“It’s happening now”: Middle school students’ thinking about climate change

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Maryland and Delaware Climate Change Education, Assessment, and Research

Project Overview

Maryland and Delaware Climate Change Education, Assessment, and Research (MADE CLEAR)

NSF Phase I & II Climate Change Education Partnership (CCEP) grant

Partners include:

NSF
Towson University
University of Delaware
University of Maryland Center for Environmental Science
University of Maryland
University System of Maryland
mpt
Maryland State Department of Education – Preparing World-Class Students
Delaware
Sea Grant Delaware
Delaware State University
Center for Research and Evaluation – Lifelong Learning Group

A Project Objective Guiding This Study

Advance learning sciences research to create new understandings of how individuals from diverse backgrounds learn about climate change

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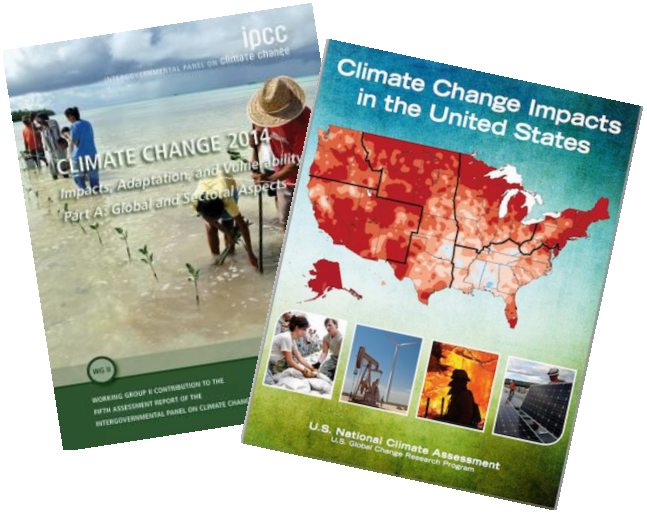
Advance learning sciences research to create new understandings of **how individuals from diverse backgrounds learn about climate change**

Aligns with conceptual change theoretical perspective

Aligns with sociocultural theoretical perspective

Rationale for Climate Change Education Focus

NEXT GENERATION SCIENCE STANDARDS



First set of U.S. national standards to explicitly include climate change

"Defining global challenge of our time" (U.N. 2014)

Already having regional and global impacts (U.S. Global Change Research Program, 2014; IPCC, 2014)

Background

- Students may hear about climate change through various channels within their social/cultural contexts (Bodzin & Fu, 2014; Boon, 2010; Boyes et al., 2008; Devine-Wright et al., 2004; Hansen, 2010; Varma & Linn, 2012)
- Students may come to the classroom with climate change ideas that are scientifically supported and not scientifically supported (Bodzin & Fu, 2014; Jin et al., 2013; Mohan et al., 2009; Shepardson et al., 2009)
- Students may vary in their concern about climate change and sense of its relevance to their lives (Byrne et al., 2014; Chhokar et al., 2011; Leiserowitz et al., 2011)

Study with Middle School Students

Approach: Case study (Stake, 1995)

Context:

- Mid-Atlantic U.S. state, vulnerable to climate change impacts (e.g., extreme weather, sea level rise)
- Suburban blended-learning charter school
- 6th grade science class, during NGSS-aligned *Weather and Climate* unit

Participants (N=31):

- 6th grade students; mostly middle class; racially and ethnically diverse

Climate Change in the Science Curriculum

- Two 75-minute blended learning sessions
  - Higher than U.S. average (Plutzer, McCaffrey, Hannah, Rosenau, Berbeco, & Reid, 2016)

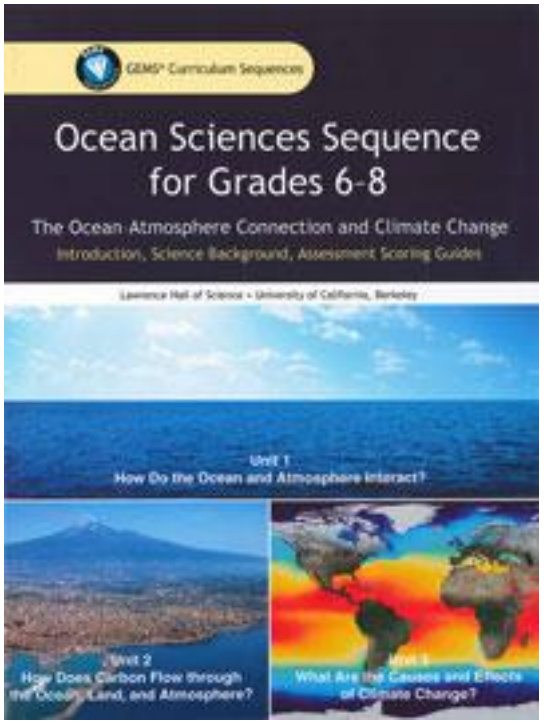
- Learning objectives:
  1. Describe greenhouse gases and explain their effects on the environment and on organisms
  2. Explain measures for reducing global warming

- Content:
  - Greenhouse gases (e.g., carbon dioxide), greenhouse effect, carbon footprint, global warming, climate change, roles of human activities

Human activities contribute to climate change.

