

Investigating Science Educators' Conceptions of Climate Science and Learning Progressions in a Professional Development Academy On Climate Change Education

University of Maryland:

Emily Hestness, J. Randy McGinnis, Wayne Breslyn,
R. Christopher McDonald, and Katy Wellington

University of Delaware:

Chrystalla Mouza, Nicole Shea



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Photo by Emily Hestness

Project overview

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

Multi-year project supported by NSF Phase I and II Climate Change Education Partnership (CCEP grant)

Partners include:



MADE CLEAR project objectives guiding this study

- **Advance learning sciences research** to create new understandings of how individuals from diverse backgrounds learn about climate change
- **Include climate change in professional development** for middle and high school teachers and informal educators
- **Assess approaches to professional development** that foster changes in teacher knowledge, skills, dispositions



Professional development and climate change



First U.S. national science standards to explicitly include the topic of climate change

Inclusion of climate change in teacher education and professional development can help teachers:

- **Increase content knowledge** related to climate change science (Lambert et al., 2012)
- **Become aware of relevant resources** to support teaching about climate change (Hestness et al., 2011)
- **Develop communities of practice** (Lester et al., 2006)



Learning progressions

- Descriptions of **increasingly sophisticated ways learners can think about a science topic** over time (Duschl, Schweingruber & Shouse, 2007)
- Generally organized into **different levels** of achievement (e.g., Alonzo & Steedle, 2008; Lehrer & Schauble, 2012; Mohan, Chen, & Anderson, 2009)
- Levels can serve as **diagnostic tools, instructional targets** (Lehrer & Schauble; Shea & Duncan, 2013)

