

The Nature of Mathematics

In 2000, the National Council of Teachers of Mathematics published the Principles and Standards for School Mathematics for all grades pre-k through 12. The principles are tenets of high quality mathematics education, while the standards are the content goals for students to master. Within standards, a further subdivision exists between content and practices. For content, there are 5 overarching content areas: Numbers and Operation, Algebra, Geometry, Measurement, Data Analysis and Probability. The practices discuss how mathematics should be discussed and explored in the classroom to better model authentic learning of mathematics as an organic body of knowledge.

The **Principles** are mapped out below:

Equity. *Excellence in mathematics education requires equity—high expectations and strong support for all students.*

Curriculum. *A curriculum is more than a collection of activities; it must be coherent, focused on important mathematics, and well articulated across the grades.*

Teaching. *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*

Learning. *Students must learn mathematics with understanding, actively building new knowledge from experience and previous knowledge.*

Assessment. *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*

Technology. *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

It's clear from the Principles above, that the teaching of mathematics is more than just an isolated classroom mastering a set of algebraic procedures. The teaching of mathematics should embody strategic long-term planning within the mathematical community within the school, ranging from vertically aligning a coherent curriculum across grade levels, bringing relevance in mathematics to life based on student interest and populations, implementing technology intentionally, and measuring and modifying plans after reflecting on student successes. These principles make it clear, that to be a successful teacher means more than just teaching.

A buzzword in education reform is “21st Century Classrooms”, highlighting one the principles above under Technology. It's a buzzword that persists, as it is easy to see technology's importance increasing with each passing year. Students are not only expected to learn the curriculum, but also be able to interact with that curriculum through advances technological applications like programming, excel sheets, calculator syntax, analyzing computer output, ... As a result of this, I wanted to explore the **Nature of Technology** and how it relates to mathematics education. Below, I will list out the CCSS Mathematical Practices alongside the Standards of Technology in order to explore some of the intersections of philosophy and expectations among the technology and mathematics communities.

Mathematical Practices

Problem Solving. ... By solving mathematical problems, students acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations that serve them well outside the mathematics classroom.

Reasoning and Proof. ... People who reason and think analytically tend to note patterns, structure, or regularities in both real-world and mathematical situations. ...

Connections. Mathematics is not a collection of separate strands or standards, even though it is often partitioned and presented in this manner. ...

Representations. Mathematical ideas can be represented in a variety of ways: pictures, concrete materials, tables, graphs, number and letter symbols, spreadsheet

Communication. Mathematical communication is a way of sharing ideas and clarifying understanding...

displays, and so on. ...

Technology Standards

Standard 1: Students will develop an understanding of the characteristics and scope of technology

Standard 2: Students will develop an understanding of the core concepts of technology

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Similar to the mathematical practices, the technology standards are not a curriculum. They are not detailed instructional goals that define learner outcomes. They are instead frameworks that build a philosophical net for how a learner should interact within the learning community in order to explore ideas and concepts. They are the why and how, while the content standards themselves serve as the what. The technology standards are almost too vague to be of direct use, however the Nature of Technology chapter outlines examples of how to implement each of these standards by grade level. Elaborating specific examples of certain tasks that would meet proficiency per grade level chunks helps to be able to plan lessons that are on grade level or beyond with more concrete support. Many of these examples are actually framed within the science perspective, however it is definitely within the realm of possibility to apply them into the mathematics classroom as well.

The following examples are from the G9-G12 section.

- “Technology diffusion is increasing” can easily be explored through logistics curves alongside population growth.
- “Most development of technologies these days is driven by the profit motive and the market” can easily be explored through the mathematics of business, revenue, and profit.
- “Optimization is an ongoing process or methodology of designing or making a product and is dependent on criteria and constraints.” is a topic that screams for Calculus. Intentionally including examples from the technological world would do wonders to highlight this effect.

After reading the Nature of Technology, I feel as though the mathematics community has done a lot more to develop the principles, standards, and practices than the technology community has. I would like to see more development of these from the technology community, as to be better guides for the M and S communities on adequately preparing our students for future; one in which technology literacy will be of utmost importance.