Item number	Title/reference (academic style) name initials (year) title, publisher, volume, pages	Name of reviewer
5	Phillips, T.B., Ballard, H.L., Lewenstein, B.V. and Bonney, R., 2019. Engagement in science through citizen science: Moving beyond data collection. <i>Science Education</i> , 103(3), pp.665-690.	Karl Donert

Review of findings / main outcome

This paper focuses on citizen engagement in citizen science activities. It attempts to qualitatively characterize citizen science engagement across multiple projects and from the perspective of the participants.

They suggest engagement cannot be measured by quantifying data contribution outputs alone, as this leaves critical gaps in what engagement actually means. The participants may take part in multiple scientific activities including collecting and submitting data, formulating hypotheses, asking and answering questions, interpreting and analyzing data, and using data as evidence and even presenting results to stakeholders.

The study aims to identify the most relevant and important features of citizen engagement.

The study analyses the interviews of 72 participants from six different environmentally based projects.

 TABLE 1
 Summary of project description aligned with situated learning theory characteristics

NestWatch (Nestwatch.org) Doxes Contributory; monitoring bird nest boxes Doxes Individual, some peer to-peer interactions online Contributory; counting monarch larvae on milkweed plants Community Collaborative, Rain, Hail, and Snow Network (cocorahs.org) Hudson River Eels Estuary Project (dec.ny.gov/lands/49580.html) Contributory; counting monarch larvae on milkweed plants Contributory; monitoring bird nest to-peer interactions online data retrieval, online data retrieval, online and in-person materials and training Collaborative; measuring precipitation events Collaborative; counting glass eels Collaborative; counting glass eels Contributory; monitoring bird nest to-peer interactions online data retrieval, online data retrieval, online data ollection, online data retrieval online materials and training Nest boxes, binoculars, field guide; paper and online data retrieval, online materials and training Rain gauges, measuring sticks, online data entry and retrieval online materials and training Count of the following plants of the peer interactions on line data entry and retrieval online materials and training Count of the following plants of the peer interactions on line data entry and retrieval online materials and training Count of the following plants of the peer interactions on line data entry and retrieval online data entry and retrieval			Durit to an and	
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Estuary Project (dec.ny.gov/lands/ 49580.html) Alliance for Aquatic Resource Monitoring (www. dickinson.edu/ allarm) Co-created; monitoring air quality Monitor peer interactions in person person peer interactions in person data retrieval, in-person conductivity meters, paper, are online data collection; online data retrieval, in-person training Group, most peer-to-peer interactions in person Group, most peer-to-peer interactions in data collection, in-person Air monitoring buckets; paper data collection; online data collection, in-person data retrieval, in-person Air monitoring buckets; paper data collection; online data collection, in-person	Collaborative, Rain, Hail, and Snow Network		to-peer interactions	online data entry and retrieval,
Resource quality peer interactions in conductivity meters, paper, ar online data collection; online data retrieval, in-person training Global Community Co-created; monitoring air quality Monitor Group, most peer-to-peer interactions in data collection, in-person data collection, in-person	Estuary Project (dec.ny.gov/lands/	Collaborative; counting glass eels	peer interactions in	paper data collection; online data retrieval, in-person
Monitor peer interactions in data collection, in-person	Resource Monitoring (www. dickinson.edu/	,	peer interactions in	data retrieval, in-person
	Monitor	Co-created; monitoring air quality	peer interactions in	data collection, in-person

It undertakes an examination of cognitive, affective, social, behavioral, and motivational dimensions of engagement involved in citizen science projects.

Major nodes	Description		
Behavior	Observable aspects of participation—both the number and kinds of different scientific practices, tasks and/or activities that participants engage in as part of the project		
Motivation	The underlying psychological need for why someone does something expressed as initial cause for participation or why they stay involved in the project		
Affective/feelings	Expressions of feelings or emotions about specific activities, other people (friends, family members), or other living and nonliving things (plants, animals, places)		
Social/project connections	A sense of belonging to the project or the extent to which individuals feel allegiance to a group expressed through interactions with participants, project leaders, and connections to the larger scientific community		
Cognitive/learning	Thinking about the situated aspects of engagement, that is, applicable content and real-life contexts to support learning and individual reflection on their learning		

The results obtained related to each of these dimensions is discussed in detail. The authors suggest that all these components are important to engagement.

The authors present a Dimensions of Engagement framework to facilitate the innovation of new approaches and methodologies for studying engagement in citizen science and different forms of informal science education.

Dimensions of Engagement

Behavioral Activities Affective/Feelings • Collect/submit data • Concern • Share information • Communicate findings Surprise • Explore data • Interest/Excitement Ask/answer questions Efficacy Motivations Recognition/credibility • Intrinsic • Extrinsic Learning/Cognition Social/Project Connections • Experiential learning • Resources/artifacts Relationships Pre-existing knowledge Mutual resources Learning from others Shared knowledge • Reflection, awareness, • Role Expansion understanding Skills and behaviors

The Dimensions of Engagement Framework highlighted the many ways that participants in citizen science projects contribute emotionally, behaviorally, cognitively, and socially to this collective endeavour.