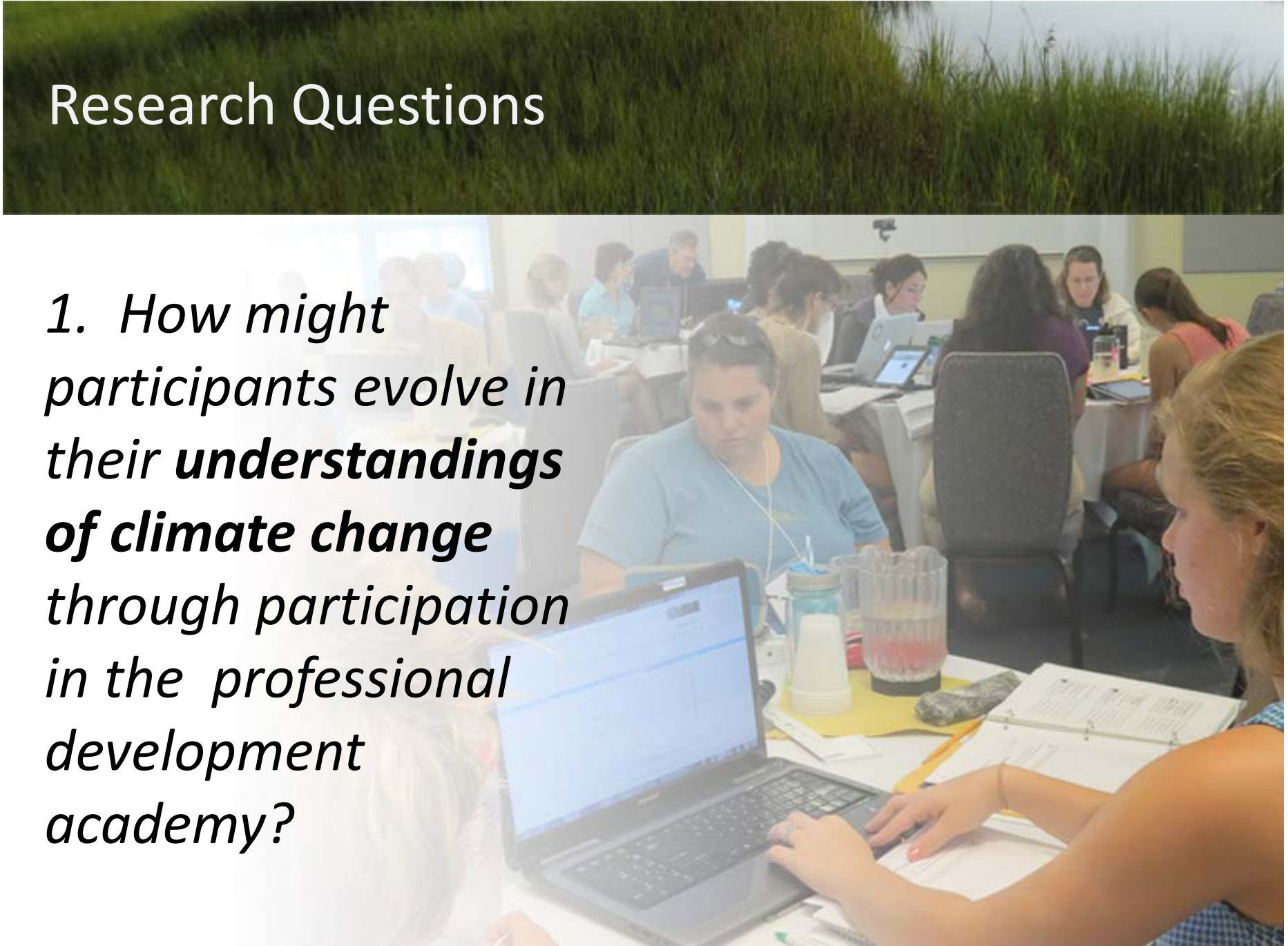


Professional development and learning progressions

- **LPs have the potential to coordinate curriculum, instruction, assessment** (Alonzo & Steedle, Berland & McNeill, 2010; Duschl et al., Furtak, 2012; Gunckel, Covitt, Salinas, & Anderson, 2012; Lehrer & Schauble; Shea & Duncan; Songer, Kelcey, & Gotwals, 2009)
- Emphasis on the **developmental nature of student thinking** over time (Furtak & Morrison, 2013)
- All responses as valuable **stepping stones to be leveraged** in instruction (Furtak, 2012)

