

How Does Learners' Sociocultural Participation in Their Communities Shape Their Ideas About Climate Change?

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Introduction

We conducted a qualitative case study (Stake, 1995) to investigate the climate change ideas that one group of adolescent students expressed prior to formal instruction on climate change. We viewed students' ideas as being influenced by disciplinary content knowledge gained through school science learning experiences, and through learning experiences across other social and cultural contexts in which they participate.

Background

Students may become aware of climate change as a result of its presence in diverse sociocultural arenas, including:

- Political discourse (Albe & Gombert, 2012; Boon, 2010)
- Media (Boyes et al., 2008; Hansen, 2010; Svilha & Linn, 2011);
- School-based curriculum and instruction (Bodzin & Fu, 2014; Boon, 2010; Kiliç et al., 2008; Varma & Linn, 2012); and
- Out-of-school learning environments (Devine-Wright et al., 2004).

As a result, students may come to the classroom with varying prior knowledge and prior mindsets (Feinstein, 2015) regarding climate change. We argue that these ideas may have potential implications for developing and meeting instructional goals in the climate change education arena.

Theoretical Perspective

Our thinking was informed by Rogoff's (2003) sociocultural perspective, which posits that: "Humans develop through their changing participation in the sociocultural activities of their communities, which also change" (p. 398). We were interested in how students' social interactions within varied communities may shape how they engage with and come to understand climate change.

A sociocultural perspective is valuable for gaining insight into student learning related to climate change, a phenomenon experienced variably across places (U.S. Global Change Research Program, 2009) and interpreted variably across communities (Howe, Mildemberger, Marlon, & Leiserowitz, 2015). The scientific community continues to evolve in its climate change understanding and research practices; local communities are experiencing and continuing to determine how they will respond to climate change impacts; and school communities are evolving in their instructional practices around climate change, especially as they seek to align with the NGSS. In the midst of the changing practices of these communities and others, students asked to make sense of a complex and dynamic scientific topic.

Research Question

How does middle school learners' participation in the sociocultural activities of their varied communities inform their understandings of climate change?

Context and Participants

We conducted our study within the context of a suburban charter school in a Mid-Atlantic U.S. state, which employed a blended learning instructional approach. The school was located near a large university, within a county whose residents generally accepted that climate change was occurring (72% agreement), but were divided on whether climate change was caused by human activity (49% agreement) (Howe et al., 2015). However, a majority of local residents expressed concern about climate change (60% agreement) and believed that it posed a threat to future generations (62% agreement) (Howe et al., 2015). Within the school context, students were primarily middle class, though 17% were eligible for free or reduced-price lunch. The school was racially diverse with approximately 60% Black/African American students, 15% Latino students, 13% White students, 6% students of two or more races, and 5% Asian students. Participants in this study (N=39, 26 girls and 13 boys) were all in 6th grade and enrolled in a general science course.

Data Collection and Analysis

Multiple-choice Climate Science Knowledge Assessment Instrument (CSKAI). We used a researcher-crafted instrument, consisting of 18 multiple-choice items with distractors for each item. For select items, students were asked to provide written explanations (Hestness, McGinnis, & Breslyn, 2016).

Sample question: Which of the following would cause Earth's average global temperature to rise?

- Changes in the length of seasons
- Changes in the thickness of Earth's atmosphere
- Changes in the amounts of gases in the atmosphere
- Changes in the amount of heat from Earth's molten core

Why is your choice the best answer?

Drawings. All students were asked to respond to the prompt: "Draw what comes to your mind when you think about climate change. Please include yourself in the drawing, and some details about how climate change relates to your life or your community (if you think it does)." The purpose was to gain insight into students' climate change ideas, including their views of its implications for their own lives.

Content knowledge interviews. We used a researcher-crafted interview protocol with a purposefully selected subset of students (n=14) who completed the CSKAI. The interviews followed the sequence of climate change constructs included in the CSKAI (human activity, mechanism, consequences, and mitigation/adaptation).

Sample question: Temperature data from the past 100 years show that the earth is getting warmer. How does human activity influence this warming trend, if at all?

Sociocultural interviews. With a separate, purposefully selected subset of participants (n=15), we administered another researcher-crafted interview protocol designed to provide insight into students' sources of information on climate change and their senses of personal connection to the issue.

Sample question: Do you think climate change relates to your life? (probe: home, school, recreation)

Findings

1. Understandings prior to formal instruction on climate change (what the students brought to the learning environment)

Mechanism: Most students were aware that the atmosphere functions to hold heat energy to warm the Earth (77% on CSKAI) and that fossil fuels were increasing the amount of CO₂ (68% on CSKAI). However, some (42%) attributed global warming to ozone depletion (Fig 1); others (39%) attributed it to atmospheric thickening.



Human activities. On the CSKAI, a majority of students (81%) indicated that increases in atmospheric CO₂ were a result of increased fossil fuel use, and the recent increase in global temperatures was attributable to human-generated air pollution (74%). However students generally spoke about human activities releasing pollution/gases, and not specifically CO₂.

Consequences: On the CSKAI, a majority (77%) of students indicated that a warmer global climate would have impacts for humans and Earth's ecosystems, and that sea level rise would impact people who live on the coast (68%). Fig. 2 presents an example of how a participant represented sea level rise causing damage to homes.



Mitigation. Consistent with their widely shared view that human activities that rely on fossil fuels exacerbate climate change, most participants (84%) agreed on the CSKAI that driving cars less often would help to mitigate climate change. Participants also suggested actions such as using alternative sources of energy, government action, public education campaigns, planting trees, and recycling.

2. Sociocultural Activities that Informed Students' Understandings of Climate Change that They Brought to the Learning Environment

Students' participation in communities within and beyond the world of school appeared to inform their thinking about climate change. In particular, their interactions with **media** (e.g., Internet, television) and their **school-based learning experiences** (e.g., conversations with teachers) appeared to most strongly inform their ideas. However, it was less common for students to identify their climate change ideas as being informed by their family members or peers. These initial ideas about climate change—whether scientifically supported or not—led students to make connections between climate change and their **everyday activities**. That is, they not only came to the classroom with ideas about climate change as a science phenomenon, but also with initial ideas about how climate change was relevant to their participation in the activities of their lives.

Key Implications

In recognizing students' climate change understandings as linked to their participation in the activities of varied communities, a clear implication of our study is that educators should be informed of the need to develop pedagogical approaches that emphasize linkages between climate change and the communities and activities that matter to their students.



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