An introduction to the profound potential of connected mathematical activities: Issues of representation, engagement and pedagogy

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What is Technology?

• Re-examine in a serious and reflective way of what is technology and where is it, and what does it do?

• Is the “it” more global and social?

• Representation and Communication Infrastructures

• A historic note on notation systems
Overview

• Immersion into Classroom Connectivity - example: TI-Navigator Learning System and a series of activities.

• Reflections

• Introduction to Networked MathWorlds (beta) - from Calculator MathWorlds (83Plus) to Java MathWorlds (Cross-Platform)

• Discuss profound issues for education and educational technology
Predictions Re the Future of Educational Technology Devices

- They will increasingly be embedded in wirelessly connected systems of multiple device-types
- Their patterns of use will increasingly shift from private interactions with one device to public interactions in classrooms
- Discuss scale and patterns of interaction
Combining two volatile ingredients

• Dynamic Mathematics - Interactive Objects that Students Control to DO Something (Not only manipulate a traditional notation system)

• Connectivity Support for Integrating Math with Personal and Social Experience Inside the Classroom
Two basic technology affordances

• Representation
  Old static forms re-instantiated in dynamic-interactive media
  Old syntactically-defined actions redistributed from human to tool (e.g., CAS symbolic manipulators)
  Dynamic linkages across inherited forms
  Creation of new forms (e.g., Dynamic Geometry and other dynamical mathematical objects, Iterative Mathematics, …)

• Communication
  Outside Classrooms (WWW, etc.)
  Inside Classrooms - Major new possibilities!
  Synergistic Combinations of the Two Affordances
immersion ... lets start with TI-Navigator Learning system
Reflections: Pedagogically

- Students make mathematical objects to be publicly shared & discussed
- Students project their personal identity into the objects and motions
- Students math experience and social experience are deeply intertwined
- Teachers are in a central role orchestrating classroom events
Introduction to SimCalc MathWorlds

- Two pieces of parallel software
- Common data structures
- Dynamic Simulations + Connectivity
A SimCalc Assumption: Math Needs to Be About Something
Basic MathWorlds Features

• Dynamic simulations hot-linked to graphs & formulas (which are about the motions)
• Graphically definable & editable functions, including piecewise-defined functions
• Import & re-animate CBR/L motion data
• Visualization tools (e.g., “dropping marks” during motions)
• Hot-linked rate & accumulation data (e.g., velocity & position)
Warning!

- Beta!
- We will examine the software from an activity perspective
- Focus on a trajectory from computer to device
- Exciting Sack Race: from a qualitative form of slope to understanding rate and the mean value theorem by manipulating representations!
Week 2 - Classroom Connectivity

- Networked MathWorlds
- Combining Calculators and computers
Technologically, What Is Happening?

• We have a common data-structure across computer and hand-held versions of SimCalc MathWorlds (Calculator MW & Java MW)

• We integrate with Navigator’s communication infrastructure to move data (especially MathWorlds functions) between device-types
How Do We Exploit Connectivity?

• Facilitate work-flow to & from students: activities, assessments, homework, etc.
• Make individual mathematical constructions public, e.g., “mathematical performances”
• Aggregate student constructions to:
  • Vary essential parameters on a per-student basis
  • Elevate student attention from single objects to parametrized families of objects
• Provide opportunity for generalization across cases
  • Expose common thought-patterns (e.g., errors)
Strategically, What Are We Doing?

• We enable the teacher to render an individual’s mathematical activity public in a shared display
• We interlink mathematical structures and classroom social structures (both designed and naturally occurring) to create new forms of learning, new activity structures
• We intensify, focus & manage student attention
• We promote the infusion of personal & social identity in students’ mathematical constructions
Reflections on the Projection-of-Identity Into the Public Space

• Each person/group is “up there” (no place to hide)
• What is given & what is hidden is tightly manipulable to serve a wide range of pedagogical & curricular aims
• Personal identity is projected into the public object
• Attention can be explicitly managed by the teacher by showing/hiding/grouping students’ constructions
• Classroom is infused with affect & social authenticity
• The above features in combination enable the teacher to enhance the intensity of classroom learning in new ways
Constructing Pedagogical Actions

How do your:

Motion(s)  Look Different as An Individual vs. the Group
Graphs  Look the Same as An Individual vs. the Class
Formula
Tables  The Group vs. the Class