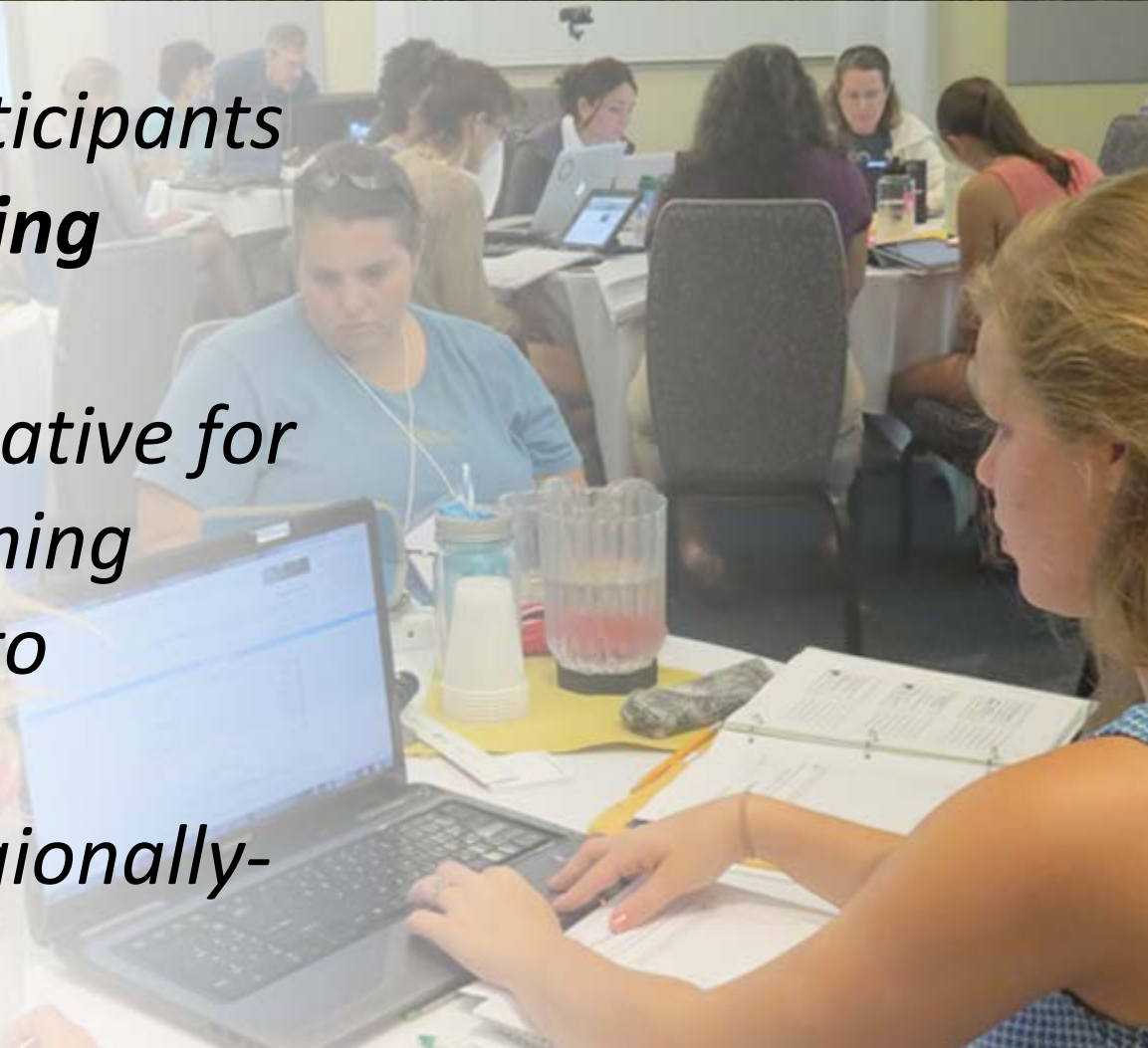
Research Questions

*1. How might participants evolve in their **understandings of climate change** through participation in the professional development academy?*



Research Questions

2. How might participants understand learning progressions as potentially informative for their science teaching practices related to climate change, particularly its regionally-relevant aspects?



Study context: 2013 Summer Climate Science Academy



Collaboration between
practitioners, climate scientists,
learning scientists

5-day residential experience at
Univ. of Delaware Virden Center

N = 27 participants

- 14 MS science teachers
- 7 HS science teachers
- 4 informal science educators
- 2 university educators





Learning Progressions in the Academy

- Full day of activities led by a researcher (Miller) from a mature learning progressions research project (Carbon TIME project - Anderson et al., Michigan State Univ.)
- Presentation of draft hypothesized learning progression on sea level rise, a regional observation of climate change relevant for our two states
- Development of learning segments incorporating concepts from the sea level rise learning progression

