Investigating Students' Conceptual Understanding and Transfer in Mathematics

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Motivation

Gain insights into students' …

- Conceptual development of mathematical understanding over time, and their
- Ability to work in different contexts and with different representations.

Research Questions

- RQ1: If and when do students develop conceptual understandings of mathematical ideas such as functions?
- RQ2: How do students' conceptual understanding of mathematical ideas support or fail to support transfer of learning to new contexts?
- RQ3: Do experiences from other contexts support development of conceptual understanding in pure mathematics?

Theoretical Perspective

APOS Theory (Dubinsky '91) Rate students' conceptual understanding as at the Action, Process, or Object level.

Action: able to carry out rote procedures, bound to specific representations

Process: able to see the process as a whole, can use multiple representations, can reverse the process, compose with other processes, etc.

Object: reify the process into an object, can discuss properties of the object or collections of examples of the process

In determining these ratings we also utilize the ideas of Vygotsky's Zone of Proximal Development and consider what students can accomplish both on their own and with additional hints.

Research Context

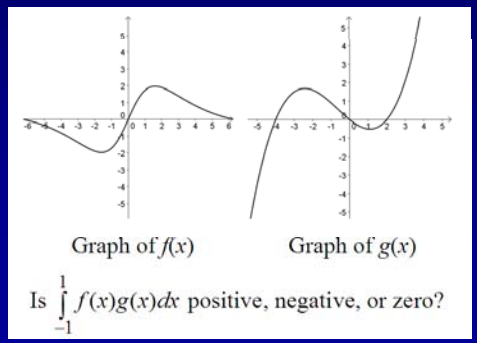
- Calculus sequence through Differential Equations
- Longitudinal tracking through additional courses in physics and engineering

Methodology

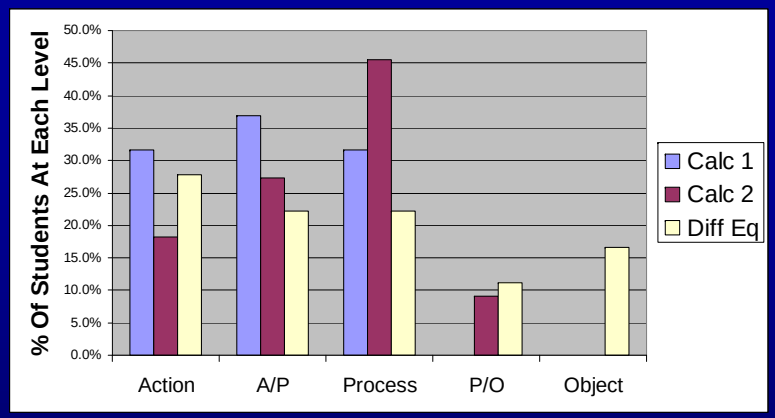
Individual teaching/learning interviews with problems at multiple levels that call for manipulating representations other than algebraic formulas for functions

Using the table below, what is g(f(2))?

x	*f*(*x*)	*g*(*x*)
-2	-8	-1
-1	0	4
0	-2	-2
1	4	-8
2	-1	0



Preliminary Results



- Some students' conceptual understanding grows over time, but other students succeed in the courses without gaining conceptual understanding.
- Students typically understand multiple representations, but have trouble coordinating ideas across more than one representation in a single problem.
- Students tend to transfer ideas in algebraic representations more easily than in other representations when applying ideas to other disciplines.

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