Science Learning Through Embodied Performances in Elementary and Middle School

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Project STAGE Focus

We call our project **STAGE (Science Theater for Advancing Generative engagement)** bringing together sciences, identities, literacies, and theater

The focus is on…

Making embodiment an integral part of learning science in elementary and middle school classrooms, and exploring the affordances and challenges in doing that in classrooms of students of color and other marginalized groups including multilingual learners

Logo created by Meghan Rock

Project STAGE Team

- Teachers (Grades 1-6)
- Teaching Artists
- Graduate Research Assistants (Education)
- Undergraduate Research Assistants (Theater and Education)
- PIs (Education/Curriculum & Instruction, Theater)

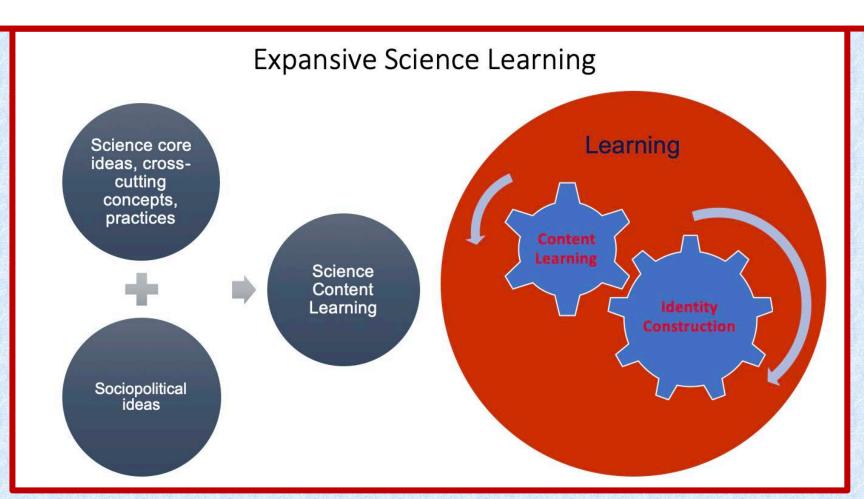## Timeline and Project STAGE Phases

4 Phases of Iterative Cycles of Design and Implementation
(1) design-based professional development (Summers and academic years - Y1, Y2)
(2) teachers' scaffolded implementation with teaching artists (Academic years - Y1, Y2)
(3) teachers' independent implementation without teaching artists (Cohort A - Y2)
(4) data analysis and dissemination (Initially during Y2, focus of Y3)

	Cohort A (5 teachers)	Cohort B (5 teachers)
Y1 Summer 2019	Design-based professional development workshop	
Y1 AY 2019-20	Scaffolded implementation with teaching artist & ongoing professional development	
Y2 Summer 2020	Design-based PD workshop	
Y2 AY 2020-21	Independent implementation without teaching artist & ongoing professional development	Scaffolded implementation with teaching artist & ongoing professional development
Y3 Summer 2021	Data analysis	
Y3 AY 2021-22	Data analysis and dissemination	

Project STAGE Theoretical Frameworks

- Social semiotics and multimodality (Jewitt, 2008; Kress & van Leeuwen, 2001; Varelas et al., 2010)
- Embodied mind and dramatizing (Bolton, 1984; Braund, 2015; Dijkstra & Post, 2015; Henry, 2000; Ingold, 2011; Varela et al., 1991; Warren et al., 2001; Wilcox, 2009)
- Master narratives and control of bodies (Cordileone, 2011; Dumas & ross, 2016; Espinoza & Vossoughi, 2014; Freire, 1970; Gregory, Skiba, & Noguera, 2010; hooks, 1994)
- Expansive science learning (Leander, 2002; Madkins & McKinney de Royston, 2019; Varelas et al., 2012a,b, 2020; Varelas, 2018; Visintainer, 2020; Wenger, 1998)

Expansive Science Learning

Project STAGE Design Highlights

- **Body** being a place of **sensing** science ideas and **dramatizing** science ideas taking on roles of science entities in **micro and macro** levels
- Disciplinary knowledges of **science education and literacies education** becoming meshed with **theater practices** and ways of knowing the world
- Working with **teacher colleagues** and **teaching artists** to design possibilities for classrooms that took two broad forms: **classroom-based work** (Teacher Talk Videoclip) and **science plays** developed for larger audiences (Science Play Videoclip)
- This year (and part of last year), due to the COVID-19 pandemic, classroom-based work mostly happened in the context of **remote teaching**, and science plays in the form of **digital-media productions**

