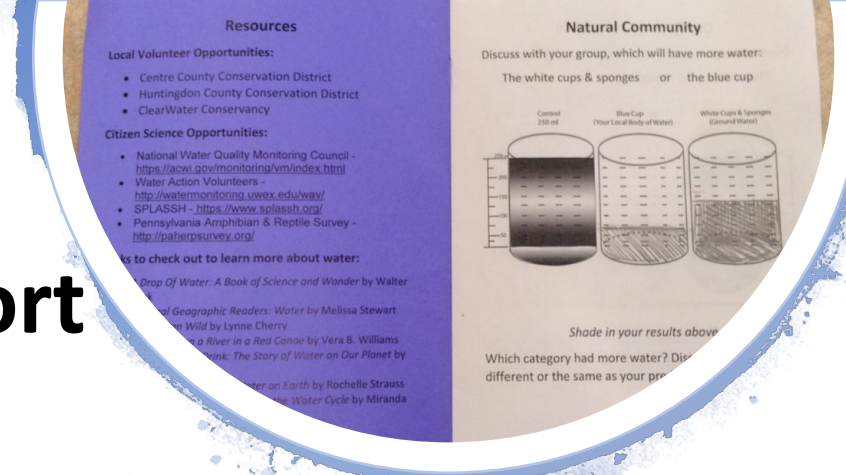


Using Family Prompts to Support Families' Sensemaking and Science Connections in a Water Quality Workshop

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Research Problem

- Family informal science learning (Bell et al., 2009)
- Parents' support of children's scientific reasoning (Gleason & Schauble, 2000)
 - parents can underestimate the challenges children faced when learning new science content
- Pedagogical strategies in supporting family science learning in informal learning settings
 - Think-pair-share (Lyman, 1987)

Research questions

- RQ 1: How do family discussion prompts influence learners' sensemaking about their rural community and water sources?
- RQ 2: How do the family discussion prompts support or hinder families' reasoning and engagement in science practices with a surface and underground water model?
- RQ 3: What role does embodiment play in the families' sensemaking and reasoning during their participation with the water quality workshop?

Theoretical Framework

- Sociocultural theories in learning (Bell et al., 2009; Vygotsky, 1978)
- Family sensemaking in informal science learning (Zimmerman, Reeve, & Bell, P. 2010)
 - Family prior experiences (Ellenbogen, Luke, & Dierking, 2004 ; McClain & Zimmerman, 2014; Zimmerman, Reeve, & Bell, 2010)
 - Science talk (Allen, 2002)
- Embodiment in sensemaking and reasoning (Azevedo & Mann, 2018; English & King, 2015; Marin and Bang, 2018)



Design of Study and Procedures

Design of the STEM Pillars Water Workshop

- Science and Engineering family workshops led by STEM professionals
- Families recruited on-site. (a parent or guardian with at least one child aged 6-10 years old)
- 75-min workshop
 - STEM professional narrative
 - Driving question: “How can we build a better world around water in our community?”
 - 3 experiments (3 water quality models)- natural, developed, and green community
 - Observe, predict, record, and interpret data



Prompts

Rural Connection Prompts	<p>#1: What types of bodies of water do you have in the community where you live? (How) do you use this water?</p> <p>#2: Discuss with your family where you think the water you use comes from?</p> <p>#3 (= #4): Before we had a lot of people, what did the land look like? what was the natural environment like in the community WHERE YOU LIVE before people moved in and altered it?</p> <p>#6: What are things people build in their communities to live?</p> <p>#8: Discuss with your family and compare the different results. What might be some ways to increase groundwater in your developed community?</p> <p>#10: Discuss with your family: Are there any of these designs that are currently in your neighborhood? Are there any of these designs you could potentially implement inside your community?</p>
Prediction Prompts	<p>#5: Where do you think the water will go? Which one will get more water: the white cups and sponges (groundwater) or the blue cup (local body of water)? (1st experiment)</p> <p>#7: Make your prediction: where do you think the water will go this time? (2nd experiment)</p> <p>#9: Discuss your predictions: will there be more runoff, or more infiltration (i.e., more water in the blue cup, or more water in the sponges and cups for groundwater)? (3rd experiment)</p>

Data collection

- 4 workshops led by 3 water experts at 4 libraries/museums
- Video-based records (Derry et al., 2010) of STEM professionals and families' conversations and interactions
- 13 consented families
 - (30 participants: 14 adults & 16 children)

