Title: The Role of Gesture as a Form of Participation in Networked Classrooms  
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**Focus & Introduction**

Role of Gesture

We have been studying the role of gesture as a mechanism to understand how students make sense of mathematical structures (e.g. families of functions) in networked classrooms. We have integrated SimCalc software into Algebra High School classrooms. The software works on a TI-83/84+ and in parallel on a desktop PC, in conjunction with TI-Navigator’s wireless network. The software allows students to create functions algebraically or graphically (e.g. dragging hotspots) and see dynamic representations of these functions through animations of actors whose motion is driven by the defined function. We have created sets of activities that exploit these new technological affordances in a mathematically meaningful way.

**What is a wirelessly connected classroom using SimCalc Connected MathWorlds?**

- A connected classroom combines two basic technology affordances: Representation and Communication.
- Parallel software: Students create mathematical objects on our software running on a TI calculator, while aggregated into our host software running on the PC via TI-Navigator wireless network.
- Such an action by the teacher, though, was not done in an arbitrary fashion (i.e. collect all work) but in a mathematically meaningful way.

**Categories of Gesture**

- **Mathematical Activity:**
  - An Analyze the family of linear piecewise functions created by y=2x+g where g is Group Number.
  - Students describe how the graphical representation of the piecewise-motion will look.  
  - The teacher of the class then mimics his gesture. 
  - Mike is describing the graph of the piecewise-motion.
  - Public: Mathematical Slope-as-Rate  
  - Static  
  - Iconic {McNeill}

- **Mathematical Activity:**
  - An Analyze the motion of a linear piecewise function in order to describe it graphically.
  - Molly-Kate uses his hands to describe how the graphical representation of the piecewise-motion will look.  
  - Students trace with gesture, using his hand and arm, how the graph of the piecewise-motion will look.  
  - He moves his hand back and forth, as though tracing a curve.  
  - The teacher of the class then mimics his gesture.
  - Public:  
  - Mathematical Slope-as-Rate  
  - Dynamic  
  - Teacher  
  - Iconic {McNeill}

- **Mathematical Activity:**
  - An Analyze the motion of the family of functions created by:  
  - v(t) is count-off #1's motion of a pair of functions that pass the point of intersection; he is explaining that this motion is due to a domain that lasted too long.
  - His hand moves back and forth, as though tracing a curve.  
  - The teacher of the class then mimics his gesture.
  - Public:  
  - Mathematical Slope-as-Rate  
  - Static  
  - Iconic {McNeill}

- **Mathematical Activity:**
  - An Analyze the motion of the family of functions where each student and their partner starts equidistant from 3 feet and travels at a constant rate to meet at 3 feet at the same time in a chosen duration.
  - Ashleigh uses hands to describe the erroneous motion of a pair of functions that pass the point of intersection, he is explaining that this motion is due to a domain that lasted too long.
  - The teacher of the class then mimics his gesture.
  - Public:  
  - Dynamic  
  - Teacher  
  - Iconic {McNeill}

- **Mathematical Activity:**
  - An Analyze the motion of the family of functions which each student in a SimCalc intervention in which they temporarily replaced part of their regular curriculum with SimCalc materials for 3-6 weeks.
  - An Analysis of the growth of the students participating in the study.
  - Public:  
  - Mathematical Slope-as-Rate  
  - Static  
  - Iconic {McNeill}

**About the Study**

All 9th grade High School Algebra 1 students in two districts took a pre- and post-test. A selection of teachers in these schools participated in a SimCalc intervention in which they temporarily replaced part of their regular curriculum with SimCalc materials for 3-6 weeks. This bar graph illustrates the mean gains from pre to post for the Comparison vs. Treatment groups in the schools who participated in the study. In the Treatment group, mean gain is about 2 points out of a total of 22 points. In the Comparison group, mean gain is about 1 point. This group difference is statistically significant, t=2.37 (p<0.01). The majority of teachers who used the SimCalc intervention unit had the most significant gains.

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