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Many Ways of "Being" a Beaver: Students' Perceptions of Technology-Enhanced and Dramatized Embodiment in Science

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Abstract: There are many ways of embodying a beaver, including through mixed-reality technology and through acting in theatrical skits. In this study, fifth grade students engaged in both to learn about wetland ecosystems. We conducted a thematic analysis of student interviews to understand their perceptions of each kind of embodied activity. We present four themes from their reflections: perspective taking, agency, learning, and the socioemotional experience, and discuss how these perceptions can inform embodied science education.

Introduction

Scholars have increasingly attended to the role of the body in science learning, through the study of both gestures and full-body movements at the individual and group level (Danish et al., 2020; Kersting et al., 2021; Nathan, 2022). Often this work positions the body as *representational,* investigating how movements of the body might map onto conceptual ideas in science, like how we might learn how bees pollinate flowers by re-enacting their pathways through gardens (Lee et al., 2025). This kind of representational embodiment is sometimes supported by mixed-reality technologies, which can help learners visualize the conceptual link between their movements and the scientific content (Lindgren & Johnson-Glenberg, 2013). Scholars who study performing arts learning contexts like theatre and dance add that movement is also creative, expressive, and cultural, and may serve more than a representational role in helping students to explore scientific ideas (Solomon et al., 2021). In this study, we engaged students in two kinds of embodied activities that we believed would complement each other in eliciting these multiple dimensions of embodiment: mixed-reality embodied modeling and dramatized skit performances. Our goal in this poster is to understand students' perceptions of the affordances of and differences between each kind of embodiment for engaging in science.

Methodology

This work took place in a fifth-grade classroom in a public school in the Midwestern United States. Twenty students participated in the research. Students were between 10-11 years old, were predominantly white (two mixed-race, two did not disclose), 65% used she/her pronouns, while 35% used he/him pronouns.

Students participated in a nine-day unit focused on understanding the role of beavers in wetlands ecosystems. Over the course of the unit, students participated in two kinds of embodied activities: mixed-reality modeling, and non-tech dramatized skits. The mixed-reality models were supported by the GEM-STEP software and designed to help students to explore various ways that beavers impact ecosystems (Danish et al., 2020, 2022; Steinberg et al., 2025). Students interacted with the models, which were projected on a screen in the front of the room, through movement of their bodies. That is, as students moved through the room, the system tracked their movement and displayed an agent in the model moving in the same way. In the first model, Beaver Interactions (Day 2/3), each student controlled the avatar of a beaver and interacted with trees, sticks, rocks, and mud in the model, exploring what beavers do (e.g., build dams, eat trees, build lodges, hide from predators). In the second model, Energy (Day 4/5), students controlled the movement of energy through the ecosystem, exploring and demonstrating how energy moves from the sun, to trees, to beavers, to predators. In the final model, Pathway (Day 6/7), students again controlled the movements of a beaver, this time moving through a flow-chart-like 'pathway' of possible choices (e.g., building dam, playing, preparing for winter) and exploring, through displayed graphs, how their collective choices impacted the environment (e.g., more fish, cleaned water). The non-tech dramatized skits were used as an activity to help students explore, modify, and present their ideas about beavers and wetlands. They created an initial skit in small groups, in which they were tasked with telling a story about beavers (Day 1). Students had the opportunity to continue working on and to revise their skit after the modeling on Day 3, and then to create and present a final skit to the class (Day 9). Students were also given a task to convince a fictional town why beavers were important in any way they wanted (Day 8): all the groups created a non-tech skit, including themes such as persuasive arguments, news reports, and enactments of the wetlands being bulldozed.

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To understand students' perceptions of each kind of embodiment, we draw on data from student one-on-one interviews, which occurred after the activities. We analyze their answers to the following questions:

- In our activities, you became a character in two different ways: using the technology and in the skits. How did it feel being your character in the skit versus being a character using the technology?
- Did they help you to understand the characters or the science in different ways?

We conducted a thematic analysis (Braun & Clarke, 2006) to understand students' perceptions of the mixed-reality model and the dramatized skits. We began by open coding students' responses, remaining close to their ideas. For example, if a student said, "the skits were fun, like getting to come up with the ideas with the group", we generated the descriptive codes of "fun" and "come up with ideas." This process resulted in 43 initial codes describing students' perceptions of the skits and 34 initial codes describing students' perceptions of the mixed-reality modeling. We collapsed these codes into four themes, iteratively returning to the data and recoding to ensure that the themes were robust and grounded.

Findings

Students talked about each kind of embodiment in relation to four themes: perspective taking, agency, their role in science learning, and the socioemotional experience.

Perspective taking

Students positioned the dramatized skits as a way for them to better take on the perspectives of the scientific agents, usually beavers (n = 8). For example, one student explained, "the technology, basically you weren't anything, you were just moving around a beaver in there. And then the skit you were actually something, well that's confusing, but you were, in the skit, *you* would be the beaver." This division also seemed to be related to the physical kinds of embodiment that each mode supported: in the skits, you could show any action, like "how they roll in the water", but with the mixed-reality models, "you had to just walk around" and "watch the screen."

Agency

Relatedly, students expressed that they had more freedom during the dramatized skits than the mixed-reality models (n = 8), while one stated the opposite. That is, they could "make up what they wanted to do" and "add more funny stuff, more details. You can actually talk." Several students discussed that in the skits, there were "a lot more other characters, other than beavers." One explained, "if we wanted to add a bear, we could."

Learning

Students (n = 11) had mixed opinions about the value of each kind of embodiment for learning science. Some students believed that the skits did a good job demonstrating what they learned to others: "what we learned in the models we did in the skit" and were helpful for sharing ideas: "the skit could help you see what other people thought about what beavers would do." However, others felt the mixed-reality model was more useful for learning: "[the model] helped us learn that coyotes are trying to eat beavers. But in the skits, we didn't really learn nothing…our skits were not real." Many students said that the mixed-reality models helped them to figure things out: "in the model you had to figure out what you had to do so the ecosystem would stay healthy."

Socioemotional experience

Students (n = 17) also had mixed perceptions of the socioemotional dimensions of each kind of embodiment. Some found the skits to be "fun" and enjoyed "interacting with people", but one student thought they were "a little confusing" because "no one discussed the plan…everything was all crazy!" Likewise, some students described the mixed-reality models as "fun", but also "harder", as "you're a bit nervous you're going to trip or something" and the groups "weren't working together much."

Discussion and conclusion

Taken together, students seemed to see the skits as a place where they could lean into storytelling and imagination, through pretending to be a beaver and adding in other characters and ideas that felt relevant to them, while they treated the mixed-reality model like a simulation in which they "controlled" a beaver to figure out how things "really worked." We believe that both kinds of embodiment have relevance for science education, with mixed-reality helping students to make sense of content through engaging in inquiry (Lindgren et al., 2016), and skits helping students to then express and communicate their personal understandings of and experiences with that content (Steinberg et al., 2024; Varelas et al., 2024). Future work should explore this balance further, towards understanding how multiple forms and dimensions of embodiment can work together to support science learning.

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