Data analysis

- Video-based qualitative analysis (Jordan & Henderson, 1995)
- 13 Family prompt analytic accounts
 - Prompts delivered and following family talk
 - Screenshots of family interactions
- Fieldnotes and content logs



Findings and Analysis

Overview of prompts asked

Site	Site 1	Site 2	Site 3	Site 4
STEM professional	Ed	Chelsea	Chelsea	Cassandra
Prompt asked + family talk	#1, #2, #3, #9	#1, #3, #5, #6	#1, #3, #5, #7, #9	#1, #3, #5, #6, #7, #8, #9
Prompt not asked	#5, #7	#7, #9	#8, #10	N/A
Prompt asked as anti-question (STEM professionals answer themselves)	#6, #10	#10	#2	N/A
Prompt asked at the workshop-level (individual participants answer, no family discussion)	#8	#2, #8	#6	#2

red= prediction prompts

Emerging theme-1

Prompts supported family
sensemaking through making
rural and family connections

Emerging theme 1-

Prompts supported family sensemaking through making rural and family connections

Family prompt

- initiated parent re-voicing/ family prior experiences/parents asking questions
- encouraged families to make rural and family connections about water sources in their local community

Excerpt #1- Avril (ages 8), Sade (Mom)*

Water expert: Before we start it, I want you to take a couple minutes with whoever brought you here, whoever you're with, and talk about- What are some of the bodies of water, you know, lakes, rivers in the ground, What are some of those near where you live and how are you using that water?

Transcript:

Mom: She wants us to talk about what kind of **natural water** is near us.

So- what kinds of **streams, rivers, ponds...marshes**

Avril: [a marsh].

Mom: [a marsh] is **right down the road**.

Avril: At **dad's house**...

...

Mom: What about some other streams you can think of that's around here? . . What about in [a borough]? **When we were driving**, remember when we were driving?

Yellow- rural connection

Blue- family connection



*all names used throughout this presentation are pseudonyms

Excerpt #1 (continued)

Yellow- rural connection
Blue- family connection

Transcript:

Avril: On the way to dad's house there? There's a **swamp**.

Mom: There is. You're right. You're right. There's a **big swamp** right there, isn't there?

Avril: ((nods))

Mom: Right up by um- you know **the Christmas tree farm**. What about um . . . **that pond that we see when we go on the way to [a place]**?

Avril: ((nods))

Mom: So what does all that water do? What does **the marsh** do? How are **we using the marsh in our community**?

Avril: It helps- it helps to suck up um. . . floods.

Emerging theme-2

Prompts supported family participation with science practices (predictions and explanations)

Emerging theme 2-

Prompts supported family participation with science practices (predictions and explanations)

Family prompt

- engaged families in making predictions on where the water would flow on the model
- initiated parent seeking explanations from the child

Excerpt #2- Britain (ages 7), Shawn (Dad)- **Engaged in science practices (predictions and explanations)**

Water expert: Let's again put back on your scientist's hat and come up with- does anyone remember that word? The word we come up with to mean prediction or guess? So, I want you make a hypothesis about where you think the water's gonna go this time, and how it compares to our first natural environment.

Transcript:

Dad: Where would water go?

Dad: Would they all go to one? Humans built these stuffs, so water can't go through.

Britain: How about there?

Dad: That's the lake.

Britain: Oh

Dad: Then, would it all go to lake?

Britain: Flood.

Dad: Let's see what happen.

Dad: They didn't do the soaking part.

Britain: But in some parts there are grass, grass would lead down to the ground.

Dad: Yeah. But that's before, when it was natural.

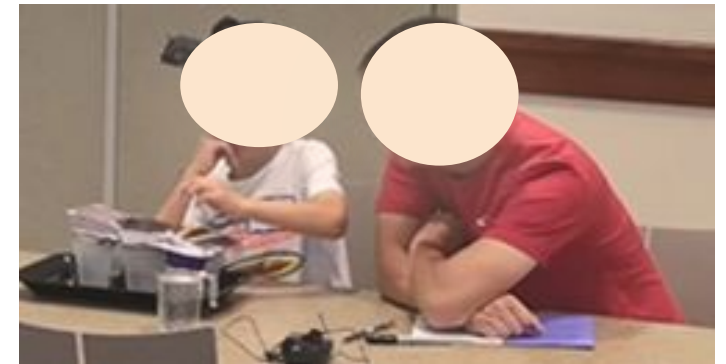
...

Dad: Why?

