funded any Crowdsourcing and Citizen Science (CCS) activities during Year 3 or Year 4 of the funding cycle? This includes trainings, exhibits, programming, etc.
- Response Rate: 92% (11 of 23)
- 5 responded yes to funding CCS activities in Year 3/4

Q3: If yes for Q#2 and #3, provide the Activity Title(s) and Start and End date(s) of the CCS activity(s) from DRS. For each activity, please also describe your promotion strategy(s).
- Response Rate: 30.4% (7 of 23)
- Types of activities (funded or conducted) include
  - Citizen Science Month 2019/2020
  - Wikipedia Edit-a-thons—conducting, webinars, training
  - Exhibiting NLM resources for Citizen Science
  - Education
  - All of Us Training
  - Presentation for public and librarians, conferences
  - ALA Policy meeting with SciStarter
  - Case studies from high school science teachers
  - General updates on NLM activities
  - Reading club
  - One case of having an award available but ultimately not funded

Q4: In funding announcements for Years 3 to 5, did your RML specify available funds for CCS activities?
- Response Rate: 92% (11 of 23)
- 4 respondents allocated funds for CCS activities

Q5: How interested do you think your network members are in implementing CCS projects in their communities?
- Response Rate: 39% (9 of 23)
- 4 respondents say network members are somewhat interested in CCS projects (44%)
- An equal number of respondents say network members are somewhat to moderately interested (3 each) in CCS activities using NLM tools/data

Q6: What resources do you think are important for successful implementation of CCS activities by your Network members?
- Response Rate: 39% (9 of 23)
- For general CCS activities, respondents say training and technical assistance are most helpful for network members (7 votes for each)
- For NLM-specific activities, respondents say "Off the Shelf"/pre-made activities would be most helpful (9 votes total)
    - Other suggestions include using All of Us tools/data and ensuring strong partnerships with CCS orgs such as SciStarter

Q7: Which promotional tools do you think are helpful in engaging and recruiting participants for CCS activities in your region?
- Response Rate: 39% (9 of 23)
- 7 respondents found that social media materials would be most helpful in recruiting participants for general CCS activities
- 8 respondents found that both printable and social media promotional materials would be most helpful in recruiting for NLM-specific activities
    - Other suggestions include materials that can be co-branded by libraries or others sponsors, as well as a course on how to set up CCS programs (education as promotion?)

Q8: Which audience(s) do you think are interested in CCS activities?
- Response Rate: 39% (9 of 23)
- 8 respondents found that K-12 teachers, staff, and librarians would be interested in general CCS activities; only 2 respondents thought hospital librarians would be interested
- 6 respondents found that academic and K-12 librarians and staff and public health professionals would be interested in NLM-specific CCS activities; only 3 respondents thought hospital librarians would be interested.
    - One respondent made note that all audiences may be interested in these activities for different purposes

Q9: What do you think are the opportunities for your RML network members to conduct CCS programming?
- Response Rate: 26% (6 of 23)
- Suggested opportunities include:
    - All of Us data browser and participant portal
    - Collaborating across library types (academic and public, etc.)
    - Facilitating CCS events
    - Promoting health departments
    - Academic libraries offering CCS opportunities
    - Using timing to our advantage—increased interests in digital engagement and virtual activities
    - Following up with CCS webinar/training attendees to see if they actually implemented CCS activities
    - Encouraging researchers to use CCS
    - Crowdsourcing COVID-19 information from public health members, hospital consumer health librarians, etc.

- o Marketing to school librarians
- o Continue to partner with SciStarter beyond CS Month
- o Connecting public health and environmental public health with crowdsourcing data opportunities
- o Funding opportunities for CCS in K-12

Q10: What do you think are the barriers for your RML network members to conduct CCS programming?
- Response Rate: 30% (7 of 23)
- Barriers include:
  - o Funding
  - o Training
  - o Limited staff
  - o Barriers to communication based on pre-existing channels
  - o Translations and accessibility measures for materials
  - o Technical support; hosting events; archiving of video events
  - o Current events (COVID-19)
  - o Coordinating materials—lending, purchasing
  - o CCS information is decentralized
  - o Siloed information; outreach to bring awareness
  - o Not sure where to start
  - o Finding a connection between NLM resources and CCS programming
  - o Abundance of other programming choices

Q11: If CCS activities are funded, how can you/your NNLM staff support network member in conducting CCS programming?
- Response Rate: 39% (9 of 23)
- 9 respondents say that they can support network members conduct CCS program through funding; 8 respondents suggest logistical support
  - o Other also suggests promotion

Q12: What do you/your RML colleagues need to support your network members in conducting CCS programming?
- Response Rate: 39% (9 of 23)
- 8 respondents say they need instruction and train-the-trainer toolkits to support network members in CC programming.
  - o Other responses suggest co-facilitating with network members and learning how to offer virtual CCS activities

Q13: The following are potential CCS activities using NLM information and data. Please indicate your level of experience with each:
- Response Rate: 39% (9 of 23)
- The activity with the most amount of experience recorded is annotating records (6); the activity with the least amount of experience is code-a-thons (7). Only 1-2 respondents expressed interest in gaining experience in each of the suggest activities.

Q14: Is there anything else you would like to tell us about Crowdsourcing and Citizen Science?
- Response Rate: 8% (2 of 23)

- All of Us expresses great interest in CCS (we knew this)
- CCS may be an opportunity to leverage expertise of partners
- Suggested approach is RMLs providing promotion and support, while NLM tool owners lead projects themselves (as we envisioned)