

**SECTION 7**  
**TECHNOLOGICAL APPLICATIONS**

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## **42. WHAT TECHNOLOGY WORKS FOR TEACHING MATHEMATICS AND WHY – A PERSPECTIVE, PART I**

One important question that is really not asked much is “What technology works for teaching?” It is generally assumed that calculators, graphing and others, are “it.” But are they really? In this brief report, we consider just a couple of aspects of technology such as

- What’s important?
- Old Technologies
- Research says?
- General technology principles
- Not-so-old technology
- New and emerging technologies
- Household technologies

What’s important for students? The three “T’s,” of course: training, testing, and tutorials. What’s important for teachers? There is teaching mathematics, guided assessment, identifying misconceptions, and tracking progress. And what’s important for the schools? We offer successful students, quality education, teacher quality, and elevated standardized test scores. The fundamental question relates to how technology helps make this happen. So, just how is technology used in the schools?

Technology for students is a multi-faceted affair. We have

- Student learning (including interactive applets, video tutorials, and calculators)
- Student remediation
- Student communication
- Student to student interaction including collaboration (including communication)
- Diagnosing student ability and learning issues
- Assessment of students
- Distance learning—synchronous and asynchronous

Technology for teachers is likewise, multi-faceted, and we observe the following types of applications

- Teaching students
- Diagnosing student ability and learning issues
- Assessment of students
- Assessment of teachers

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Teachers communicating with parents and teachers  
Management of student/teacher progress  
Concept discovery  
Guided assessment

Covering all these points would involve a book-length article. So, to confine ourselves to just a couple of pages, we consider just one question: “What should technology do?” More particularly, what should technology do in the mathematics classroom? Here are the basic points:

Be an integral part of the problem solving process.  
Enable understanding – not just give an answer.  
Not do the thinking. Thinking must be key to the process.  
Have a gentle learning curve with more power coming with more study, but powerful even at the entry level.  
Be interactive, engaging, empowering, and even cool.

This sounds good, but is not that easy to achieve – especially the last point. Is the technology “engaging, empowering, and even cool?” Do students see a need for it after graduation? Can it be used to solve problems? Do their parents use it? Do their “heroes” use it? Is it important?

Let’s look as some old technology, such as pen and paper algorithms, look-up tables, counting boards – abacus, slide rule, adding machines, calculator, and chalk – slate blackboard. How many are still used today – even after thousands of years? What made them successful is that they were fun, engaging, and empowering. They enabled us to solve problems better/faster, consider more complex problems, and led to enhanced algebraic thinking (e.g. programming). Moreover, what they did was remarkable. They sped and facilitated problem solving, allowed the mechanical parts of problems (e.g. arithmetic) to be faster, allowed more realistic problems to be solved, empowered the user, and were used ubiquitously. Once again, the last point is most important. If a technology is regarded only for classroom use, students will relegate it just to the classroom and not as a part of their lifelong learning.

Just as how important the technology is and what it can do, we have the flip side of what it does *not* do. Namely, good technology does not substitute for thinking, interfere with the mathematics understanding, detract from mathematics learning, or have steep learning curves (mostly). *All* of these are key points. Technology must not get in the way of actual learning and thinking! So what does the research say?

Technology has been proven effective when...

Implemented carefully  
Leadership is on board  
Professional development is given  
Appropriate curricular design is achieved

WHAT TECHNOLOGY WORKS FOR TEACHING MATHEMATICS AND WHY

But many educators have

- Miscalculated the difficulty of implementation

- Over-promised the deliverables

- Over-promised the ability to extract a learning return on technology

Read the Cisco-Metri report. It is enlightening. See <http://www.cisco.com/web/strategy/docs/education/TechnologyinSchoolsReport.pdf>

We will continue this discussion in the next article.