Science Capital and Science Identity and Learning Through Citizen Science

Co-Chairs
Katherine Mathieson, British Science Association, UK
Rick Bonney, Cornell Lab of Ornithology, USA
Richard Edwards, Faculty of Social Sciences, University of Stirling, UK
Tina Phillips, Cornell Lab of Ornithology, USA

Supported by funding from the Science Learning+ Programme, with thanks to the Wellcome Trust, NSF and ESRC
Aims of Session

• to explore existing research and practice in the areas of learning, science capital and science identity within citizen science; and

• identify possibilities for future research and practice on how science, learning and civic capacities can be enhanced through citizen science in mutually reinforcing and beneficial ways.
## Structure of session

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<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>1.30pm</td>
<td>Introduction – Katherine Mathieson</td>
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<td>1.35pm</td>
<td>Short introductions to the six contributions to the session</td>
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<tr>
<td>2.05pm</td>
<td>Roundtable group discussions – 1-2 presenters per table</td>
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<td>2.35pm</td>
<td>Discussion groups identify 1-2 questions/issues for future research and practice for plenary</td>
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<td>2.45pm</td>
<td>Plenary/feedback session – Rick Bonney</td>
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<td>3.00pm</td>
<td>Finish</td>
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Learning outcomes of citizen science

• interest in science and the environment;
• self-efficacy;
• motivation;
• knowledge of the nature of science/science literacy;
• skills of science inquiry;
• stewardship and behaviour.

*We know less about the learning processes – how people learn through citizen science*
Science identity & science capital

• Science identity – self-identification with science and scientists, and identification by others as having positive dispositions towards science

• Science capital – the social and cultural resources that dispose people to participate in science activities, education and careers based upon:
  • scientific literacy;
  • scientific-related values;
  • knowledge about transferability of science in the labour market;
  • consumption of science-related media;
  • participation in science learning contexts outside educational institutions;
  • knowing people who work in a science related job;
  • family science qualifications;
  • talking to others about science.
Contributions

• Examining how participation and engagement in citizen science influence learning: a mixed methods, collaborative research project, Tina Phillips, Cornell Lab of Ornithology, USA

• Evaluating learning in online Citizen Science: reflections on a mixed methods approach, Laure Kloetzer, University of Neuchatel, Switzerland

• Considering external resource use in forum discussions as an indicator of citizen scientist learning, Thomas Hillman and Åsa Mäkitalo, University of Gothenburg, Sweden

• Exploring the relationship between educational background and learning outcomes in citizen science, Richard Edwards, Diarmuid McDonnell, Ian Simpson, University of Stirling, UK

• Designed for Learning: impacts and future direction of the Vital Signs program, Sarah Kirn, Gulf of Maine Research Institute, USA

• Improving participation in citizen science using the Science Capital concept – a workshop exploration, Neil Bailey, Earthwatch Institute
Exploring Engagement and Science Identity through Participation in Citizen science

Examining how participation and engagement in citizen science influence learning: a mixed methods, collaborative research project

Research Questions

• Q1: What are the dimensions of citizen science engagement across different types of projects?
• Q2: What is the relationship between participant engagement and science learning outcomes?
• Q3: How does degree and quality of citizen science participation develop and/or reinforce science identity in participants?
Question 1: What are the dimensions of citizen science engagement and how can we measure these dimensions across different types of projects?
Question 2: What is the relationship between participant engagement and science learning outcomes?
Question 3: How does degree and quality of citizen science participation develop and/or reinforce science identity in participants?
Project Partners

Contributory *(scientist driven)*

Co-created *(community driven)*

- NestWatch
- Monarch Larva Monitoring Project
- Community Collaborative Rain, Hail, and Snow Network
- Hudson River Eel Project
- Global Community Monitor
- Alliance for Aquatic Resource Monitoring
Phase 1: Interviewee Demographics

Engagement level of interviewees by project

- MLMP (12)
- NW (12)
- CoCoRaHS (12)
- EELS (12)
- ALLARM (10)
- GCM (14)

# of Participants

- LOW
- MEDIUM
- HIGH
Dimensions of Engagement

**Behavioral**
- Data collection
- Submission
- Data exploration & analysis
- Communication

**Affective**
- Interest
- Commitment
- Motivation

**Social**
- Shared knowledge
- Mutual resources
- Social connections

**Effort**
- Duration
- Frequency
- Intensity
- Change over time
Next Steps

Motivation
- Effort/Intensity
- Activities (12 items, Range 0-48)
- Interest
- Connectedness

Participant Engagement Metric

Individual Learning Outcomes
- Self-efficacy
- Skills of Science Inquiry
- Environmental Stewardship

What’s missing?
Is this helpful to the field?
Where does science capital fit in?

