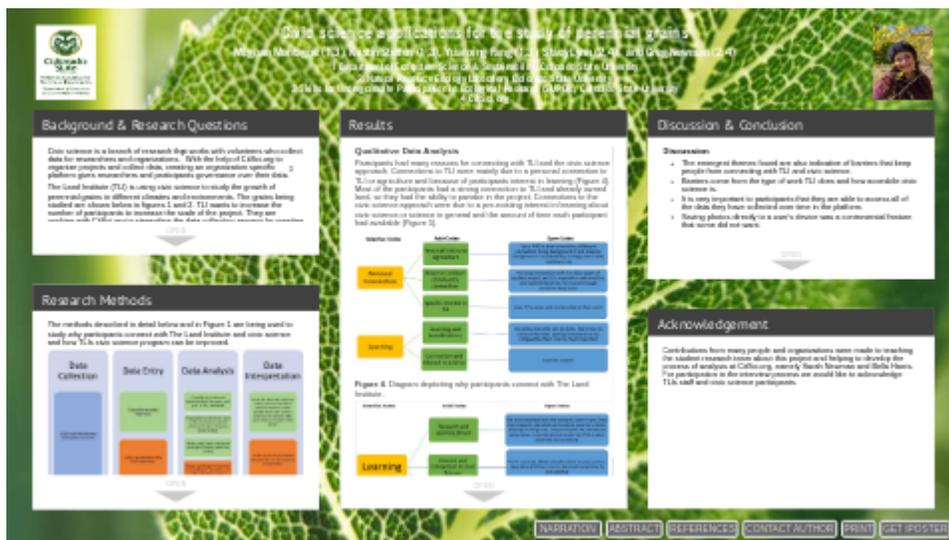


Civic science applications for the study of perennial grains



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PRESENTED AT:



BACKGROUND & RESEARCH QUESTIONS

Civic science is a branch of research that works with volunteers who collect data for researchers and organizations.¹ With the help of CitSci.org to organize projects and collect data, creating an organization specific platform gives researchers and participants governance over their data.³

The Land Institute (TLI) is using civic science to study the growth of perennial grains in different climates and environments. The grains being studied are shown below in figures 1 and 2. TLI wants to increase the number of participants to increase the scale of the project. They are working with CitSci.org to streamline the data collection process by creating a platform which will increase the diversity of their program. It is important to know why participants connect with TLI and civic science in order to appeal to more participants once the platform is created.



Figure 1. The silphium plant, a perennial crop that resembles the sunflower.



Figure 2. The sainfoin plant, a perennial legume plant.

Research Questions

1. Why do participants in the perennial grain civic science programs connect with The Land Institute?

Hypothesis: Participants connect with The Land Institute because of a personal connection with agriculture.

2. Why do participants in the perennial grain civic science programs connect with civic science as an approach?

Hypothesis: Participants connect with civic science because of their personal history with science and learning.

3. Why are not all participants interested in technological assistance in the civic science agricultural data collection process?

Hypothesis: The platform and App contain different advantages and disadvantages in the agricultural process of participants

RESEARCH METHODS

The methods described in detail below and in Figure 1 are being used to study why participants connect with The Land Institute and civic science and how TLI's civic science program can be improved.