Global warming causes glaciers to melt.

Additional Co-Taught Class Sessions



- Two 75-minute active learning sessions drawn from the GEMS Ocean Sciences Sequence (Lawrence Hall of Science)

- Content:
  - Day 1:
    - Sea level rise mechanism (thermal expansion, ice melt)
    - Climate change evidence (glacial melt, sea ice cover, sea level change)
  - Day 2:
    - Greenhouse effect, heat-trapping gases
    - Climate change mitigation/adaptation

Research Questions

1. What sources of information appear to inform 6th grade students' ideas about climate change?

1. What do 6th grade students know about climate change? (i.e., role of human activities, mechanism (greenhouse effect), consequences, and mitigation and adaptation strategies)

1. How do 6th grade students understand climate change as relevant to their lives?

Data Sources

Sociocultural interviews (pre)

- Subset of participants (n=15)
- Discuss sources of climate change information and personal relevance

Multiple-choice instrument (CSKAI)

- All participants pre- and post-instruction (31 completed)
- 18-items probing knowledge of:
  - Human activities
  - Mechanism
  - Consequences,
  - Mitigation/adaptation

Content knowledge interviews

- Subset of participants (n=14)
- Further discuss ideas about constructs assessed in CSKAI

Data Analysis

Sociocultural interviews (pre)

- Structural coding (Saldana, 2012) using NVivo software (QSR International)
- Analytic lenses:
  - Learners' sources of information on climate change
  - Personal relevance of climate change

Multiple-choice instrument (CSKAI)

- Scored pre- and post-assessments by construct
  - Human activities
  - Mechanism,
  - Consequences,
  - Mitigation/adaptation
- Examined selection of distractor options

Content knowledge interviews

- Inductively coded for key themes relevant to constructs
  - Human activities
  - Mechanism,
  - Consequences,
  - Mitigation/adaptation

Insights: Sources of Information

- Prior to instruction, learners primarily cited school and the media as sources of information; print media, family and peers cited less
- School as a trusted source of information; media varied in trustworthiness
- Media sources included news (usually TV), Internet, popular media for children/adolescents

