INFORMAL LEARNING IN AN ONLINE CITIZEN SCIENCE COMMUNITY

Karin Ekman
University of Gothenburg (SWEDEN)

Abstract

The engagement of volunteers to participate in scientific and monitoring activities has become increasingly popular. In Citizen Science, volunteers are contributing to scientific or monitoring processes by assisting with observations and classifications, or by creating data by e.g. monitoring species or air quality. I have studied the community of a Citizen Science initiative that uses passive (or participatory) sensing, where participants are collecting data particulate matter from small digital monitors for automatic sensing that are placed in their back yards. Even though the activities and outputs of the Citizen Science initiative are strictly technical and do not promote learning, the organization of a social media community could open up for participants to interact and engage further.

My aim is to explore if participation in a Citizen Science initiative generates further engagement and informal learning. To do this, I used qualitative methods to study the participants of a Citizen Science initiative in their social media community. Data on posts, likes and comments were collected and analyzed.

Preliminary findings on participant activity in the social media community show that the members interact and engage in a variety of different topics. Members mainly engaged in ways aligned with the activities promoted by the Citizen Science initiative such as organizing workshops to build more air quality sensors, giving and getting support, and engaging with unusual data. In these conversations, I found a range of opportunities for learning and also found elaborated engagement in conversations about air quality and the effects of air pollution. This indicates an engagement in the science of society beyond that which is directly related to the activities of the Citizen Science initiative.

Keywords: Informal learning, Citizen Science, engaging in science with technology, digital environmental sensors, Facebook.

1 INTRODUCTION

In Citizen Science, volunteers contribute to scientific or monitoring processes by assisting with observations and classifications, or by creating data to e.g. monitor species or air quality [1]–[3]. Volunteers are gathered in Citizen Science initiatives to contribute to scientific research, to engage in science in society issues such as taking on the role of stakeholders in policy issues, or for civic mobilization to take action against such situations as environmental issues in collaboration with others [2]. Even though this implies that Citizen Science can be seen as a method of inquiry [4], [5], the methods and degree of complexity varies between initiatives and it cannot be seen as a single approach [2]–[4].

Research argues that Citizen Science has the potential to generate new scientific knowledge [1], [6], [7], create learning opportunities for members of the public [1], [7]–[10] and enable public participation in scientific research [1], [7], [8]. Research has proposed numerous potential outcomes in Citizen Science, but there is little systematic evidence that these outcomes occur widely in practice (see for e.g. [9], [11]). Specifically, there seems to be a lack of capacity in the field of Citizen Science to evaluate outcomes that are not related to scientific knowledge [9], [10], [12]. To this end, previous research on learning in Citizen Science initiatives has focused on whether participation has an effect on scientific literacy (see e.g. [1], [12], [13]) and content- or topic knowledge (see e.g. [14]). Some research has attempted to examine behavioral change outcomes (see e.g. [15]–[17]) in specific Citizen Science initiatives, but has tended to rely on conclusions drawn from self-reports through surveys.

Reflecting on the lack of evidence in the area, Kasperowski, Kullenberg and Mäkitalo [2] argue that there is a need to scrutinize whether science-for-society arguments for the benefits of Citizen Science as an approach in terms of empowerment and learning are justified. In a critical review of research related to informal reasoning regarding socio-scientific issues, it was concluded that just being exposed to socio-scientific issues is not enough to make people better at scientific reasoning [18]. However, while it might be difficult to achieve desired behavioral changes, it has been argued that socio-scientific issues may
still provide a forum for working towards them [18]. For example, in a study aimed at developing a better understanding of volunteer’s experiences in online Citizen Science initiatives, it was found that learning tends to be informal, unstructured and social [19]. The researchers also found a feedback loop between learning and sustained motivation and participation that entails that the more aspects the participants were involved in, the more they learned, and especially if there were possibilities for engaging socially in chats, forums or websites [19]. Such sharing of knowledge and expertise was also seen to be important in a study examining group interactions in the first year of participation in the New Zealand Garden Bird Survey through the lens of Communities of Practice (CoP) [20]. This research describes “the use of social media to support and encourage a diverse range of volunteer participants” (p.1) and concludes that the Facebook group they were studying functioned as an active CoP [20].