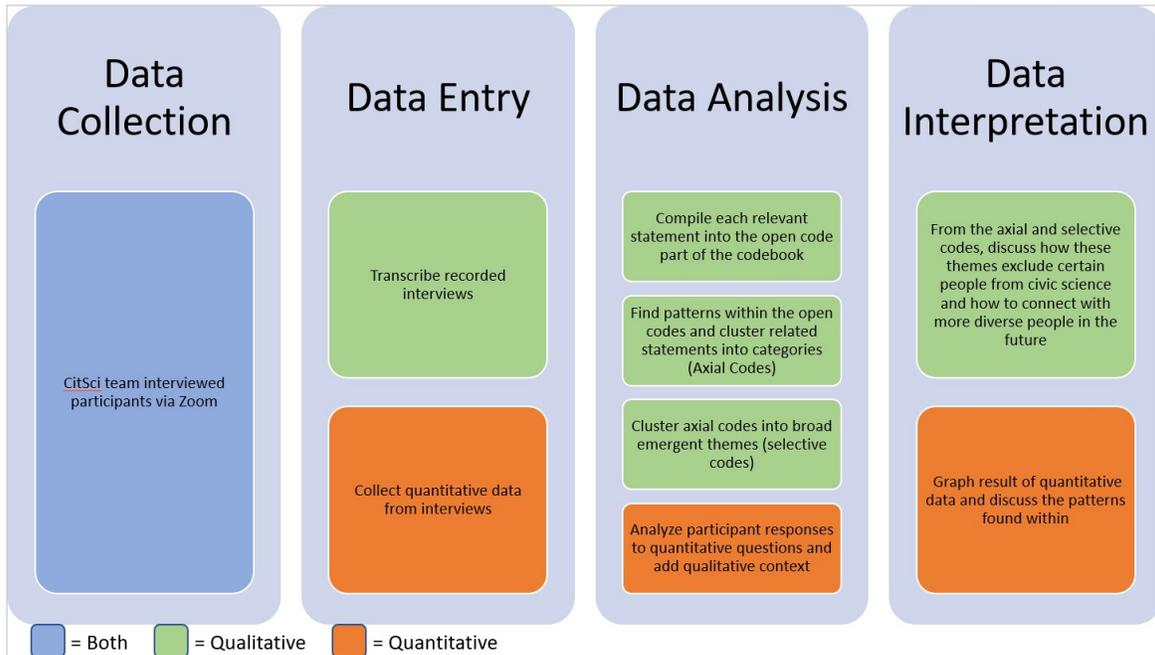


Figure 3. Diagram depicting the necessary workflow to complete for both qualitative and quantitative data analysis. Qualitative specific steps are in green while quantitative steps are in orange.

Quantitative Data Analysis: Each interview contained 16 quantitative questions, seven in reference to the CitSci and TLI platform (Figure 4) and nine in reference to the CitSci and TLI phone application (Figure 5). Participants ranked statements on a scale of 1 to 5, with 5 being really want and 1 being it doesn't matter. These answers were collected and graphed to find patterns within the data and analyze what was most important to participants.

Qualitative Data Analysis: Each interview was conducted, recorded and then transcribed and saved to a database for ease of reference. The transcripts were analyzed for relevant statements to each question, known as open codes, every new statement was entered into a new row in the spreadsheet. These initial statements are known as open codes. The next step was axial coding, which involved clustering open codes into related categories.² Finally, the axial codes turned into selective codes by going through another round of clustering to find emergent themes.⁴ The categories and themes were used to uncover how civic science programs and TLI can better connect with a larger and more diverse group of people.

PLATFORM	
P1	Access to resources and information
P2	Communicate with TLI directly via a messaging button
P3	Communicate with others in the civic science project via forums
P4	Communicate with individuals in the civic science project via messaging
P5	Submit observations that you have take in paper form
P6	See data that you have submitted over time in your profile on the CitSci platform
P7	Visualize results to see your data overlayed with data collected by others in visual format (graphs)

Figure 4. Interview questions about platform functionality.

APP	
A1	Access to resources and information
A2	Submit observations directly via the app in a single step
A3	See data you have submitted over time in your profile on the app
A4	Receive notifications and alerts from TLI
A5	Submit photos of things you have questions about directly through a data sheet rather than email
A6	Record audio responses to upload audio file
A7	Record audio responses for voice-to-text
A8	Complete TLI surveys as a data sheet in the app
A9	Automatically save photos directly to your device's photo stream

Figure 5. Interview questions about APP functionality.

RESULTS

Qualitative Data Analysis

Participants had many reasons for connecting with TLI and the civic science approach. Connections to TLI were mainly due to a personal connection to TLI or agriculture and because of participants interest in learning (Figure 4). Most of the participants had a strong connection to TLI and already owned land, so they had the ability to partake in the project. Connections to the civic science approach were due to a pre-existing interest in learning about civic science or science in general and the amount of time each participant had available (Figure 5).

