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Overview of Principles and Standards for School Mathematics

Principles for School Mathematics

Educational decisions made by teachers, school administrators, and other professionals have important consequences for students and for society. The Principles for school mathematics provide guidance in making these decisions.

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The Equity Principle

Excellence in mathematics education requires equity--high expectations and strong support for all students.

All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study--and support to learn--mathematics. This does not mean that every student should be treated the same. But all students need access each year they are in school to a coherent, challenging mathematics curriculum that is taught by competent and well-supported mathematics teachers.



Too many students--especially students who are poor, not native speakers of English, disabled, female, or members of minority groups--are victims of low expectations in mathematics. For example, tracking has consistently consigned disadvantaged groups of students to mathematics classes that concentrate on remediation or do not offer significant mathematical substance. The Equity Principle demands that high expectations for mathematics learning be communicated in words and deeds to all students.

Some students may need more than an ambitious curriculum and excellent teaching to meet high expectations. Students who are having difficulty may benefit from such resources as after-school programs, peer mentoring, or cross-age tutoring. Students with special learning needs in mathematics should be supported by both their classroom teachers and special education staff.

Likewise, students with special interests or exceptional talent in mathematics may need enrichment programs or additional resources to

keep them challenged and engaged. The talent and interest of these students must be nurtured so that they have the opportunity and guidance to excel in mathematics.

Well-documented examples demonstrate that all children can learn mathematics when they have access to high-quality mathematics instruction. Such instruction needs to become the norm rather than the exception.

The Curriculum Principle

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

Mathematics is a highly interconnected and cumulative subject. The mathematics curriculum therefore needs to introduce ideas in such a way that they build on one another. Instead of seeing mathematics as a set of disconnected topics, students should perceive the relationships among important mathematical ideas. As students build connections and skills, their understanding deepens and expands.

The curriculum also must focus on important mathematics--mathematics that is worth the time and attention of students and that will prepare them for continued study and for solving problems in a variety of school, home, and work settings. The relative importance of particular mathematics topics is likely to change over time. Topics such as recursion, iteration, and the comparison of algorithms have emerged and deserve increased attention because of their relevance.

Students should have opportunities to learn increasingly more sophisticated mathematical ideas as they progress through the grades. They should not spend a significant part of their instructional time reviewing mathematics content. A well-articulated curriculum is necessary for teachers at each level to know what mathematics their students have already studied and will study in future grades.

The Teaching Principle

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

Students learn mathematics through the experiences that teachers provide. Teachers must know and understand deeply the mathematics they are teaching and understand and be committed to their students as learners of mathematics and as human beings.

There is no one "right way" to teach. Nevertheless, much is known about effective mathematics teaching. Selecting and using suitable curricular materials, using appropriate instructional tools and techniques to support learning, and pursuing continuous self-improvement are actions good teachers take every day.

The teacher is responsible for creating an intellectual environment in the classroom where serious engagement in mathematical thinking is the norm. Effective teaching requires deciding what aspects of a task to highlight, how to organize and orchestrate the work of students, what

questions to ask students having varied levels of expertise, and how to support students without taking over the process of thinking for them.

Effective teaching requires continuing efforts to learn and improve. Teachers need to increase their knowledge about mathematics and pedagogy, learn from their students and colleagues, and engage in professional development and self-reflection. Collaborating with others-- pairing an experienced teacher with a new teacher or forming a community of teachers--to observe, analyze, and discuss teaching and students' thinking is a powerful, yet neglected, form of professional development.

Teachers need ample opportunities to engage in this kind of continual learning. The working lives of teachers must be structured to allow and support different models of professional development that benefit them and their students.

The Learning Principle

Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

Research has solidly established the importance of conceptual understanding in becoming proficient in a subject. When students understand mathematics, they are able to use their knowledge flexibly. They combine factual knowledge, procedural facility, and conceptual understanding in powerful ways.

Learning the "basics" is important; however, students who memorize facts or procedures without understanding often are not sure when or how to use what they know. In contrast, conceptual understanding enables students to deal with novel problems and settings. They can solve problems that they have not encountered before.

Learning with understanding also helps students become autonomous learners. Students learn more and better when they take control of their own learning. When challenged with appropriately chosen tasks, students can become confident in their ability to tackle difficult problems, eager to figure things out on their own, flexible in exploring mathematical ideas, and willing to persevere when tasks are challenging.

Students of all ages bring to mathematics class a considerable knowledge base on which to build. School experiences should not inhibit students' natural inclination to understand by suggesting that mathematics is a body of knowledge that can be mastered only by a few.

The Assessment Principle

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

Assessment should be more than merely a test at the end of instruction to gauge learning. It should be an integral part of instruction that guides teachers and enhances students' learning.

Teachers should be continually gathering information about their students through questions, interviews, writing tasks, and other means. They can then make appropriate decisions about such matters as reviewing material,

reteaching a difficult concept, or providing something more or different for students who are struggling or need enrichment.

To be consistent with the Learning Principle, assessments should focus on understanding as well as procedural skills. Because different students show what they know and can do in different ways, assessments should also be done in multiple ways, and teachers should look for a convergence of evidence from different sources.

Teachers must ensure that all students are given an opportunity to demonstrate their mathematics learning. For example, teachers should use communication-enhancing and bilingual techniques to support students who are learning English.

The Technology Principle

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

Calculators and computers are reshaping the mathematical landscape, and school mathematics should reflect those changes. Students can learn more mathematics more deeply with the appropriate and responsible use of technology. They can make and test conjectures. They can work at higher levels of generalization or abstraction. In the mathematics classrooms envisioned in *Principles and Standards*, every student has access to technology to facilitate his or her mathematics learning.

Technology also offers options for students with special needs. Some students may benefit from the more constrained and engaging task situations possible with computers. Students with physical challenges can become much more engaged in mathematics using special technologies.

Technology cannot replace the mathematics teacher, nor can it be used as a replacement for basic understandings and intuitions. The teacher must make prudent decisions about when and how to use technology and should ensure that the technology is enhancing students' mathematical thinking.

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