#ECSA2016
Evaluating learning in online Citizen Science: reflections on a mixed methods approach.

Laure Kloetzer, Institute of Psychology and Education/University of Neuchatel, Switzerland
Daniel Schneider, Julien da Costa, Oula Abou-Amsha, TECFA/University of Geneva, Switzerland
Charlene Jennett, UCLIC/ UCL, Great-Britain

The Citizen Cyberlab Research project was funded by EU FP7.
• Citizen Cyberlab’s goal:
  • Understanding and enhancing (informal) learning outcomes and processes in Citizen Cyberscience

• Research questions:
  • What are volunteers learning through participating in online CS?
  • How are they learning?

• Building a collaborative framework for evaluation with heterogeneous CS projects
# Mixed-methods analysis

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<th>Eyewire</th>
<th>Transcribe Bentham</th>
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What do we learn thanks to which methods?

Observations

Learning processes
- Passive participation
- Active participation: doing
- Active participation: doing - community - competition

Learning outcomes
- No learning outcome except understanding of the volunteer computing
- Limited learning outcomes: BOINC mechanics - some technical concepts and skills
- Using external resources
- Using project documentation
- Interacting with others
- Personal creations
- Transforming the environment

Interviews

Learning outcomes
- Contributing to the project
- Pattern recognition
- On topic knowledge and skills
- Scientific literacy
- Off topic knowledge and skills
- Personal development

Feedback loops

#ECSA2016
What do we learn thanks to which methods?

Survey (ILICS, 2500 participants, 925 full answers)

- higher order learning is related to active and social learning within a virtual community of learning
- 37.5% of the participants claim that participation in a CS project helped them discover a new field of interest
- heterogeneity of learning outcomes and processes: people learn different things, in different ways
Complexity of CS field, complementarity of research methods

• Observations and interviews take a lot of time, but they enabled us to get a deep understanding of the perspective of the participants, as well as interaction between project features, interactions in the project, and ongoing learning dynamics;

• The pre-post surveys proved difficult to implement and provided “dirty” data;

• The one-shot general ILICS survey provided confirmation of most of our hypotheses (for example on the importance of social dimensions for learning, diversity of learning outcomes and learning paths, as well as the very low correlation between level of education and perceived learning). They confirmed also the lack of correlation between project type and learning.

• User analytics provided basic information on participation (esp. relation between promotion events and participation, for example) and a typology of users. In a case (the complex particle physics game) they also helped us check whether the participants were following the “right” path in the game.
Considering external resource use in forum discussions as an indicator of citizen scientist learning

Thomas Hillman & Åsa Mäkitalo
University of Gothenburg, Sweden

Project funded by the Marianne & Marcus Wallenberg Foundation
Where is citizen scientist learning in classification projects?

- Classification tasks tend to deliberately require low skill levels
  - Little interaction makes learning difficult to see
- Communities of volunteers develop around classification tasks
  - Activity in these communities is a rich source for finding learning
- The resources citizen scientists use are visible in their discussions
  - References to scientific resources outside the citizen science project are clearly identifiable through URLs
- Changes in resource use can be an indicator of learning
  - Drawing on a sociocultural conception of learning as the appropriation of cultural tools (or resources)
Resource use trajectories on Galaxy Zoo
New astronomer resource use shifts

• From popular to scientific resources
  • e.g. news story on astronomy to astronomical database

• From curating content to formulating arguments
  • e.g. sharing a type of astronomy image not available in Galaxy Zoo to using that image to argue for a particular interpretation of a Galaxy Zoo object

