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COMMUNITY CITIZEN INQUIRY: A TOOL FOR SUPPORTING CITIZENS, THE CASE OF NQUIRE

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Abstract

Community citizen science inquiry is a combination of two ideas: first, citizen science inquiry (mass participation citizen science and learning to be a scientist through scientific inquiry, (Herodotou et al, 2017), and a concern to involve participation by the members of a community for community purposes. We describe the work we have done on this topic developing from our initial experiments in supporting inquiry learning with school children using technology and describing how this work has developed through conducting a number of studies involving students in a university technical college, and distance education students, then widened into investigation of the ideas with members of the public conducting citizen inquiries. These experiences have been supported by the development of the web platform nQuire (<http://www.nquire.org.uk>) which is now the basis of our work.

Our approach to citizen inquiry is driven by a concern for the nature of the participation from which members of the public can benefit and goes beyond involving people solely as volunteer data collectors. We report here on our experiences of the different types of inquiries or missions which have run on the platform since 2018, and the views of some participants on their involvement. We also discuss the issues in developing our vision of community citizen science inquiry and a potential centre for democratising research.

Keywords:

Citizen science, Inquiry learning, community learning

Introduction

nQuire is a web platform to conduct investigations; it builds on research work conducted at The Open University UK around community-led citizen science, citizen inquiry and public engagement with research. Everyone, whether researchers or scientists in academic and non-academic organizations, or members of the public can contribute to advancing science and can use scientific methods to produce and use research evidence as needed. Our contention is that engaging in science inquiry, to whatever extent, opens up the process of being a scientist to members of the public. We have facilitated this approach through the design of a set of web-based and mobile technologies over the past fifteen years. This line of research is particularly relevant and timely now for a variety of reasons. Citizen Science is a growing trend, but current approaches are often limited to recruiting members of the public only to take part in experiments that have been designed by scientists and contribute data as volunteers, for example, using volunteers to record water or air pollution in an area or identify astronomical events. Curtis in her thesis work (2017) noted the growing trend in online citizen science projects responding in part to the data deluge offering scientists both an opportunity and a challenge and which coincided with the availability of digital tools both for communication with others and for analysis of data. The move to online citizen science was particularly intriguing. Her particular interest was in the opportunities for participation and engagement of members of the public and their motivations for participation. One key feature was that, for volunteers, participating in online citizen science projects offers them an opportunity to become involved in authentic scientific research for altruistic purposes but also to learn more about science. Curtis writes that the volunteers she surveyed valued this aspect of their participation and comments

projects have enabled scientists to process large amounts of data, utilise the diversity of human pattern recognition and problem-solving skills, and on occasion, have resulted in contributions to knowledge (Lintott et al., 2009, Khatib et al., 2011, Lane et al., 2013, Schmitt et al., 2014) p.314.

She provides helpful guidance for scientists setting up such activities to be sustainable in terms of suggestions about sustaining participation, recognising the difficulties of the task. She noted a particular motivation for participation in projects with an outcome contributing to the development of science for altruistic purposes.

Another motivation she identified was some participants who were interested in learning more science and more about science.

Our overarching aim for contributing to the development of community citizen science inquiry is that we wish to work with individuals and communities with limited experience of research to establish how best to engage them in designing the process of designing and running a scientific investigation.

Inquiry learning and personal inquiry

Citizen science has been for a long time a special interest for researchers in educational technology at the United Kingdom Open University. Even in the early years of the University in the 1970s and 80s there was an interest in harnessing its large UK-wide student population in collecting data to involve them and engage them in community-based inquiries. UK-wide studies were conducted with the assistance of students monitoring SO₂ pollution across Britain, distribution of drosophila, peppered moths or similar. Results from students' data collection were shared (on forms returned to Milton Keynes by post) and developed into TV programs feeding back the national picture provided by the students. These TV programmes were broadcasted by the BBC along with other OU educational programmes.

More recently, our team developed a research interest in examining inquiry learning. Our focus was involving students in the scientific methods of data collection, interpretation and analysis. Inquiry learning approaches to teaching science and the literature discussed the benefits and challenges of involving students in this teaching method. The main challenge is developing appropriate support for students in the inquiry learning process. Our research originally focused on school-based science education but more recently on informal science learning experiences.

Our vision developed through this work has been to open up the processes of citizen science so that participants can be involved in more stages of the inquiry process and thereby:

- widen the benefit for participants
- develop understanding of the scientific inquiry process among the public
- bring evidence-based considerations into community inquiries
- lead to better understanding of contemporary relevant issues and scientific controversies.

In contemporary society there is a desperate need for increasing the public understanding and engagement in science as we have seen during the covid 19 pandemic, the ongoing climate crisis and campaigns of misinformation and fake news in relation to democratic citizenship. There are also direct benefits for education by connecting informal and formal learning in science and about science using inquiry learning.