Theater Practices

For developing capacity for movement, and for expressing and advancing ideas through movement, actors' primary tools (and associated skills) are:
- **Body** (skills: relaxation, sensory awareness, grounding, warm-up)
- **Movement** (skills: movement vocabulary)
- **Voice** (skills: chanting, naming and narrating, singing)
- **Imagination** (skills: analogy, role play, viewpoints, change scale, take a perspective)
- **Interaction** (via: name games, theatre games, ensemble work, matching & harmonizing)

Theatrical exploration/investigation happens via:
- Adaptation
- Etudes
- Tableaux
- Pantomime
- Script writing
- Mash-ups
- Rehearsal
- Small-group creations
- Feedback processes
- Positive regard
- Response/critique

Project STAGE Study Highlights

Our designing and analyzing has been centering on how science ideas are represented through movement and performing (individually and collectively), and the emerging:

- multiplicity of meanings and relations between meanings and movements
- generativity of embodied performances
- multimodal literacies involved
- how science identities are constructed and reconstructed during such experiences

Data Sources

- Lesson recordings and fieldnotes
- Lesson artifacts (student work, teacher lesson plans)
- Recordings and writings on identity reflections
- Teacher meeting recordings

Prompts for Identity Reflections

- How would you describe yourself to someone who has never met you?
- What are a few things you consider important about yourself?
- Are you good in science? How?
- Does your teacher think you're good in science? How?
- Do your peers think you're good in science? How?
- Think about your classmates. Who do you think is good in science? How?
- What does it feel like to move your body and act out science?
- How is moving your body and acting out helpful to you in science class?
- Can you give a specific example when moving your body and acting out science ideas was helpful to you?
- Can you give a specific example when watching others move their bodies and act out science ideas was helpful to you?
- Are you good at moving your body and acting out science ideas? How?
- Does it matter that you are or aren't good at moving your body and acting out science ideas?
- What do your classmates think of you when you move your body and acting out science ideas?
- Think about your classmates. Who do you think is good at moving their body and acting out science ideas? Why do you think so?
- Do you think moving your body and acting out should be part of doing science? Why or why not?
- Do you tell your family about moving your body and acting out in science class? Why or why not? If so, what do you tell them?
- Do you think scientists move their bodies and act out science ideas? In what ways?

Analytical Steps

- Summarizing lessons–1st pass in capturing both unfolding of a lesson and enactments taken place, and identify moments, students, interactions resonating with the project focus
- Deepening analysis by:
  - watching back interesting excerpts
  - focusing on science learning, multimodal literacies, and identity construction
  - examining other lesson artifacts (e.g., notebooks)
- Conducting multimodal discourse analysis, LBMS movement analysis, content analysis

Coding Ideas for Multimodal Discourse Analysis

Science Idea	Multimodal tool use	Identity manifestations
• What it is • How it relates to other ideas • Alignment with scientifically accepted idea • Change over time	• Movement • Speech • Written language • Visual image • Transduction • Emotions expressed • Modal resources (framing, layering, foregrounding, dynamicity, interactivity, directionality, cohesion, symmetry, continuity, intensity, linking) • Change over time • Individual vs. collective	• Relation with idea and mode used • Choice of idea and mode used • Commitment to idea and mode used • Competence in idea and mode used • Self-positioning relative to peers • Teacher's/TA's positioning • Peers' positioning • Emotions expressed • Change over time

LBMS (Laban/Bartenieff Movement System) Movement Analysis

Components of movement (BESS)
- **Body** (the physical and anatomical and the ergonomics of their use, actions, initiation, organization, connections, and integration of posture/gesture)
- **Effort** (the dynamic qualities and phrasing of force, time, focus, and tension that visibly expresses the inner urge to move, the emotional qualities)
- **Space** (the spatial architecture of human movement or the space in which each person moves and how we use movement)
- **Shape** (the physical expression of relationship, molding the body's shape in response to the environment)

Factor	Observe	Can Express
Body	What is Moving	Sensing
Effort	How it Moves	Feeling/Inner Drive
Space	Where it Moves	Thinking
Shape	Why is it Moving	Relationship/Intuition

Phrasing: Just as in speech, how the movement components appear in sequence and emphasis over time, creates phrases expressive of meaning

Example of Thick Descriptions with LBMS Indicators

The moment before seems *transitional*: Students are rocking in place, continuing the **flow of their own movement**, which stills as the teacher begins to speak.

