Impacts of professional learning to support teachers' design capacity for localized climate units

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Climate Education Pathways Context

Context and Purpose

Creating localized, meaningful climate learning for youth is a high need for teachers and schools. Responding to this need, we designed and tested a curriculum adaptation approach to localizing climate change curriculum materials. The design approach used a set of adaptable curriculum materials that were localized by teachers. This poster shares teacher outcomes from participating in professional learning to design localized units and implement them with students.

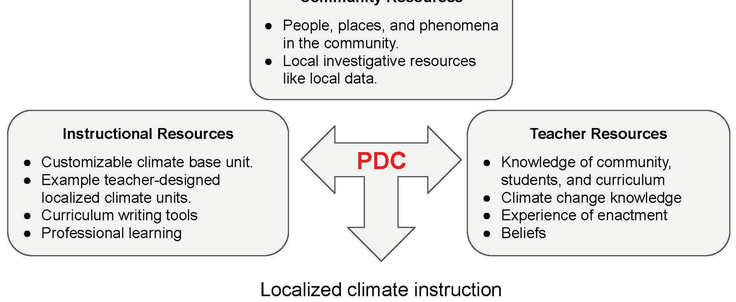
Poster Research Question

How does a professional learning program designed to support curriculum adaptation impact teacher knowledge and confidence for designing phenomenon-driven, localized climate education materials?

Background and Design

Our approach is grounded in the curriculum adaptation literature, particularly **pedagogical design capacity** (Brown & Edelson, 2003; Brown, 2009).

Figure 1. Pedagogical Design Capacity Framework from modified from Harris et al. (accepted) framework



This framework (and other literature on effective professional learning strategies) informed our 60-hour professional learning course for teachers to:

- experience lessons as learners.
- study lessons and reflect on the underlying instructional model.
- use tools to write lessons using the instructional model as a guide.
- watch videos of mentor teachers enacting lessons.
- survey and/or talk with students about what is meaningful to them to select phenomena to investigate.
- read about possible phenomena in their communities and regions.
- talk with mentor teachers, storyline coaches, and fellow participants about design ideas
- share drafts of designs for feedback from fellow participants and the research teams.
- look for local data and information for students to examine.
- discuss ideas for community-based culminating tasks with research team and fellow participants, some of which connected teachers to local places, community members, and scientists.

References

Brown, M. W. (2009). The teacher-tool relationship: Theorizing the design and use of curriculum materials. In J. Remillard, B. A. Herbel-Eisenmann, & G. M. Lloyd (Eds.), Mathematics teachers at work: Connecting curriculum materials and classroom instruction (pp.17-36). New York, NY: Routledge.

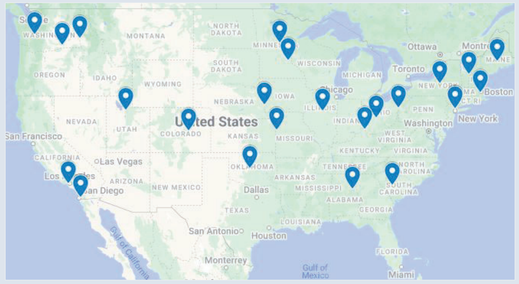
Brown, M., & Edelson, D. C. (2003). Teaching as design: Can we better understand the ways in which teachers use materials so we can better design materials to support their changes in practice? Evanston, IL: The Center for Learning Technologies in Urban Schools.

Harris, E.M., Mohan, L., Hanson, A.A., Cook Whitt, K.A., Guy-Gaytán, C., & Kenyon, L.O. (accepted). Adapting for a local space can be tricky": Designing units for teachers to localize through phenomenon adaptation. *Science Education*.

Study and Participants

This study took place within a 2-year, cohort controlled quasi-experiment. Teachers first taught a "business-as-usual" (BAU, non-localized unit) climate change unit in spring of 2022-2023, and then participated in PL to design a localized unit in summer and fall of 2023 that they enacted the following spring 2024 with students (localized unit). Participants included:

- 25 high school science teachers, with 2-31 years of experience.
- geographical diverse communities across the contiguous US.
- varied community and school characteristics for race, economic factors, and community support for climate education.
- most were new to NGSS and storyline instructional approaches.