• From soliciting to providing guidance
Key points

• Discussion forums provide rich data for understanding learning amongst citizen scientists
• Appropriation of scientific resources is a strong indicator of scientific literacy
• Resource use is a readily available attribute of discussion forum activity
• Trends in resource use are visible in terms of quantity, type and usage
• Inexperienced astronomer new members are discernable from experienced astronomers
• Progression along learning trajectories is visible for new members as they successively appropriate scientific resources
Exploring the relationship between educational background and learning outcomes in citizen science

Richard Edwards, Diarmuid McDonnell, Ian Simpson
University of Stirling, UK

Funding for this project was provided by the British Academy, UK.
Survey

- Wetland Bird Survey - data for the conservation of non-breeding water bird populations and habitats. It began in 1947, and has around 3,000 volunteers participating in synchronised monthly counts at specific locations.

- The Nest Record Scheme gathers data on the breeding success of UK birds by asking volunteers to find and follow the progress of individual birds' nests. It started in 1939 and has around 660 active volunteers.

Response rate for survey – WeBS (23%), NRS (38%); 54% aged 61+
Ornithology only studied formally by 12% of volunteers.
Findings

• Relatively the learning outcomes of citizen science are more significant for those with lower prior educational qualifications;

• While significant numbers of contributors have school-level qualifications in sciences, proportionally less have formally studied sciences beyond school;

• Learning outcomes are linked to project design – dependent on types and levels of engagement in activities;

• Dimensions of science capital – e.g. family and peer support - may not be as significant for participation as theory currently suggests;

• The impact of participation in citizen science on dimensions of science capital – e.g. engagement in science leisure and cultural activities - is negligible.
Vital Signs

Sarah Kirn

Two design decisions and their lasting impact on learning

www.vitalsignsme.org
Set novice participants up for success

• Protocols
• Resources
Invite diverse data types

- Digital pictures
- Measurements
- Sketches
- Descriptions
- etc.

Vital Signs participant 6BP19
Discussion

• Can these types of learning supports be added to or wrapped around citizen science efforts?

• Can citizen science experiences build science capital in participants?
Improving Participation in Citizen Science using the Science Capital Concept

Dr Neil Bailey
May 2016
Earthwatch & Their Participants

- Environmental NGO with over 40 years’ experience of delivering citizen science projects.
- Gathering scientific data + learning experience
- Interest in the environment/science + alter personal behaviour.

Creating Knowledge. Inspiring Action.

- Is Earthwatch ‘preaching to the converted’?
- Reach out to the disenfranchised to build a wider interest in environmental issues & science?

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Using Science Capital to widen participation?

- Engage wider audiences in citizen science (key barriers to participation?)
- Increase environmental/science knowledge (adapt project design)

  - **Science Related Cultural Capital**
    - An individual’s scientific literacy (do they think like a scientist)
    - Individual’s disposition to science/transferability to labour market
  
  - **Science Related Behaviour**
    - Consumption of science related media
    - Participation in informal science learning
  
  - **Science Related Social Capital**
    - Knowing someone who works in a science job
    - Parental science qualifications
    - Talking to others about science
    - Future science affinity
    - Science Identity - regarded as being scientific?
  
  - **Social factors**
    - Class, Gender, Ethnicity
    (from Archer et al., 2015)

(from King’s College, London)
Example Earthwatch CS Projects

Creating Knowledge. Inspiring Action.
“What practical interventions & design changes can be implemented to boost SC & widen engagement in cit science?”

Science Related Cultural Capital
An individual’s scientific literacy
Disposition to science/ scientific jobs

Science Related Behaviour
• Consumption of science related media
• Participation in informal science learning

Science Related Social Capital
• Knowing someone who works in a science job
• Parental science qualifications
• Talking to others about science
• Future science affinity
• Science Identity - are you scientific

Social factors
• Class, Gender, Ethnicity

Relevance – Results create ‘actionable knowledge’ with (local) impact

Tiered involvement beginning with every day actions (e.g. #, Instagram images)

‘Rock Star Scientists’ (Brian Cox effect 52% rise in physics apps)

Exciting/Relevant social media and communications

Changing attitudes – gamification & acknowledgement increase ‘science identity’

Targeted projects at low income groups & females

Creating Knowledge. Inspiring Action.