Examples

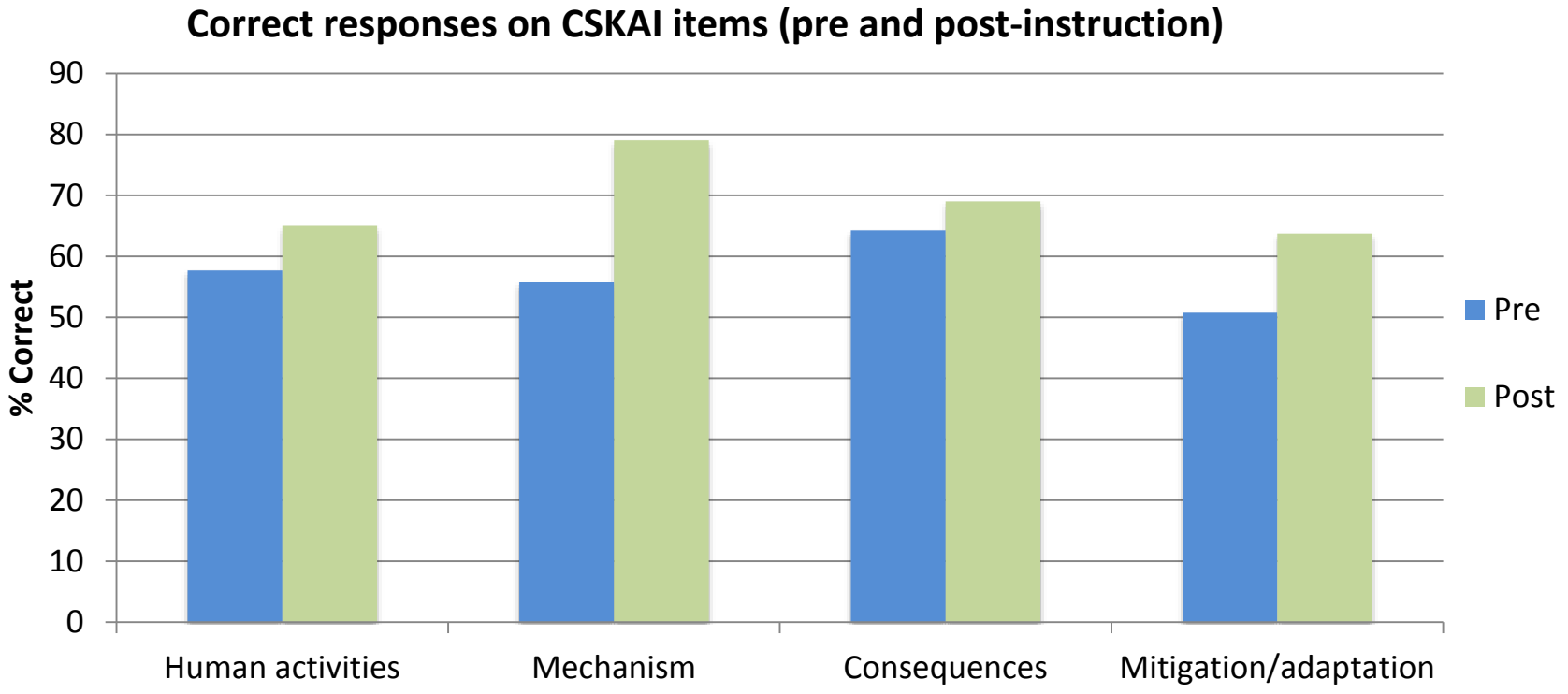
"[On the news] I heard that the gases from the factories are killing the atmosphere which is hurting the atmosphere and breaking it, which makes the sun's radiation and heat hurt… melting the polar ice caps and raising the waters and oceans. So it might be dangerous for the East Coast of the United States [and] who is around the coast."

(6th grade student Mateo)

"[On the Disney Channel show, *Jessie*, a character] blames global warming for bunches of things... Global warming is just an excuse to get out of things. Like they break something in the balcony, or outside. They blame global warming for it.... People just blame a bunch of things on global warming."

(6th grade student Ashley)

Insights: Climate Science Content Knowledge



Average score pre: 10.39 (SD = 3.77)

Average score post: 11.58 (SD = 4.30)

Example construct: Mechanism

Table 4.

Climate Content Knowledge Assessment Data for Mechanism

Item Number and Correct Response	% Correct Pre	% Correct Post
1. Which of the following would cause Earth's average global temperature to rise? *c. Changes in the amounts of gases in the atmosphere.*	39	68
8. Scientists believe that global temperatures are rising primarily because of: *b. increases in the amount of carbon dioxide (CO_2) from burning fossil fuels.*	68	84
14. What is the relationship between temperature and the Earth's atmosphere? The earth's atmosphere: *b. holds heat energy from the Sun to warm the Earth.*	77	77
17. Which of the following activities will lead to future intense storms? *a. Heat trapped by increased greenhouse gases*	39	87

Example construct: Mechanism

Table 5.

Climate Content Knowledge Assessment Alternative Conceptions for Mechanism

CSKAI Distractors Frequently Selected by Students		% Pre	% Post
1.	*b. Changes in the thickness of Earth's atmosphere*	39	23
1.	*d. Changes in the amount of heat from Earth's molten core*	16	6
8.	*c. a hole in the ozone layer allowing heat to enter the earth's atmosphere*	19	13
17.	a. *Ozone layer depletion*	42	26

Example construct: Mechanism

Table 6.

Climate Content Knowledge Interview Themes for Mechanism

Code Label	% Pre	% Post
Greenhouse gases trap sun's energy	36	64
Greenhouse Gases Escape into Space	29	36
Role of Ozone	29	29
Pollution, CO_2 Changes the thickness of atmosphere	7	14

Insights: Personal Relevance

- Students most frequently referenced climate change **impacts (consequences)** as personally relevant (e.g., extreme weather, health threats from pollution)

- When students connected climate change **causes** to their own lives, they referenced fossil fuel use, car use, electronics use, and pollution in general

- When students connected climate change **mitigation and adaptation** to their own lives, they discussed reducing fossil fuel use, limiting personal energy consumption; rarely addressed adaptation

Insights: Personal Relevance

"[Climate change] could affect me because storms... It could ruin my house and other people's homes... I might not even have a school. The school could be damaged... And, could be flooded and…ruined."