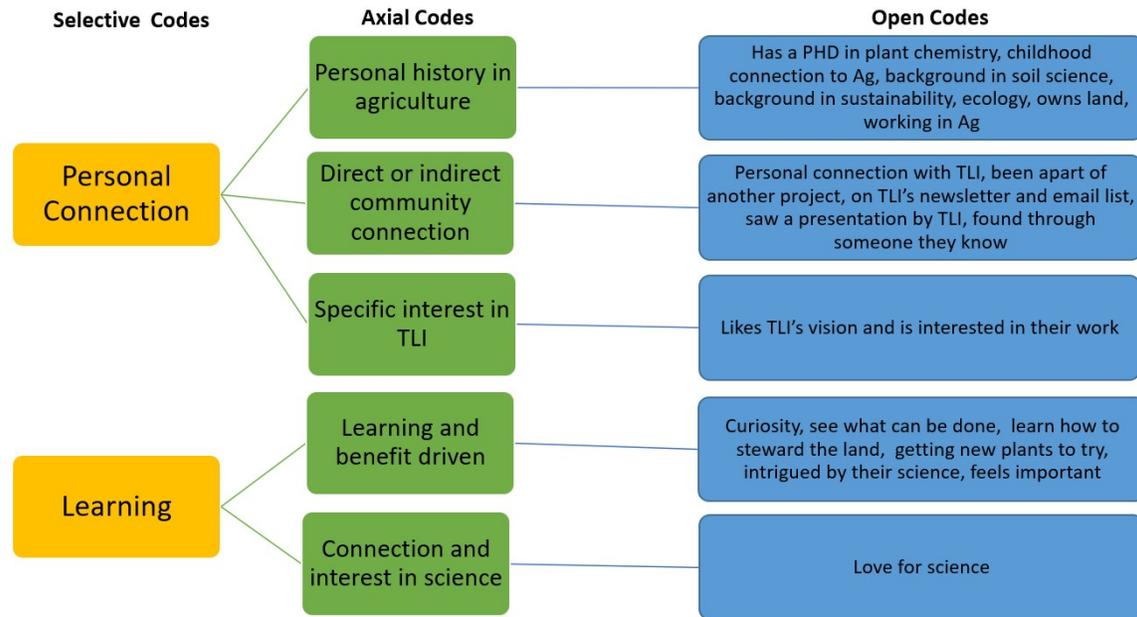


Figure 4. Diagram depicting why participants connect with The Land Institute.

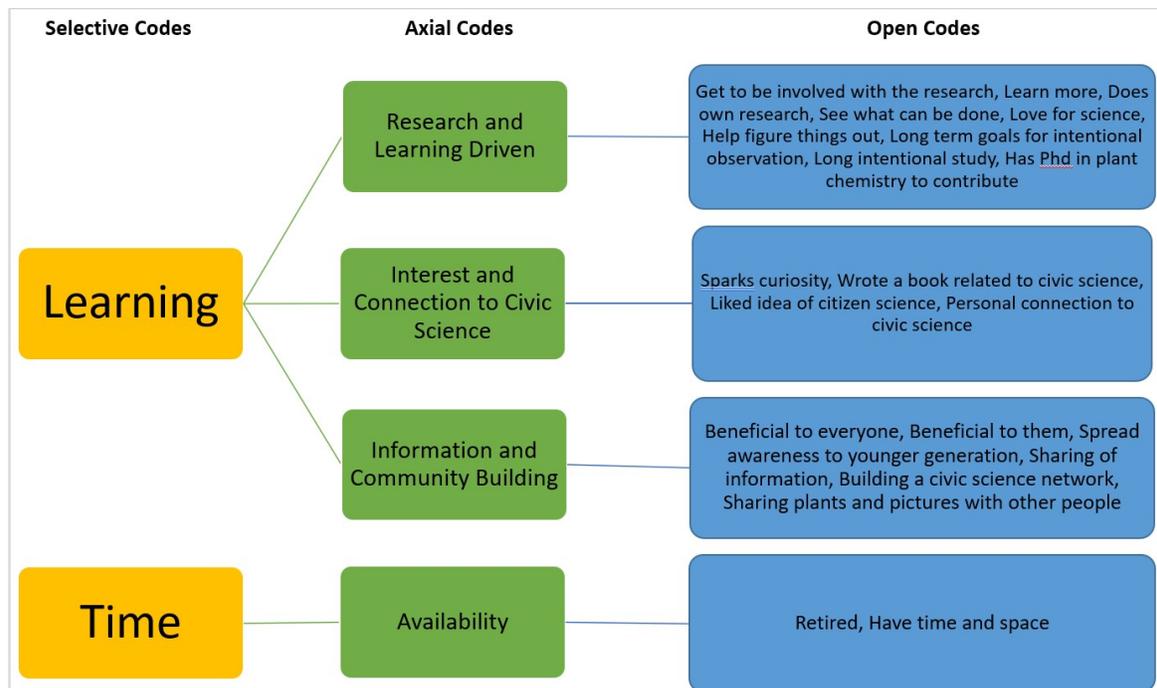


Figure 5. Diagram depicting why participants connect with civic science.