Introducing Learning Progressions in the Academy

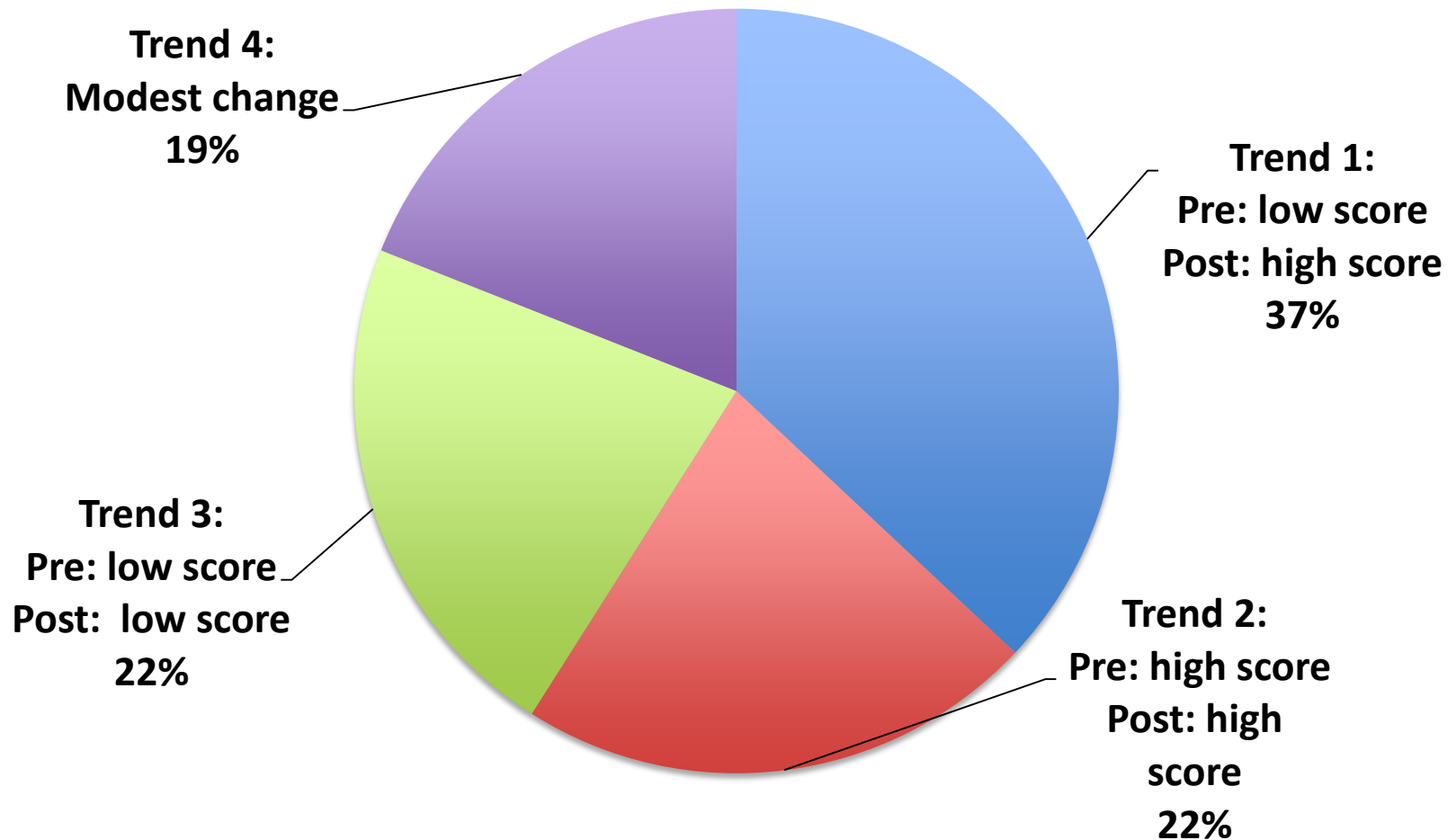




Methods and data sources

- Complementary research methods
 - Quantitative - **Climate Science Knowledge Inventory (CSKI)** (Lambert & Bleicher, 2012) assessed climate science content knowledge pre and post-Academy
 - Qualitative - Recorded and transcribed **individual interviews**

Findings: General trends in participants' science content knowledge changes as measured by CSKI

