INDUCTING CHILDREN IN THE EPISTEMOLOGY OF MODELING

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A central aim of education is to help learners understand how knowledge is articulated in the disciplines. Contemporary perspectives in the learning sciences emphasize that knowing emerges from interactions among discipline-specific practices that generate an ensemble of concepts, along with ways of thinking about their significance in light of imagined and experienced critique. To create conditions that support this kind of learning, I work with teachers to design learning ecologies in which children in the elementary grades are initiated into approximations of the practices employed by STEM professionals to germinate, revise, and maintain knowledge. The design of learning ecologies includes making informed bets about STEM practices that can be robustly and fruitfully approximated in classrooms. These commitments are accompanied by conjectures about (a) how these practices interact to develop new knowledge, (b) the kinds of tasks and means of articulation that will support this hypothetical development, and (c) how to establish and maintain settings in which children can participate in both the production and critique of these emerging concepts and practices. All of these aspects of design are orchestrated by teachers, so teaching and learning are viewed as coupled, a perspective in the learning sciences that is most directly advanced by an approach known as design research. I illustrate this epistemic perspective on learning with two examples of design research conducted to introduce children to the signature practice of the sciences, modeling. The first example traces fifth- and sixth-grade students' (ages 10,11) induction into statistical practices of visualizing, measuring, and modeling variability. Engaging with these practices supported students' development of new ways of conceiving of samples as simultaneously a distribution of outcomes from a portion of a repeated stochastic process (a sample) and as distributed (a sampling distribution). These experiences initiated a new way of thinking about inference under conditions of uncertainty, an essential form of inference in sciences. The second example describes how young (ages 6,7) and older students (age 11) experienced the essential dialectic between performative and representational aspects of modeling as they noticed and explained similarities and differences among local ecosystems (prairie, forest, and pond). On the performative side, children worked to achieve a material grip on ecosystems by designing investigations, choosing appropriate tools, and developing measures to make the workings of these systems visible. On the representational side, children invented and revised inscriptions of material arrangements and established circulation (mutual reference) among these inscriptions to develop understanding of ecosystem functioning. I conclude with suggestions for productive new directions in research to support children's participation in the epistemology of modeling.

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