1.1 Aim and research question

In an ongoing study, I am examining the opportunities for learning in a Citizen Science initiative that uses Passive (or participatory) sensing. In this Citizen Science initiative, participants are collecting data on fine dust in the air (particulate matter; PM 2.5 and PM 10), from small digital monitors for automatic sensing that are placed outside, e.g. in their back yards [19], [22]. Even though the activities and outputs of this Citizen Science initiative are strictly technical, and are not specifically intend to promote learning about the science of air quality, the use of a social media discussion forum opens up for participants to interact and engage further in the context of sensing; air quality or air quality monitoring.

The aim of this ongoing study is to explore if participation in a Citizen Science initiative generates further activities and provides opportunities for learning beyond the narrow technical scope of the initiative. I am also interested in whether engagement in passive sensing of particulate matter leads to further engagement and informal learning in science-in-society initiatives and on socio-scientific issues more generally.

The research questions in this paper are;

- What conversations do the members of the social media discussion forum show most and least engagement in?
- What topics are the most abundant in the social media discussion forum?

2 METHODOLOGY

In this section, we will describe the case that this study is based on as well as the data collection and analysis.

2.1 Luftdata; the Citizen Science initiative

The Citizen Science project involved in this case is the Swedish (Luftdata), but the ideas behind the project comes from the Germany based Citizen Science project ‘Luftdaten Selber Messen’ (Measure Air quality yourself), sometimes also referred to as Luftdaten.info. The idea is to build own particulate matter monitors and to send data back for visualisation of the measurements on a world map, where you also are able to zoom in to a particular node to see variations in particulate matter.

Both the German ‘Luftdaten Selber Messen’ and the Swedish ‘Luftdata’ could be described as civic mobilization initiatives [2] but also as participatory sensing [22]. ‘Luftdaten Selber Messen’ is initiated by The Open Knowledge (OK) Lab Stuttgart and is also a part of the Real Laboratory for Sustainable Mobility Culture of the University of Stuttgart. This way, ‘Luftdaten Selber Messen’ is also qualifying into being a Co-created or Collegial project [23] but most participants (the members of the public) are only contributing by collecting data.

The OK Lab Stuttgart is a regional group that develops software applications and visualization that “help to simplify the everyday life of citizens, enable participation or improve communication between the government an it’s citizens” (https://codefor.de/en/ueber/ March 28th 2019). The OK Labs are initiated by Code for Germany through the non-profit association Open Knowledge Foundation Germany that are committed to “open knowledge, open data transparency and citizen participation” (https://codefor.de/en/ueber/ March 28th 2019). From the website of the Real Laboratory for Sustainable Mobility Culture we identified three research questions; 1) the effects on the air quality of the high traffic volume in Stuttgart 2) How high is the particulate matter pollution in residential areas off the Neckar River? 3) How
can the air quality in Stuttgart be measured and visualized in real time? (http://www.r-n-m.net/projekte/ , March 28 2019).

The social media community is called ‘Luftbubblan’ on Facebook, an open group with 606 members (as of April 16, 2019). The group discusses “what our air contains” and the main focus of the group is to establish monitors (in Sweden) “that measure PM2.5 and PM10 based on the Luftdaten.info initiative, but everyone is free to discuss all air-related in this group. Luftdata.se is the Swedish sister project for luftdaten.info.” (the authors translation from the “about” section of the Facebook group Luftbubblan, March 22nd 2019)

2.2 Data collection and analysis

To explore if the participation in Luftdata.se can be associated with further engagement and indicators of informal learning, I used qualitative methods to study the participants of a citizen science initiative through the initiative’s social media community. Data was collected through participant observation in the social media community. Later on, a survey and interviews conducted with participants will be analyzed for more in-depth insights.

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Use in Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social media data</td>
<td>Observation of text-based posts, comments, reactions, pictures, links and asynchronous conversations in the Luftdata.se Facebook group ‘Luftbubblan’ from April 21st 2018 to September 21st 2018</td>
</tr>
<tr>
<td>Internal data</td>
<td>Aims, goals, collaborations, intentions, project webpages (<a href="http://www.luftdata.se">www.luftdata.se</a> and <a href="http://www.luftdaten.de">www.luftdaten.de</a>)</td>
</tr>
</tbody>
</table>

2.2.1 Social media data

In order to explore if engagement in passive sensing of particulate matter can lead to engagement in socio-scientific issues and informal learning, I took an ethnographic approach working with participatory observation, but also collecting content, likes and comments from posts in the social media community ‘Luftbubblan’ on Facebook.

