The recent Department of Education report ***Effectiveness of Reading and Mathematics Software Products: Findings from the First Student Cohort*** should be a wake up call to anyone looking at technology in education. The report's authors found that classrooms using math and reading software products did not produce better test results than those in control classrooms.

How can a technology that is transforming the way we acquire information throughout the economy and that is revolutionizing businesses from games to banking have no effect on education, a knowledge- and information-intensive enterprise? How can technology that is transforming training in the Department of Defense have no impact on traditional school systems? The report underestimates the impact of technology already being used, and it underscores the tragedy of national underinvestment in learning strategies that can be enabled by new technology and the software needed to make them practical.

The United States has made a huge public investment in bringing hardware to schools, but expected private investors to undertake the enormously expensive and difficult research, development and testing needed to make effective use of the hardware. Ten years ago an inside joke for economists was: "information technology is showing up everywhere in the economy except in the productivity statistics." No one is laughing now because productivity is heavily dependent on IT advances.

It took years to figure out how to actually use the technology–including major reinvention of business practices. This has not happened in education given the difficulty of marketing innovations to school systems already overwhelmed by increasing demands and fixed resources. It's painful to see that the federal government would invest $10 million in reviewing commercial software when it has made such a small investment in helping developers design and test software for schools.

Where the report is helpful:

The level of investment on research and testing by many educational software producers is often significantly below the investment made in other commercial software products. Successful users such as the Department of Defense recognize that it's expensive to develop effective products, and products only succeed if they've gone through repeated cycles of testing and improvement. In most cases, they are effective only if the basic strategies of instruction change to reflect the unique capabilities of the software–such as letting each student proceed at their own pace. It's essential that products actually purchased by schools be held to high standards of performance. The difficulty is, of course, that few commercial developers have the resources to undertake the R&D investment needed, given the complexities and high risks of developing and marketing educational software.

Where the report can be misread:

The report is not evidence that instructional technology cannot be a powerful learning tool. It proves that results on standardized tests are not significantly improved by the systems found in a sample set of schools. If nothing else, 86-92 percent of the teachers in the program found the systems useful and plan to use them. They are clearly seeing a value in the systems not measured by the tests. Furthermore, the study focused on determining whether or not the technology was better than traditional teaching methods,

yet the technologies were not examined as productivity tools. The study results indicate that while the technology produced outcomes that were no worse than traditional teaching, the use of the software enabled teachers to help individual students. The technologies offer a way to teach more students, with the same number of teachers, with no degradation of educational quality. The study seems to indicate that these technologies are good productivity tools.

The experimental methods used were carefully designed, but suffered from a number of fundamental problems that could not be avoided.

- Most of these systems were developed a number of years ago and do not reflect state of the art software.
- Some of the most important features of technology-based instruction could not be tested in most of the systems. For example, good software allows each student to proceed at his or her own pace–something not possible in standard classrooms. The best software also carefully integrates continuous testing, making it clear to the student whether they are proceeding toward a goal. A final test should bring no surprises. In most of the cases, the software was not designed specifically to produce a result on a specific test, making it unsurprising that an instructor focusing narrowly on specific test results would produce better learning outcomes.
- The study notes that "The results reported here are based on schools and teachers who were not using the products in the previous school year." This means that teachers were using the system for the first time. In subsequent interviews, 50 percent of the teachers indicated that once they had begun to use the software in the classroom they recognized the need for more support and training. It's not surprising that they were not fully fluent in using the material.
- Many of the teachers used the material for "supplementary" or "enrichment" purposes. This could have made learning more interesting to the students, but such side line instruction may not necessarily provide a specific impact on standardized test scores. In addition, in many of the tests, there was an average of one computer for every three students, making management of the instruction difficult for the instructors. The use of software products averaged only 10-15 percent of instructional time.
- To protect individual vendors, the report was forced to mix results of a variety of products probably diluting the impact of excellent products.
- The tests involved a large number of students and teachers but, since the study covered four different grade levels and several educational software packages at each grade level, the actual sample sizes (250-500 students) were not large for any given study. Some of the better software packages, such as the Carnegie Cognitive Tutor Algebra program, have involved similar sized cohorts and reached different conclusions.

Another problem is that instructional software may be at its best at teaching skills not well tested in standardized exams. The Carnegie Cognitive Tutor Algebra, for example, showed a small impact on SAT scores, but more than tripled performance on "problem solving" tests. Testing sophisticated skills is another untapped potential of instructional software.

The bottom line

There's a huge gap between the potential of educational technology and the products that are now in the market. This is a well-documented market failure–schools are a difficult market for entrepreneurs and entrepreneurs badly underestimated how difficult and costly it is to develop products that work. The new report underscores the need for public funding of research and testing to find out what works.

We need to teach an increasingly diverse population a sophisticated set of skills without blowing the budget. Technology provides a critical resource for meeting this challenge. There's no doubt that kids expect to learn from technology–they make huge use of it outside of school. There is a clear need for more federal research in designing effective instructional software and testing innovations to find out what works and what doesn't.