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Guiding Students to Make Meanings Across Modes in Science

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OVERVIEW: We identified how school science teachers can guide students to make meanings across actional, visual, mathematical, spoken, and written modes by focusing on sign features and functions in these modes.

AUDIENCE: K-12 science teachers, Secondary science teachers, Teacher educators, Physics educators, Elementary science teachers

KEY POINTS

- Students need to learn how to link meanings across modes in science.
- Teachers can support this reasoning process through focusing on how signs can function.
- These functions include enacting similarities between signs and what they refer to, making inferences from signs, and using sign conventions in science.
- Teachers need to model these functions to guide student transmodal meaning-making.

INTRODUCTION: Science students need to make meanings across modes (linguistic, actional, visual, and mathematical). This depends on linking signs or representations in one mode with new meanings in another mode, such as new insights when a tally is remade as a graph. We identified how teachers support this process. We studied one teacher's interactions with her Grade One students on the topic of astronomy, including: (a) how she elicited and responded to student meaning-making; (b) used props such as a gnome in the playground to model and track shadow change over a day, and a torch and globe to model night and day.

FINDINGS: We found that the teacher:

(1) Worked strategically with both student- and teacher-generated representations, guiding students to note visual and structural resemblances across sign systems such as connecting streamers of the gnome's shadow produced over a day with their reassembly as a graph in the classroom;

(2) Constantly checked that students understood initial, emerging and consolidated meanings within and across modes;

(3) Focused on what could be inferred from sign system similarities, such as patterns in a graph of shadow length change, or how a torch and globe can resemble and model night and day, or how a spun globe can model time-zone variation;

(4) Incorporated both improvised and conventional signs, including gestures, object manipulation, and topic-relevant vocabulary to support learning;

(5) Supported students to make meanings across modes by challenging and supporting them to construct and refine representations.

TAKEAWAYS: Our study implies the importance of science teachers focusing explicitly on features of signs or representations as resources for meaning-making across modes. This includes: (a) drawing attention to similarities between signs and their referents and between signs in one mode and signs in another; (b) modelling inferences made possible from newly-introduced sign systems; and (c) integrating different sign systems such as the meanings generated from a practical activity and its re-representation in words, and visual and mathematical modes.