What Does Technology Bring to the Common Core Mathematical Practices?

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EXECUTIVE SUMMARY

This chapter describes how technology can support the implementation of the Common Core Standards for Mathematical Practice. Example problems are provided with details about how dynamic technologies support problem exploration and students' development of the mathematical practices.

INTRODUCTION

"Major limitations of computer use in the coming decades [in teaching mathematics] are likely to be less a result of technological limitations than a result of limited human imagination and the constraints of old habits and social structures" (Kaput, 1992, p. 515).

It is left to the reader's judgment as to the predictive nature of this statement from over twenty years ago regarding the current state of technology use in teaching and learning mathematics. It is true though that while resources for teaching mathematics with technology certainly exist, there is much disagreement among teachers as to what constitutes appropriate and effective use of technology in the field (or if technology should even be allowed at all). Does a teacher introduce technology from day one in kindergarten as a tool for mathematics, or does a teacher delay the introduction of technology until a student knows the "basics" (whatever that might mean)? Is technology to be the ladder into the tree of mathematics that Kennedy (1995) described? Thereby allowing students access to mathematics that they might not otherwise experience. Or, instead, is technology a cheat? The last bastion of a student who doesn't understand even the most fundamental mathematical principles?

Since the advent of the first handheld calculators in the seventies (Waits & Demana, 2000) to the computer algebra system (CAS) enabled devices of today, the promise of technology for teaching and learning mathematics has been with us for quite some time. In 1995, the authors of *Algebra in a Technological World* wrote that, "This technology demands new visions of school algebra that shift emphasis away from symbolic manipulations toward conceptual understanding, symbol sense, and mathematical modeling" (Heid, Choate, Sheets, & Zbiek, p. 1). This was followed in 2000, by the National Council of Teachers of Mathematics (NCTM) Technology Principle, stating, "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (PSSM, p. 24).

In 2014, NCTM further reiterated their strong support for the use of technology in mathematics teaching and learning through an updated Technology Principle (called the Tools and Technology Guiding Principle) in *Principles to Action: Ensuring Mathematical Success for All*. The guiding principle promotes tools and technology as "…essential resources to help students learn and make sense of mathematical ideas, reason mathematically, and communicate their mathematical thinking" (NCTM, p. 5). Fulfilling this promise by integrating technology into a mathematics curriculum requires that one believes technology enhances and changes mathematics learning as well as mathematics teaching.

One question to ask if we are to use technology in mathematics, is what do we want from technology? Another question is what should we expect of students using technology? Should we enhance the current curriculum or should we attempt to teach even more mathematics and go further and study mathematical ideas more deeply than ever before?

With the implementation of the Common Core State Standards in Mathematics (CCSSM), a new push for the integration of technology in mathematics learning and teaching should follow. Many of the specific standards call for mathematical experiences that can either be enhanced or completely facilitated with technology. These standards should create more opportunities for the judicious use of technology in both teaching and learning mathematics.

The CCSSM represents the most recent effort to offer students a mathematics experience across the K-12 curriculum that moves "towards greater focus and coherence" (CCSSI, 2010, p. 3). Building upon the NCTM standards efforts (NCTM,