Our project started with an educational challenge- the development of an approach to science inquiry for young people in secondary schools. Our platform, nQuire, was first developed as a system to support scripted personal inquiry among young people at school (Sharples et al., 2015). The project was built on the challenge of harnessing the benefits of inquiry learning while using contemporary means of technology support (Scanlon et al., 2012). Also, the project's emphasis on personal inquiry where importance was placed on students working on investigating issues of personal relevance and significance was key. We interpreted personal inquiry as inquiry potentially relevant to the participants themselves, their environment, or their community. The computer-based toolkit we produced was designed to guide school pupils while they conducted an inquiry from start to finish. These inquiries could involve classroom lessons and data collection, or other work conducted at after school clubs, at home, and outdoors in field sites or museums or libraries, most often requiring activity in at least three of these sites e.g., classroom, field work and home but also in several different configurations. We found that the toolkit was used successfully, and in particular '*effectively supported the transition between individual, group, and whole-class activities and supported learning across formal and informal settings*'. (Sharples et al., 2015, p. 308)

A key output of this first project was the design of the platform, nQuire, and an underlying model of the inquiry process - a pedagogical approach which underpinned it. This output was taken forward in several ways: as part of the development of the Open University's Open Science Laboratory with the Lab partially supported by a grant

from the Wolfson foundation, and as part of a Nominet Trust funded project with Sheffield University Technical College. Our development of software to support our development of community citizen science inquiry occurred through the evolution of the various instantiations of nQuire (described variously as Activity Guides, nQuire-it, BBC Tomorrow's World nQuire).

A connection with Higher Education arose with the opportunity of working as part of the Open Science Laboratory a project supported by the Wolfson Trust. This opened up new possibilities for investigating inquiry learning with nQuire, extending the experience of using nQuire from within secondary education to undergraduate courses and university outreach activities. It also represented an opportunity to investigate citizen inquiry. As elements of the Open Science Laboratory were designed to include citizen science and adapted for access by the public, we were able to develop an activity. The Moon Rock Explorer as an example (Villasclaras-Fernandez et al., 2013). The Moon Rock Explorer was a prototype demonstrator and test-site for citizen inquiry. It provided a self-managed investigation into Moon geology for those with no previous knowledge of Moon rock or geology. A user accessed the system through a public URL and was presented with a video introduction to moon rock and an appeal to 'Investigate Moon Rock'. It had three features which extended the possibilities of using nQuire: a simplified representation of the inquiry features, integration with other scientific tools (the Virtual Microscope which was also available in the Open Science lab) and the addition of online communication tools.

Funding from the Nominet Trust allowed members of the nQuire team also to work with more teachers and pupils. Collaboration with Sheffield University Technology College, which specializes in creative technology design for children aged 14-19, allowed us to work with young people as full partners in design, implementation and testing in the nQuire: Young Citizen Inquiry project. Sheffield University Technical College (UTC) is a technology college specialising in project-based work in collaboration with industry. The outcome was the collaborative development of set of sensor tools on mobile devices (see Sharples et al., 2017) which would engage the students in practical science investigations. A design workshop with students aged 14-15 developed the initial interaction design and example investigations. Development of Sense-it (Sharples et al. 2017) then continued at The Open University (OU), with trials among OU staff members and with Sheffield UTC.

Sharples et al. (2015) wrote on this experience that typically

'an individual or group will initiate a new investigation (or 'mission') around a question or topic of interest or concern. They will encourage others of all abilities, including trained scientists, to join and contribute to the mission. All the data collected as part of the mission is made visible and available for download and sharing. As the mission progresses, the participants discuss the topic online, through comments and replies linked to the mission and each item of data, and attempt to reach a consensus about the findings. Social network features allow users to 'like' data items and be notified of comments and likes from other users. Themes (such as 'investigate the weather') can combine a set of missions with differing aims, methods and contributor. (p. 367)

This work developed alongside the work of a PhD student who was to investigate what was necessary to provide a community of practice round personally driven investigations or now called, missions (see Aristeidou et al., 2017).

This pattern of continuing work on inquiry and investigation came to the attention of the BBC who have had a long history of engaging the public in science via their Lab UK initiative (see [BBC Lab UK - Wikipedia](#)). An approach from people who had worked on Lab UK and the relaunch of an iconic BBC brand as Tomorrow's World led to a major investment by the BBC/OU partnership in the development of Tomorrow's World nQuire. This most recent version of the nQuire platform was supporting online science investigations. These allow the public to participate in science investigations linked to TV and radio broadcasts. This project led to a redesign of the nQuire tools aimed to engage members of the public in being fully engaged citizen scientists. That is, by involving them in designing experiments, recruiting participants, analysing findings and sharing results, we want to empower individuals or groups of citizens to design their own investigations, and in addition have experienced scientists offer support and assistance. This holds great potential as an approach as citizens can understand how science works, tackle problems in their communities or do investigations meaningful and relevant to themselves. The process of setting up an activity on nQuire means that they engage with the scientific method to set up an investigation. Our contention is that engaging in informal science activities may involve a process that

can promote the development of critical thinking skills and argumentation. This is an important skill given the increasing demands on citizens to make sense of information for scientific claims and the possibility of misinformation and contested science in the public sphere.

