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Students doing citizen science on an unfolding pandemic

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Abstract: School-based science inquiry tends to focus on already answered questions. We describe how we used the COVID-19 pandemic in a high school citizen science unit for students to witness and engage in real-time science. High school students developed proposals to study questions about their experiences related to the pandemic. Teacher and student interviews and observations showed that this globally-relevant experience also offered a personally relevant context through which to understand the scientific process.

Introduction and conceptual framework

COVID-19 has brought science to the forefront of public discussion, and highlighted the importance of scientific collaboration and transparency at all levels of its process (Fry, Cai, Zhang & Wagner, 2020; Rempel, 2020). While this global event had serious implications for students' lives (illness, social isolation, shift to online schooling, inaccessibility of public spaces), it also created opportunities for authentic inquiry learning experiences. Whereas traditional science inquiry learning in US schools tends to focus on already answered inquiry questions (Furtak & Penuel, 2019; Linn, Gerard & Matuk, 2016), we saw an opportunity for citizen science (CS) to leverage the global relevance of the pandemic for students to witness and engage in the scientific process unfolding in real-time, and particularly around questions that were personally relevant to their experiences at the time. In classroom-based CS, students and teachers contribute to the work of scientists by generating research questions and participating in data collection and analyses (NRC, 2012). In this study, we ask: How can real-time phenomena, like a pandemic, support students in learning about the scientific inquiry process? We report on initial findings from our implementation of a CS unit on human behavior related to the pandemic.

This work is grounded in participatory science learning, an approach that emphasizes authentic problems, the social negotiation of knowledge, the roles of more knowledgeable others, reflection, and students becoming members of a community (Barab & Hay, 2001). Our design embodies the ideals of participatory science learning by supporting students' collaboration with peers and experts, encouraging them to identify and pursue personally and socially relevant questions, and guiding them through an authentic process of iterative inquiry and reflection. It is through this lens that we both designed the unit, and conducted our analyses.

Methods: Context, participants, and data

We collaborated with a science teacher at a private high school, Ms. C, to implement a 4-week long unit on brain and behavior (B&B) research in her class of 20 juniors and seniors (18 of whom participated in this study). The initial curriculum design focused on the relationship between environmental decision-making and human behavior (e.g. what leads to pro-environmental behavior, psychology of climate change). The unit's learning goals included introducing students to open science, ethics in human subjects research, B&B experimental study design, research proposal writing, and scientific peer review. Students' proposal development also leveraged a beta version of MindHive, a web-based CS platform, that facilitates the proposal, data collection, and analyses of research projects. During the unit, the beta MindHive platform hosted two B&B citizen science research studies (i.e. social influence and climate change, risk-taking in adolescents) designed by partner scientists. Students, via MindHive, participated in these studies and the unit also leveraged the studies as cases to teach experimental design, proposal writing, and introduce basic analysis. When the pandemic shuttered schools and forced us to move online just 2 weeks before implementation, our team opted to use COVID-19 as a relevant context for the aforementioned learning goals. This involved curriculum changes like integrating a lesson on the role of preprints and peer review that utilized active research about COVID-19. We also pivoted to supporting

students in developing inquiry questions about the pandemic and recast existing content (e.g., experimental design) in terms of studying pandemic-related behaviors (e.g., social isolation, disrupted routines, mask wearing, online learning). Our data include an interview with Ms. C and an interview with 2 students, asking them to reflect on their experiences implementing and participating in the unit respectively. We also collected draft and final research proposals from all four groups, field notes from synchronous class sessions, post-unit student reflections from 10 of the 17 students, and curriculum materials. Our preliminary analyses used open coding (Charmaz, 2014) to explore the impacts of contextualizing students' CS inquiry within an unfolding pandemic on students' attitudes toward, and understanding of the nature of the scientific process.

Findings

Our initial analyses show 1) how students' proposals gave them opportunities to pursue personally and socially relevant questions 2) how participating in a proposal writing process led to insights about scientific inquiry 3) how students' attitudes toward the scientific research process changed throughout the unit. Students' research questions were at once based in their personal experiences, as well as novel and globally relevant (e.g., "How is zoom school affecting student mental health and morale?"). In addition, students gleaned insight about authentic science as revealed in their culminating reflections like, "the interdisciplinary and cooperative nature of science… was something that I had not thought much about prior to this semester in science." Students also started to understand key facets of scientific inquiry like the iterative nature of scientific discovery and its relationship to experimental design in B&B: "I never really understood just how much research was required before going into an experiment. I always assumed that it was simply looking into something you want to test, but there's a lot of preparation involved for each experiment." Ms. C also underscored the value of a participatory science (Barab & Hay, 2001) explaining, "there is something about going through a process from beginning to end… when we're writing a lab report (in class), we'll often skip procedures. This experience was really thorough… This project brought new members into the class community; professionals with academic credentials; collaborating on a different level who wanted to know what students had to say and what they were thinking." Being in conversation with scientists and exploring authentic phenomena made the curriculum experience compelling and valuable. However, students found it difficult to effectively collaborate remotely, resulting in discordance over research questions, collecting background research, and designing tasks. Ms. C also noted that ideally synchronous class sessions would have been more student-centered, but online learning instead emphasized adult-led lessons.

Significance

This study shows the value of using an unfolding global event as a context for students to learn about the scientific process. It also demonstrates how CS learning can continue amid disruptions caused by the pandemic: By leveraging its global and personal contexts, we can engage students in investigating personally and socially relevant questions that also contribute to emerging knowledge about crises through open and participatory science.

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