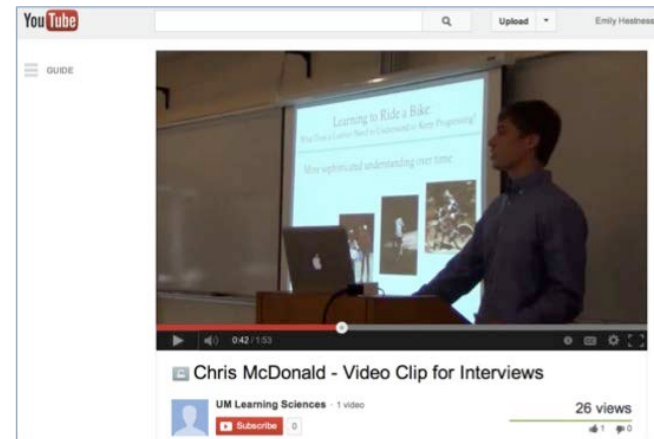


Interviews

- Individual interviews (N = 27)
- ~ 15 minutes each
- Days 3 and 4 of Academy

Sample question:

- *What did you learn about how learning progressions can guide your teaching about sea level rise, an example of a locally relevant effect of climate change?*



Learning progressions themes:

“Students should progress” [Advancing understanding]

- May not see LPs as providing a new perspective*
- May view advancement over relatively short timeframe

*“I don't really think I learned anything in particular... to me, that is intuitive for good teaching that you are going to start and you are going to **build upon that little by little**, and that's a name [learning progressions] that's been given to it recently, I suppose, but it's not a new idea in teaching to me...”* (Tanya)

Learning progressions themes:

“Knowing where students are” [Assessing understanding]

*“[It is important to] really understand what the kids do and don't know, **what they may have misconceptions about**, before really moving forward... You just end up causing more problems or missing things along the way if you don't do that” (Mike)*

- Focus on using LPs for diagnostic assessment
- Identifying initial level of understanding, then retesting post-instruction to assess change
- Identifying misconceptions*

Learning progressions themes:

“Knowing where you want students to go”

[Instructional planning]

- Varied conceptions of goals (e.g., advance one level, advance to upper anchor*)
- Connected with existing theories of instructional planning (e.g., spiral curriculum, backwards planning)

“Knowing the goal... Okay, what is a four? That's where I'm trying to get to.” (Todd)

“I like to take the big picture and work backwards. I think the learning progression does that.” (Amy)



Learning progressions themes:

“Meeting students’ diverse needs” [Instructional supports]

- LPs as informing ways of differentiating instruction

“Once we understand [where students are], we can differentiate our instruction in order to meet their needs.”