The particular aspects of ethnography that I used involved taking an active role as researcher in “observing, watching, seeing, looking and scrutinizing” (p.15) [24]. Through participant observation, I was able to establish a relationship with the actors by interacting with them in the situations, and hence learn about how and why they act as they do, in order to understand the meaning of their actions [24].

Since this is an ethnographic study of an online community, I also observed online behavior and experienced what it is like to participate in the Facebook group [25]. The study started with a lurking phase, where interactions were observed to familiarize myself with the online community [25]. After the lurking phase, data on the content and number of likes and comments on posts were collected.

I collected and coded 205 posts in the social media community of the Citizen Science initiative. These posts are from a five-month period between April 21st 2018 and September 21st 2018. The posts were coded according to date and main content (technical, science, policy or social). A post was coded as technical when the content of the post was more focused on technical and/or physical aspects. If a seemingly technical post talked more about monitoring or about the data than about technical aspects, the post was coded as having scientific content. Some posts were neither technical nor scientific, and were hence coded ‘social’ or ‘policy’. In a second round of coding in Nvivo12, more elaborate and content specific codes were used to establish patterns of the topics of conversations in the posts.

The number of likes and comments on the initial 205 posts were analyzed in Excel where I also identified the posts with most combined likes and comments. Since I did not analyze the likes on comments inside the threads responding to posts, I am not able to draw conclusions on the total number of interactions in the data at this time. With this in mind, the unit of analysis here is posts (and not their comments), and I coded the content and the number of reactions to each post in terms of likes and comments, but not the content of those comments.
3 RESULTS

Preliminary findings on participant activity in the social media community revealed the topics the participants interacted with and engaged in. They show that participants generally engaged in ways aligned with activities promoted by the Citizen Science initiative by organizing their own workshops to build more sensors, engage in peer support and in unusual data.

3.1 Findings from the social media data

The 205 posts analyzed each generated up to 31 likes and up to 50 comments. In total, the 205 posts had 1153 likes and 1023 comments, which gives each post a mean of 5.5 likes and 4.8 comments.

Of the 205 posts, 97 were coded as featuring primarily scientific content, 90 as technical, 14 as social and 7 as primarily having a content related to policy issues.

3.1.1 Engaging posts

The fourteen (14) posts that had the most reactions by e.g. liking had 15 to 31 likes or reactions each. They are categorized into the following topics: 1) building new sensors (9 posts), 2) other projects and sensors (2 posts), 3) one (1) post on comparing data from 13 sensors, 3) one (1) post with a link to a report on using wood for heating, and 4) one (1) post about starting a non-profit association. When coded, only two (2) had a scientific content, nine (9) a technical content and three (3) a social content. All but eight (8) of the 205 posts had at least one (1) reaction or like. Four of these posts with only one reaction had 10-22 comments. Three of these were posts that engaged peers in technical support and one of them were coded as science, since it evolved around how damp air influences the measurements on particulate matter.

---

Figure 1. Two of the most engaging posts in the selection from the social media discussion forum (with a translation from Swedish to English)

The 14 posts that had the most comments (posts with 15 to 25 comments) can be categorized into the following topics: 1) building new sensors and/or asking for support on technical issues (8 posts), 2) similar projects and other sensors (3 posts), 3) wildfires and data (2 posts), and 4) visualization of data (1 post). The majority (13) of these posts were coded as having a technical content and only three (3) as having a scientific content.

When looking at the combination of likes and comments, or the posts that attracted the most engagement, I found that 30 posts had a sum of likes and comments greater than or equal to 20. Only...
one (1) post had 15 or more likes and 15 or more comments (29 likes and 21 comments). This particular post was from a workshop where about 50 new sensors were built. Of these 30 most engaging posts (with most likes and comments combined), seventeen (17) were coded as technical, nine (9) as science, and four (4) as social. This most engaging category (combining likes and comments) overlaps in topics with the most liked and most commented posts. These most engaging posts are often longer and more elaborating on the content than other posts. They are also inviting to reactions and/or comments by statements or pictures, see Figure 1. Three of the top four most engaging posts are very similar to the workshop-post in Figure 1, with a picture from a workshop where monitoring several to many monitors are built. The most engaging posts are the ones technical support is invited, for example in connection to assembling the monitors.

