manipul8

An Interactive Experience to Inspire Pattern-Based Algebraic Thinking and Representational Fluency

MOTIVATION

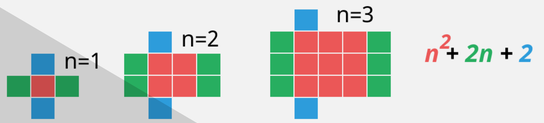
Mathematics learning has long utilized representations to aid in access to and mastery of ideas. Further, these representations can be portions of representational systems (Goldin, 1987), which are composed of multiple external representations that produce outputs relative to changing inputs. The conceptualization of basic algebraic structures and equations as representational systems may be particularly helpful for learners.

Patterns are a common visual entry point for mathematics learners in considering these algebraic functions; however, students typically struggle with the geometric visualization of functions, visualization of additional pattern terms, and formation of conceptual connections between position value and the pattern itself (MacGregor & Stacey, 1995; Warren, 2000).

Representational Fluency

The ability to fluidly translate between and relate representations of the same mathematical idea (Cramer, 2003; Kaput, 1989)

Pattern Graphic



RESEARCH QUESTION

How might dynamic and tangible technological systems support learners in realizing algebraic thinking and representational fluency as related to polynomial functions?

LEARNING GOALS

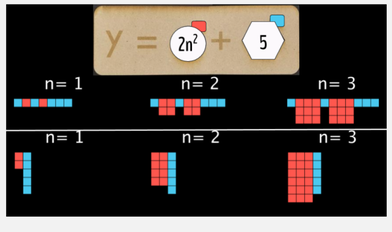
1. Explore patterns and equations to build **algebraic thinking** and consider structures inherent within algebra.
2. Make conceptual connections and transfer between external representations toward the achievement of **representational fluency**.

FUTURE WORK

- Development of additional modes of co-designed interaction
- Analysis of user noticing and sense-making
- Applications for online learning and professional development

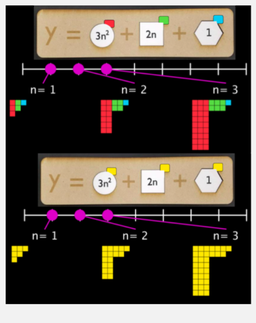
DESIGN RATIONALE

Multiple Representations



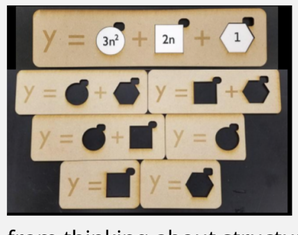
Manipul8 supports multiple modes of digital pattern visualization tightly-coupled with tangible equation representations.

Fadeable Color Scaffolds



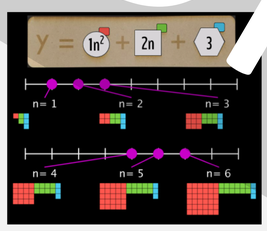
The application supports a color scaffolding mode, allowing users to intentionally link terms to corresponding pattern portions.

Structured Equation Frames



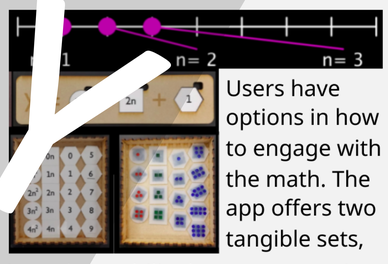
Users choose an equation frame/structure before choosing terms. This shifts users' cognitive load from thinking about structure and terms synchronously to considering them independently.

Dynamic Feedback



The digital layer of the TUI provides dynamic feedback to users. Immediately after a tangible is placed, the chosen pattern terms and corresponding pattern portions are rendered.

Learner Agency



Users have options in how to engage with the math. The app offers two tangible sets, interchangability between equations, and a slider for exploring multiple values of 'n'.

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