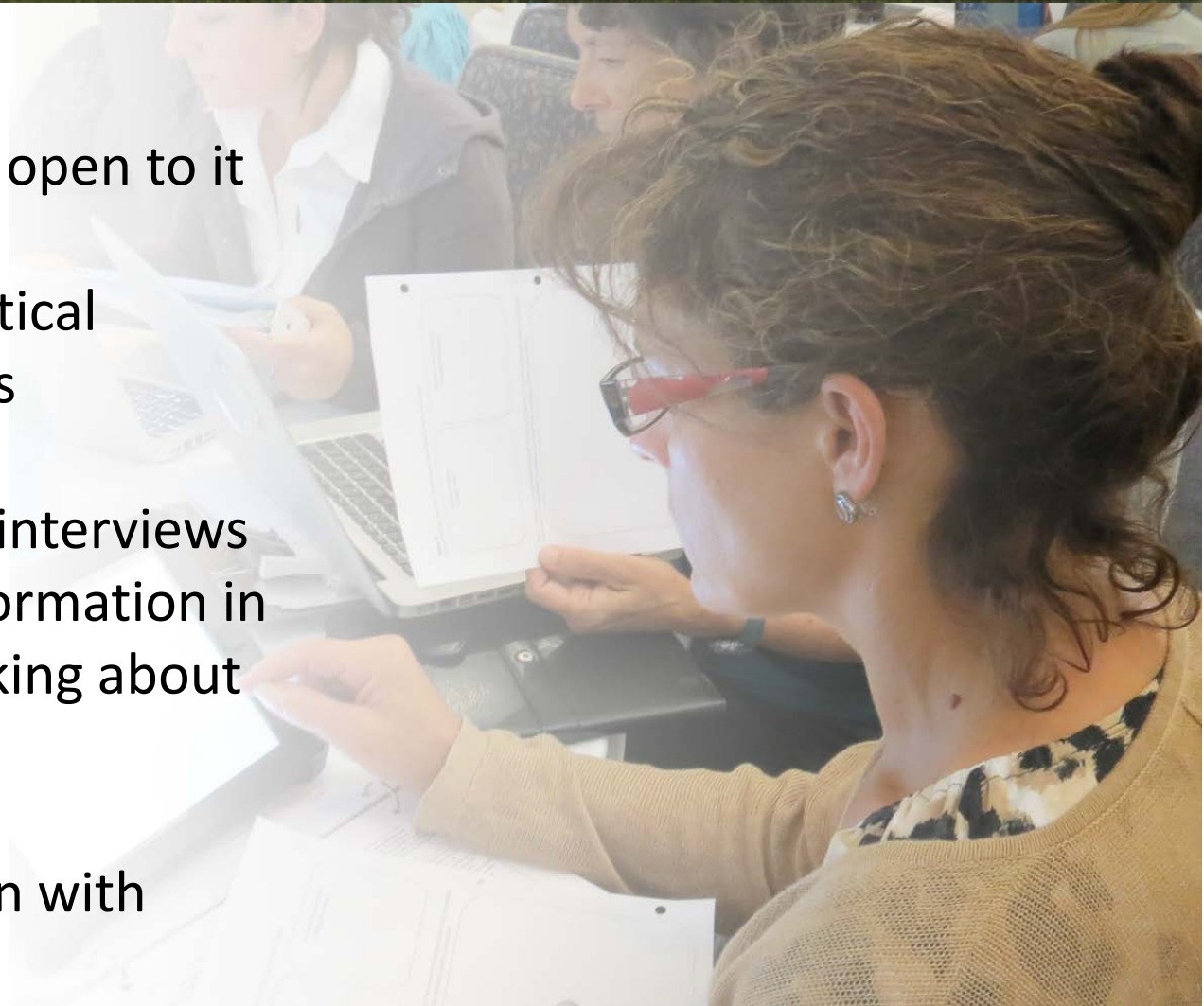
(Todd)

- LPs as informing ways of scaffolding learning

“When you help students get from one place to another and you slowly move the supports away, they call that scaffolding...I don't know if they have given it that name but that is sort of what we have done...” (Tanya)

Lessons learned: Inclusion of learning progressions in professional development

- LPs as a new tool; participants were open to it
- Interested in practical applications of LPs
- Little evidence in interviews of genuine transformation in participants' thinking about student learning
 - Possibility of transformation with more time?






Member check results

- Insights emailed to participants; 5 responses, confirmed insights to be reasonable
- Further reflection on learning from the Academy

“I found insights thought provoking - the experience felt more like an opportunity to increase my content knowledge, and to exploit the expert and collaborative resources among the group. I was surprised at the amount of pedagogy that I have since processed and internalized.” (Barb)



Member check results

“I am realizing that I didn't really understand that learning progressions were used a) as a research tool...on a much longer continuum than the academic year and b) in different ways than scaffolding instruction...

Perhaps that is a product of my experience in training seminars that provide teachers with a research-based tool for teaching rather than a tool for our own research purposes... (Mike)

Future directions

- Refining Climate Science Academy in 2014
- Consider adaptations for diverse levels of climate science knowledge
- Connecting learning progressions and assessment; collaborating with participants as co-researchers
- Collection of student data to validate and refine sea level rise learning progression





Maryland and Delaware Climate Change
Education Assessment and Research

MADE CLEAR Learning Sciences Research Team

University of Maryland: J. Randy McGinnis, Wayne Breslyn, Emily Hestness, Chris McDonald, Katy Wellington, Will Lacey

University of Delaware: Nancy Brickhouse, Chrystalla Mouza, Nicole Shea, Andrea Drewes

Towson University: Asli Sezen-Barrie