The Shapes of Change: How Students Represent Change Across Multiple Scenarios and Media

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Motivation & Theoretical Background

Changes in Viz and Data: Computational technologies have changed the way we collect and communicate information about the world. Dynamic Representational Competence: Ways of representing systems that exhibit measurable patterns of change over time. Multiple Media and Task Types: students’ approaches to constructing and interpreting representations are context-sensitive, both respect to the task at hand and the mediating representational tools available. Constructive Resources / Conceptual Dynamics: Students possess a wealth of experiential and intuitive ‘resources’ – pieces of knowledge – and learning involves utilizing and establishing connections between these resources.

Goal: Identify common resources within a diversity of dynamic representations.

Methods

Phase 1 Story

A car is speeding across the desert, and the driver gets very thirsty. When he sees a cactus, he stops quickly to get a drink of water. But he has already know that the mom has stopped growing.

Scientists are tracking a population of animals. For the first 15 years, the animals are doing very well – every year more animals are born than the year before, while the number of animals that die each year does not change. However, after 15 years, a virus begins to spread through the population that makes the animals weaker. So, now the number of animals that are born each year gets smaller and smaller until the next 10 years, the animals are doing very poorly.

Some children in Missouri grew some flower plants. Soon after the flowers were planted, they measured the height of each plant. The average height of the plants was 10 mm and the tallest was 80 mm. The children kept measuring the plants to see how tall they grow.

Emergent

Irene: Why do you think the flowers are growing big? Alex: The flowers need water. Irene: They need more water. Alex: Yes, and then the mom should stay the same.

Statistical

In our collection of 127 representations, we found all but 26 included explicit evidence of a setting. The representations featured an average of just under 2 objects each, and 18 included verbalized rules.

Emergent Themes

Setting

Unchanging organization of space or context cues to indicate the situation within which quantitative change is taking place. Active, changing entities that represent particular quantities or measures. Specific changes to objects’ position, quantity, color, appearance - to indicate the value of a quantity. Instructions, usually in the form of sentences, for how objects/indicators should respond to future change.

Emergent Themes Table

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<th>Objects</th>
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Interviews

Establishing a Setting

Irene: Want to do it like a graph for every person? Say how many flowers they grow every year, but we already know that the mom has stopped growing. Alex: Probably the grandpa. What my family usually does is that we mark our heights on the corner of the wall and then we date it.

Defining Objects

Alex: So, there are lines down the middle and then lines for all the other people with dates. Irene: You could have the first one be really tiny and say baby.

Articulating a Rule

Irene: And then I wrote everyone but grandfather and mom grow two inches until ten years.

Written Work

FA11: 9 semi-clinical interviews
FA11: 44 classroom worksheets
SP12: 10 animation s-interviews

Conclusions, Implications & Future Work

Computational technology has changed what we can measure, and how we can show information. This, in turn, is placing new demands on what is important to know about representational practice. We see dynamic representational competence - students' ability to design indicate change over time using dynamics and rules as a representational components - as an important part of this practice. Here we began articulating patterns in how young learners approach problems of dynamic representation across a variety of situations and representational media. We hope this work will begin to provide us with traction for describing, comparing, and identifying productive correspondences among a large diversity dynamic representations, including nonnormative student expressions and just emerging disciplinary conventions for complex STEM phenomena.

Selected References