(6th grade student Kendra)

*[Personal relevance of climate change **consequences**]*

"We have to use computers and it prepares us for college, but I don't think that we should be plugging in to charge our laptops 24/7"

(6th grade student Alison)

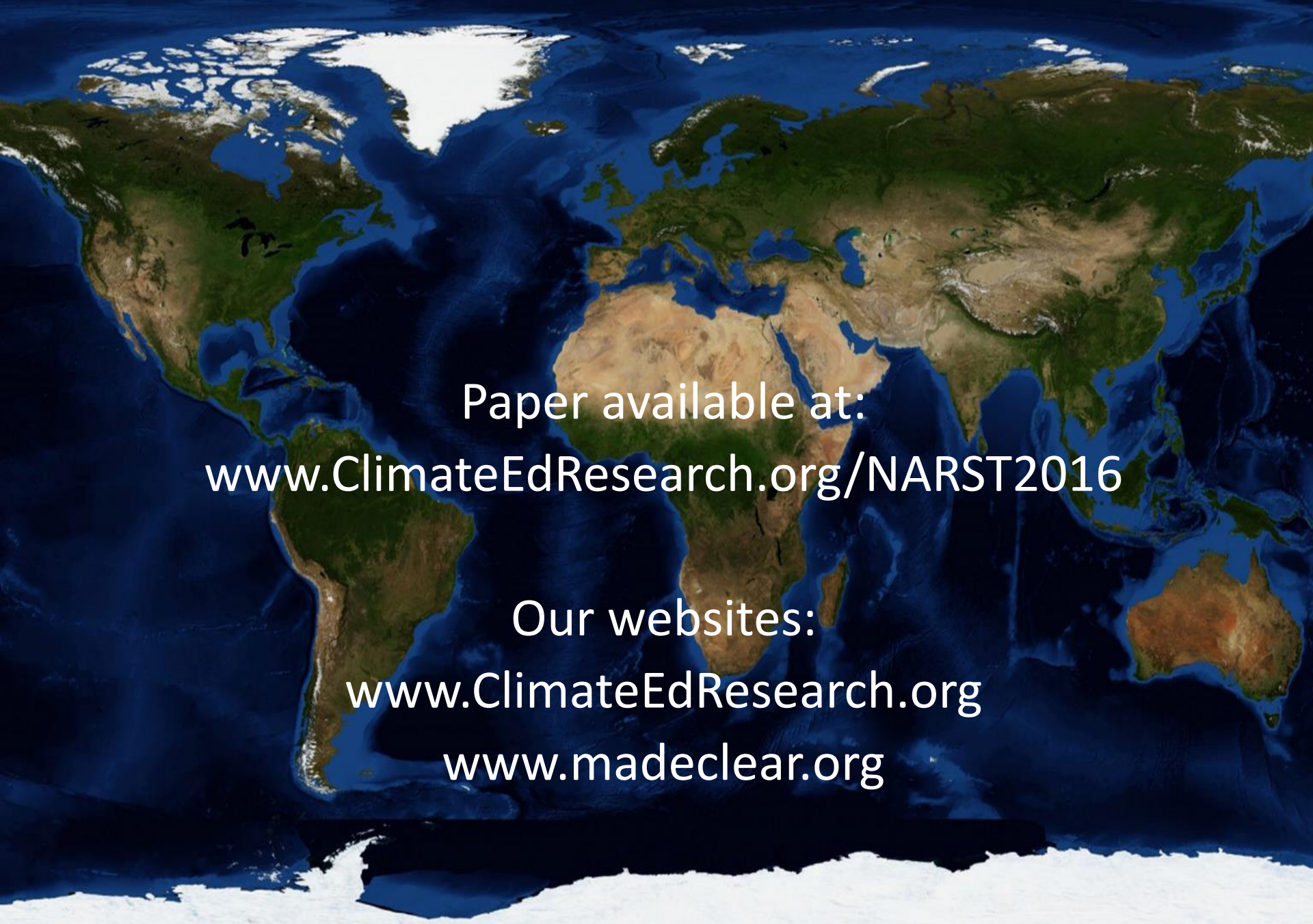
*[Personal relevance of **human activities** related to climate change]*

Synthesis

- Value of multiple perspectives on climate change understanding
- Possible linkages between in-school and out-of-school climate change learning
- Possible linkages between knowledge and personal relevance

Future Research with Middle School Students

- Examination of student thinking about climate change in other contexts and grade levels
- Examination of student engagement with other kinds of instructional interventions
  - Possibly related to interests and concerns students bring to the classroom



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