Quantitative Data Analysis

Interviews were conducted from two aspects: platform (seven sub-questions) and mobile application (9 sub-questions). Data collection and analysis were conducted on the interviewers' views on the process of technological assistance in agriculture during their participation. The interviewers gave a satisfaction score to 16 sub-questions, representing their attitude towards technological assistance in the agricultural process (Figure 6). The score ranges from one to five points. The higher the score, the higher the degree of satisfaction and the positive attitude. The lower the score, the lower the degree of satisfaction and the negative attitude.

Platform Functionalities								
Rating	P1	P2	P3	P4	P5	p6	P7	
5	7	3	5.5	2.5	5	10.5	10	
4	6	6	3	0.5	1.5	3.5	2	
3	2	5	2.5	6	3.5	1	2	
2	1	2	2	4	3	0	1	
1	0	0	3	3	3	1	1	
Emergent Rating	67	58	54	47.25	50.5	70.5	67	

App Functionalities									
A1	A2	A3	A4	A5	A6	A7	A8	A9	
7	11	8	8	10.5	4	8	8	2	
3	5	3	3.5	3.5	2	1.5	5	1	
3	0	3.5	2.5	2	6	4.5	3	4	
2	0	1.5	2	0	0.5	1	0	0	
1	0	0	0	0	3.5	1	0	9	
61	75	65.5	65.5	73.5	50.5	62.5	69	35	

Figure 6. The rating results for the interview questions counted from all participants. The green column represents that the participants gave more consistent positive comments on the interview questions. The yellow column represents that the participants gave roughly the same score but with some differences. The red columns represent controversial and exploratory interview questions.

Most important functionalities

1. A9 - Automatically saving photos directly to a user's device. Overall, users rated this feature the lowest of all proposed features. Although some interviewers would like these photos to stay on their device, more interviewers do not want the photos to take up space on their phones. One participant commented that if this is a feature, it should not be a default but a choice. . All participant data will be available to the individual participant within their profile, so whether or not they save the photo to their device, they will have access to the photo on the CitSci platform.
2. P2 - Communicating with TLI via a messaging button within the platform instead of using email. Participants' opinions on this feature are diverse, and the degree of need varies greatly according to the individual. Some participants think that transmitting information through the platform would be a useful feature, but others would rather use email for communication with TLI. This functionality still needs more discussion, but we anticipate that we will add the functionality, and that some participants will use it, and others will use email. CitSci thinks that it is important to provide options to CitSci users, including TLI, so that the platform works well for most (Lynn et al 2019).
3. P6 - Being able to access all of the data they had submitted over time, including photos, in the CitSci platform. Users rated this feature one of the highest of all proposed features. This feature will help platform users to access all data that they collect over time within the cloud storage. This will help them recall and summarize what they have been doing this work for, to see the value of what they are doing. They can also track patterns of change in the growth and development of their plants by accessing previous measurements, and our interview participants liked this.

DISCUSSION & CONCLUSION

Discussion

- The emergent themes found are also indicative of barriers that keep people from connecting with TLI and civic science.
- Barriers come from the type of work TLI does and how accessible civic science is.
- It is very important to participants that they are able to access all of the data they have collected over time in the platform.
- Saving photos directly to a user's device was a controversial feature that some did not want.

Conclusion

People connect to the things that they are interested in, the things that bring them joy or remind them of their personal histories. TLI and their civic science participants connected because of a shared interest in agriculture and learning. It is our belief that TLI will be able to connect with a larger and more diverse audience, through the platform and app, by cultivating their relationship with participants in these shared interests.

ACKNOWLEDGEMENT

Contributions from many people and organizations were made to teaching the student research team about this project and helping to develop the process of analysis at CitSci.org, namely Sarah Newman and Bella Harris. For participation in the interview process we would like to acknowledge TLIs staff and civic science participants.

ABSTRACT

As the global population grows it is becoming increasingly apparent that the world needs to refine its agricultural practices to improve sustainability. Agriculture today is focused on producing annual grains because of their long-standing place in our diets despite having a negative impact on soil and water quality (Cheng & Zhang 2015). This study utilizes the citizen science network to analyze the use of technology to streamline the civic science data collection, submission, management and analysis process to allow The Land Institute to increase the scale of their program for multi-year perennial crop cultivation projects. Through a series of interviews, coded qualitative and quantitative data analysis was performed to look at the agricultural, gardening, educational and other backgrounds of participants, how participants value their engagement with The Land Institute through civic science, and challenges that they may have faced during their participation. The goal is to develop an application that mitigates challenges and provides a user-driven experience to meet the needs of civic scientists.

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