Data Collection and Analysis

Instruments

1. **Climate change knowledge** assessed prior to BAU enactment (Pre) and at the completion of enacting the localized unit (Post Localization).
2. **Confidence surveys** assessed teachers' confidence for teaching climate change, enacting phenomenon-driven learning strategies, and tapping into local relevance and students' interests and experiences. Assessed at three time points, prior to BAU enactment (Pre), at the completion of the PL (Post-PL), and at the completion of enacting the localized unit (Post Localization).
3. **Teacher reflections** at the end of each PL session and in a post PL survey.

Instrument	Example Item(s)
Knowledge	Where do you think that most of the carbon atoms in tundra plants come from? Which is the best definition of a positive feedback loop in the climate system?
Confidence	Please respond with your level of confidence when using the following items in a classroom setting: • Using phenomena to motivate science instruction • Helping students develop explanations about science phenomena over several lessons
Reflection	What went well in the professional learning that you found helpful?

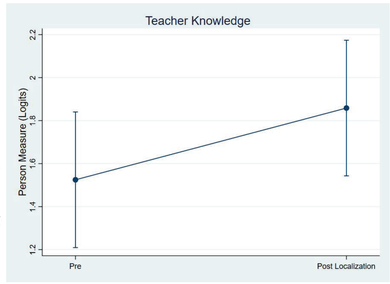
Analysis

To examine changes in teacher knowledge and confidence we transformed raw scores from each survey to Rasch person measures, measured in logits, which were then used in mixed-effects maximum likelihood regression models. Teacher reflections were used to better understand and further elaborate on the findings from the knowledge measure and confidence surveys.

Results

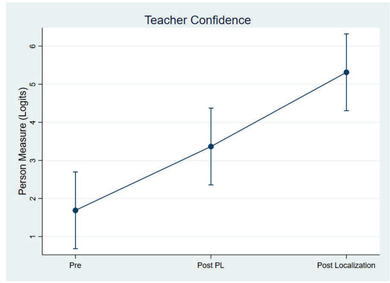
Climate Change Knowledge

- significant increase (Coef. = 0.3336, z = 2.29, p = 0.022).
- Teacher quote: *"I had been concerned that I needed to understand ALL the climate science in a lot of depth to adequately teach it in the classroom. This helped me gain clarity in both teaching using storylines and in the content critical to making sense of the causes and solutions for climate change."*



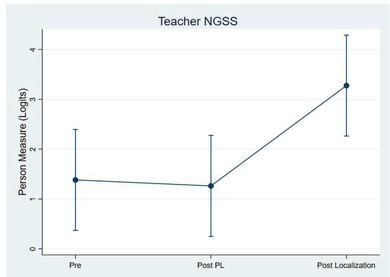
Confidence: Teaching Climate Change

- significant increases for both Post-PL (Coef. = 1.676, z = 3.35, p = 0.001) and Post-Localization (Coef. = 3.6256, z = 7.24, p < 0.001)



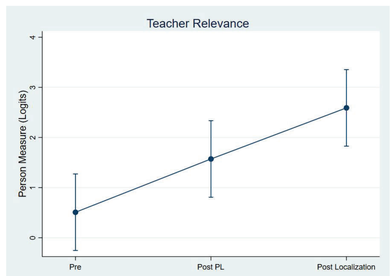
Confidence: Phenomenon-Driven Teaching

- non-significant effect for Post-PL (Coef. = -0.12, z = -0.23, p = 0.817) and a significant increase post-localization (Coef. = 1.8932, z = 3.64, p < 0.001) compared to pre-implementation.
- Teacher quote: *"I appreciate the modeling by teachers for how to teach in this fashion: phenomenon-based, student driven. That is probably the scariest part…It added confidence to see so many other teachers being successful. This is my first time utilizing this teaching style."*



Confidence: Tapping into Relevance for Students

- significant increases for both Post-PL (Coef. = 1.0632, z = 3.01, p = 0.003) and Post-Localization (Coef. = 2.0824, z = 5.89, p < 0.001) compared to pre-implementation.
- Teacher quote: *"When students see the relevance to their daily lives, hopefully they will become passionate about change...and hopefully they will see that small changes can make a difference."*



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