3.1.2 Least engaging posts

Only two (2) posts didn’t get any reactions or comments. One of them appears to be a mistake, since another similar, but more elaborate post was posted shortly after. The other one is a link to a conversation about air-pollution and crime. When looking at the combination of likes and comments, I found that 61 posts had 4 or less comments and likes. These 61 posts had content coded as technical (24), social (2), policy (3) and science (32). The technical posts were simpler technical support questions (e.g. how to power the sensor) or links to sites with information on technical tools for visualization or other projects. The scientific posts consisted of links to sites with information or films on other projects and effects of air pollution. All but 12 of these 61 posts had more likes than comments. The 12 (without more likes than comments) had a technical content.

![Figure 2: Three of the least engaging posts in the selection from the social media discussion forum (with a translation from Swedish to English)](image)

Of the 27 posts with only one (1) reaction or like, thirteen (13) were coded as science and fourteen (14) as technical. The technical posts were similar to and somewhat overlapping with the technical content in the least engaging posts above, with simpler technical support questions or issues. The majority of the scientific posts in this category were related to monitoring issues of e.g. particulate matter, temperature or indoors (7). The other posts with scientific content in this category were links to other projects.

Almost 25% (51) of the 205 posts generated no comments. Of these, 32 were coded as having a scientific content, 15 as having technical, and 4 as having a social content. The posts in this category
were almost exclusively links to information on other sites. Also, six (6) of the posts with no comments generated 10-15 likes each. As can be seen by the examples in Figure 2; the least engaging posts are short and many just state facts or post links without elaborating on the content. They can only be differentiated from the other posts by the way they were presented, and not by their content. They were shorter, non-elaborate, and were not written in a way that invite other members to comment or react.

3.1.3 Engaging topics

The coding of the content in the posts confirms the findings on reactions and comments on the most engaging posts. The most abundant topics when coding the content of all the collected posts were; problem solving (32), other projects (30), other sensors (20), data (15), building sensors (13) sensors (11), and workshops (11). The patterns I found emerged around the following four topics 1) problem-solving and building new sensors (105 codes), 2) monitoring air pollution (86 codes), 3) Air pollution and effects of air pollution (35 codes), and 4) Data and visualizations of data (32 codes).

3.2 Findings in relation to previous research on Citizen Science

The social media discussion forum serves an important function where members give support to help each other with problem solving in the Citizen Science initiative. These activities were most abundant when members assemble and register a new monitor (often as new participants in the Citizen Science initiative), which is well in line with the findings from the online study of WeatherBlur [26].

New members often post pictures of their monitors and ask for technical support when needed, but most stop posting when their monitors are up and running. However, the ethnographic observations show that some of the new members seem to develop an interest in, and find a personal relevance in air quality monitoring. This finding of personal relevance has been described in previous research [9]. Such elaborated engagement tends to evolve after some time in the social media group after a few months, and is hence not always visible in the selection of posts analyzed for this paper. The phenomenon of evolving an elaborated engagement has been described as gaining “collective knowledge that increases the capacity of the socioecological community”(p.308) [14]. In another way of showing further engagement, some members also moved beyond the activities provided by Luftdata.se by visualizing data and in expressing a desire to monitor air pollutants not included in the initiative. Such shifts in behavior has also been seen by other researchers when examining group interactions in the first year of participation in Citizen Science initiatives through the lens of Communities of Practice [20].

The ethnographic observations in this study reveal that members engage socially by, for example, cheering on each other on showing pictures of their sensors. These findings confirm the conclusions described in previous research that a supportive nature and tone in combination with member driven conversations is encouraging dialogue [19, 20]. The findings in this study also confirms research argues that the opportunities for learning are unstructured, informal or incidental, and are related to the engagement in the social aspects of the project [19].

4 CONCLUSIONS

The most engaging conversations in the social media discussion forum were more often of a technical, rather than scientific character in the sense that they more often engaged people to react or comment by elaborating on the content of a post. The most engaging topics were related to problem-solving and building new sensors, and to the technical properties of air quality monitoring. However, the least engaging posts could only be differentiated from other posts by the way they were presented, and not by their content. They were shorter, less elaborate, and were often not formulated in a way that invited other members to comment or react. In terms of topics, those that received the most engagement were aligned with the aims of the Citizen Science initiative, but other topics were also abundant in the social media discussion forum such as conversations about air quality, effects of emissions, and about data quality and visualization. The latter topics could be seen as traces of engagement in the terms of the science-in-society movement, but more in-depth research is needed to determine if and how this engagement could be seen as learning.

ACKNOWLEDGEMENTS

I would like to thank all members of the Luftbubblan Facebook group.
REFERENCES


