RESEARCH IN MATHEMATICS EDUCATION AT THE NEXUS OF MATH, MIND, BRAIN, AND WORLD

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All mathematicians concern themselves with mathematics, and most scientists and engineers concern themselves with mathematical applications. Some psychologists concern themselves with mathematical cognition, and a few neuroscientists have recently begun to concern themselves with the physiology supporting mathematical thinking. This broad spectrum of study comes to a focus in mathematics education. It would seem appropriate therefore, that mathematics educators and researchers in mathematics education concern themselves with how these studies interrelate.

Understanding the relation between mathematics and the material world has long been a classical problem in the history of the philosophy of mathematics. More recently, the potential roles of psychology and physiology have been added into this equation. Can recent psychological developments in cognitive science, or recent physiological findings in the neurosciences shed light on this problem, or do they complicate the matter further? This talk is concerned with identifying and explicating some central issues that are emerging in understanding research in mathematics education at the nexus of math, mind, brain, and world.

What, for instance, are the implications for teaching and learning mathematics of limiting or defining mathematics and/or mathematical cognition in neural terms? Can, or should we try to extend our understanding of mathematical cognition downwards into the very fabric of the world out of which the human organism has emerged? In terms of mind-brain identity and interaction theories, how and at what level(s) do categorical structures of cognition relate to physiological structures?

At a more functional level, what mathematical operations are primitive and which are derived or adapted? What operations are innate, if any, and which result from the conscription of preexisting neural processes that may have evolved for different purposes? In terms of mathematical applications, what aspects of mathematical understanding, if any, are unconsciously embodied in the evolutionary past of human development (e.g., numerosity)? What aspects are normative? That is to say, what aspects may have been consciously developed solely on the basis of more recent human motivations and purposes (e.g., cryptology)?

The emerging need to address such issues requires critical evaluation the ability of our existing conceptual frameworks to do so. Some basic philosophical assumptions may need to be reevaluated, and some consideration of new ones may be warranted. Attempting to develop new roadmaps for navigating through these kinds of issues poses many new interesting questions and challenges for teaching and learning mathematics, and promising new directions for research in mathematics education.