The Tomorrow's World nQuire Project has developed a set of enabling technologies for supporting citizens' participation in scientific activities. In particular, the nQuire platform hosts at the moment, more than 200 investigations set by individuals, organisations and schools worldwide and more than 250,000 contributors. nQuire allows anyone to set up a new mission with mobile phones as data collectors, recruit other people to take part, and run a social network to discuss the data and restore results. This research connects to the mission of the Open University because it explores extending the involvement in citizen science projects to members of the public in terms of setting up missions, and in developing learning about science, and science concepts. We wish to work with members of the public in a variety of ways not just as data collectors, although recruitment to scientific endeavours is a valuable activity. We want to use our experience of the impact of involving people in personal inquiries.

Since the 2018 redesign of nQuire, 39 investigations have been conducted. The scale of the missions ranges quite widely with contributions from participants in individual missions ranging from 20 to 230K. Our largest mission was the BBC Garden Watch. Most of the missions have involved some scientific focus, for example, GardenWatch, birds, starling murmuration, pollinators (e.g., bees), mammals, worms, or climate related missions for example, heatwaves, climate anxiety, and other science topics such as astrobiology. Some missions were related to psychology, such as cognition, and the therapeutic value of sounds of nature, and some related to educational topics in particular on educational technology and online learning. Many of the missions involved academic researchers from a range of Universities, research organizations and charities.

Outcomes

We have captured the impact of using nQuire on learning and development, such as increased awareness and behavioural change, through a survey of 150 nQuire participants. This produced evidence of how participation in research activities via nQuire can enable life-long learning and achieve engagement with science (Herodotou et al., 2022). Herodotou writes: *'The main motivation for taking part in a scientific study on nQuire was to contribute to research and science (59%). A number of other participants participated because they believed that helping with science is important (13%) or had an a priori personal interest in the topic of the investigation (11%). 10% wanted to learn more about the topic of the investigation, 5% wanted to experience what is like to participate in a CCS project A majority of 48% said they know a little more about the topic of the mission, and 8% a lot more about it'. (p.15)*

However, there was less confidence in learning more than a little about a topic and in being interested in or confident in setting up their own missions. Herodotou et al. write:

'the transition from participating to creating scientific investigations is not a straightforward one; we observed a great majority of participants reporting that it is unlikely or highly unlikely that they would create their own mission. Amongst the factors explaining these perceptions were a lack of knowledge and skills for designing a study, a lack of support, and a lack of time'. (p. 17)

Conclusions

Our work has been to investigate inquiry learning and then to develop a distinctive approach to citizen science, community citizen science inquiry which is distinctive in privileging the idea of learning by engagement in such activity. The synergy of this activity of public engagement and public participation with the OU mission to be open to people, places, methods, and ideas is important to us. Having designed free online tools which are open and accessible to all, we have started to put in place an infrastructure which would empower citizens to set up their own research projects, an important enabler for digital citizenship. This facilitation of citizen engagement together with the potential to attract, inform and engage young people, or adult students by involving them in formal or informal inquiries has encouraged us to continue our exploration of this theme. We see how this approach can promote educational opportunities in line with the OU vision for social justice. We want to extend the reach of this initiative to many more people, including those from disadvantaged backgrounds.

We have described here how we take a democratic view of citizen science. We see members of the public as very important in the process, and in our work extend and encourage opportunities for involvement that are not limited to volunteering their time as data collectors, or being part of a crowdsourcing activity that is directed to addressing the questions of other scientists. This type of activity has its place obviously, and can lead to a sense of fulfilment by contributing to the creation of scientific knowledge, and as we saw in the work of Curtis, these activities can be motivating. However, as we have described here we see the potential benefits of citizen science approaches as being much more wide reaching than this. We are exploring the potential of a centre for democratising research connecting with our vision of opening up the research process to more people. This chimes with contemporary notions of participants as co-investigators.

To make progress with this ambition we need to develop our expertise in this area further. In terms of the findings of our survey of participants, despite some positive outcomes we have work to do to raise awareness of all the possibilities and the benefits of conducting community citizen inquiries. For individuals moving from the role of participant to creator of missions requires a better understanding of the potential role that using systems like nQuire can play in helping communities and individuals to collect evidence to underlie decision making in their community. To successfully do so, we are exploring further the need for training to support the skills to design and carry out investigations.

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