Britain: Because all these (referring to buildings) are here so water would go here (to the cup)

Orange- parent or child asking questions or seeking explanations

Green- family making predictions or explanations



Emerging
theme-3

**Prompts elicited embodied
sensemaking and reasoning
amongst families**

Emerging theme 3-

Prompts elicited embodied sensemaking and reasoning amongst families

Family prompt

- elicited families' pointing and gesturing in the air, on the model and on the table when talking about community landscape and making predictions

Excerpt #3- Tina (ages 6), Corinna (Mom)- Embodied reasoning with the water quality model

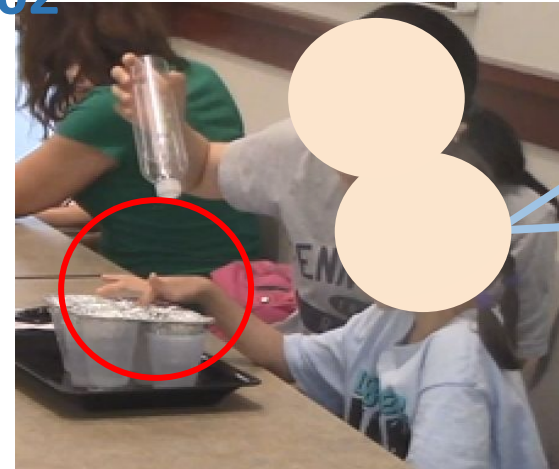
water expert: Before you get started, I want you to talk about what you think is going to happen. Where do you think your water is going to go? Will it end up in the surface area or the natural areas? Once you've talked about that, go ahead and get started.

01



Mom: "You pour water in here ((**takes up the rain maker**)), and see where the water ends up." ((Gets closer to Tina.))

02



Tina: "It will go here." ((**points** at the holes on the muffin tin.))

03



Tina: "Less water will go there." ((**points** at a cup))

Mom: Okay.

04



Mom: "You think the water's gonna go here, right?" ((uses the rain maker to **point** at one of the holes of the muffin tin.))

Excerpt #3 (continued)

05



Tina: "I think it's gonna go here" ((**points** at a cup))

06



Mom: Which one will have the most water?

Tina: Most.

Mom: Most of the water.

Tina: "This one" ((**points** at a cup))

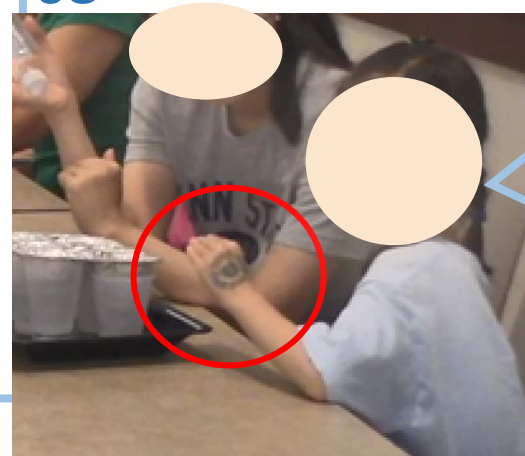
07



Mom: the blue one?
Has most of the water?
Why? Because it is the lowest one?

Tina: Yeah.

08



Mom: And the highest? ((Tina **leans** towards the model))

Tina: "No, I think the highest one will only have a little" ((**gestures to show the little amount of water**))

Discussion and Contribution

- Family prompts designed for the workshop and delivered by the STEM expert supported families' sensemaking about local bodies of water through making connections to family experiences
 - Aligns with literature that supports the importance of prior family experiences during the science sensemaking process (Ellenbogen, Luke, & Dierking, 2004 ; McClain & Zimmerman, 2014; Zimmerman, Reeve, & Bell, 2010)
- Prompts supported families to engage with science practices, specifically predicting and explaining
 - Parents specifically re-prompted children to clarify/explain their predictions and science reasoning (Gleason & Schauble, 2000)
- Gestures often supported families' verbal explanations
 - Embodied learning supported families' science sensemaking and reasoning in a workshop setting (Azevedo & Mann, 2018; English & King, 2015; Marin and Bang, 2018)

Implications

- Strategies for scientists to better engage families in making connections to science
 - **Family-focused prompts** that are designed for and embedded into workshop programs can support family science conversations and embodied sensemaking about their local communities
 - **STEM experts (scientists)** can support families during science workshops by articulating these prompts throughout the workshop
 - Training is recommended for STEM experts that lead family science workshops in order for the designed prompts to be effective during the actual program

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Thank you!