During "Think about how you can use your hands and arms to show," Justin waves his arms from shoulders up into space quickly, **each arm on its own trajectory and time**, while keeping his eyes on the teacher showing gas breaking apart as it spreads out.

Amari shows "**wind**" sweeping her hands in a **horizontal circle near the front of her torso**. From the beginning of the clip, Amari had risen to her knees at the back of the class, and as she masters containing the depiction in her hands, her hips counterbalance the movement **integrating whole body in support of the depiction with her hands.**

Immediately, before even hearing what to do with hands, three students **extend their hands at shoulder height**. The moment the teacher invites movement, students' **attention turns to her and to the movement itself**. When she says "Now, take your hands and think of a gas," many students begin to move exploring their thoughts with their hands and arms, which for some, **animate their whole body floating up lightly and indirectly, shifting their weight**.

In response to the question "do gases move fast or slow"–a question that emerged from the students as they had to figure out how to move their hands to show gases, some students raise their hands, others 'answer' with movement, **slowing or speeding up their movement**.

Findings

Forms of Embodied Generative Engagement

- Enactments as spaces of question generation (Closed and Open Circuits Videoclip; Gases and How They Move Videoclip)
- Enactments as places of collaboration (Filtration to Clean Water Videoclip)
- Enactments as enhanced performances after revision (Water Cycle Videoclip)
- Enactments as generating multiple dimensions and connections (Impact of Air Pollution on Human Body Videoclip)
- Enactments as showcasing representational diversity (Planets Videoclip)
- Enactments in home settings (Life Cycle Videoclip; Plant Growth Videoclip)

Teachers' Roles vis-à-vis Embodiments

- Reviewing using embodied representations co-constructed by students and teacher in previous lessons (Genetics and Traits Videoclip and Image)
- Scaffolding through improvisation (Infiltration Videoclip and Image)
- Interpreting students' enactments (Water Moving Videoclip)

Teaching Artists' Roles in Enacting

- Leading theater games (How Air Sounds Videoclip)
- Encouraging enactment and narration (Weathering Videoclip)
- Developing capacity for movement–building body skills (Stretching to Get Ready Videoclip)
- Connecting students' ideas (Viscous Liquids Videoclip)

Identity Performances and Narratives

- Identities in practice (Being a Chef Videoclip)
- Narrated identities (Understanding More by Moving Videoclip; I Like Doing Enactments Videoclip)

Me ayuda a // a entender mas las cosa que no entiendo. Porque si tienes que entender y aveces no entiendes nada y lo tienes que actuar a veespara entenderlo más (It helps me to // to understand more the things I don't understand. Because you have to understand it and sometimes you don't understand anything and you have to act it sometimes to understand it more) (3rd)

I explain it [science] really good when I'm acting it out (5th)

It feels good because it will make sense when we act it out (5th)

Students' midyear sharings

It is helpful because when I see other people's enactments that are helpful is about what they're trying to do (5th)

I'm not very good at explaining so I decided to like show it with my motions and with my hand movements and my body movements. (4th)

When people talk sometimes they like to use hand gestures I think that counts as acting out an idea (6th)

I'm GOOD at acting because even I'm not great actor but they like it (4th)

Moving your body should be part of science because you get good energy and exercise (5th)

It makes me feel free and it makes me feel good and happy (4th)

When we do it get inspired and understand what we are learning (4th)

Acting it out make science fun and can be easily understood (6th)

It's embarrassing but it makes us understand more (5th)

When our team was communicating with each other it boosted up our team building level (6th)

Students' end-of-year sharings

It feels amazing because I get to act out and acting is so fun and you can get as creative as you want with acting so I love it (5th)

I think my classmates like it when I turn to a flower and start blooming. We all have fun doing this, the way we move. I really enjoyed acting out as rocks and how much we learned about it (2nd)

You can understand it better by acting out your idea because maybe someone doesn't really understand you and/or doesn't speak the same language as you (4th)

Its helpful because we can think more when we are acting it out (4th)

[The teacher] always helps us understand it by showing us how to use our body so we can understand it (6th)

It gives out more visual models (5th)