

Why is having access to portable handheld devices in a teacher's own math classroom better than going to a computer lab?

Research Note 11

Prepared for Texas Instruments by the Center for Technology in Learning, SRI International,
December 7, 2007

Why is having access to portable handheld devices in a teacher's own math classroom better than going to a computer lab?

Research Notes 11

Portable handheld devices in the teachers' own classroom enable frequent, integral use of technology in teaching, whereas when a teacher and students must go to a different room, computer labs are likely to be occasional and peripheral to the learning process. Frequent, integrated use in teaching provides greater benefits from an investment in

Frequent, Integral Use is Important

Time is a precious resource in classrooms; students learn more when they spend more time on academic learning tasks (Cotton, 1989). Consequently, teachers will not use a technology often if it adds time, technical difficulty, or distractions. Portable handheld devices can be better than computers when they are designed to:

- Start up instantly;
- Be more rugged and less prone to unexpected crashes; and,
- Focus on key pedagogical tools and limit access to distracting, off-task tools.

Coherence is another precious resource; students learn more when all classroom resources are aligned around the same pedagogical goal (Schmidt et al., 2005). To achieve coherence, technology must be integrated with other aspects of classroom teaching, including textbooks, teacher-led presentations and discussions, and other physical resources in the classroom (Penuel, 2006). Portable handheld devices can be more easily integrated into a math classroom when they are designed to:

- Emphasize math (and not general Internet browsing);
- Be quickly picked up or put down without interrupting the flow of activity; and,
- Fit with the content and pedagogy of teachers' lesson plans.

Some of the best large-scale evidence for the benefits of frequent, integral use of handheld devices comes from the National Center for Educational Statistics (NCES) in the United States. Using data from a nationwide mathematics test that asked teachers how frequently their students used calculators, NCES found that eighth-graders (age 14) whose teachers used calculators almost every day achieved highest test performance. Weekly use was also associated with higher average test performance than less frequent use (NCES, 2001).

Computer Labs are Problematic

When technology is only available in a special purpose computer lab or ICT suite, teachers must schedule its use in advance, make a special trip to the room, and teach in a less familiar setting. Indeed, the physical layout of an ICT suite may be good for general computer skill development, but may not fit to math pedagogy.

A major survey study with more than 4,000 teachers found that increased access to computers in the teacher's own classroom, as compared to an ICT suite, was a strong determinant of computer use (Becker, 1999, 2001). Becker pointed out that scheduling the ICT suite time well in advance makes it almost impossible for computers to be integrated into the core academic work of a subject matter class. In another study, teachers report that when computers are in dedicated suites, they use technology less often for teaching because of the difficulty of scheduling time in the room and transporting students there (Adelman et al., 2002). Limited access has been often cited as a reason why teachers make limited use of technology with students (Adelman et al., 2002; Cuban, 2001; Sheingold & Hadley, 1990).

Benefits of Focused, Portable Appliances

Even though enthusiasts can make a phone call through a desktop computer, there is a reason why most of us carry a mobile phone instead. Similarly, many engineers and financial workers have a calculator on their desktop along with their computer. The idea here is what design researchers refer to as the value of *appliances* that are dedicated to serve a specific purpose exceptionally well. While a general-purpose device may do more, it is often harder to use, more complex, and more prone to error. Appliances can also be more personal and portable. Like mobile phones, well-designed appliances communicate among similar devices without complicated network issues. Indeed, the "computer" inside an appliance is often invisible;

the use of the device is so clear that people focus on the task-at-hand and not the nature of the tool (Sharpe & Stenton 2003; Norman, 1998).

Classroom-based research has provided evidence that shows these capabilities of handheld devices. In a year-long evaluation of handhelds with over 100 teachers, a large majority of teachers reported advantages of handhelds over desktop and laptop computers in portability, convenience in access, and ease in curriculum integration and information sharing (Vahey & Crawford, 2002). The teachers also reported greater student learning, student autonomy and homework completion, and more effective collaboration.

Towards a High-Quality Learning Experience across Places and Groupings

A major international synthesis (Chan et al., 2006) highlighted the ideas of “1:1” and “seamless learning” as the strongest reasons for adopting portable, handheld devices instead of fixed computer suites or “desktop replacement” laptops. Except in the most economically advantaged regions, schools cannot afford to give every student a full-featured computer. Low-cost handhelds easily enable a 1:1 student-computer ratio, making powerful learning tools (e.g., representations) ready-at-hand for *all* students. Furthermore, when every student has a device, they can use it when they need it.

Researchers also describe the potential for portable, handheld devices to support learning “seamlessly” across contexts (Pea & Maldonad, 2006; Roschelle & Pea, 2002). For example, a student can take their handheld device home, to the library, or on a school trip. Furthermore, students can use their handhelds within the classroom as the teacher leads the students through individual, small group, or full group work. The handheld’s small size and ease of use can enable learning across a range of meaningful contexts.

References:

- Adelman, N., Donnelly, M. B., Dove, T., Tiffany-Morales, J., Wayne, A., & Zucker, A. A. (2002). *The integrated studies of educational technology: Professional development and teachers' use of technology*. Menlo Park, CA: SRI International.
- Becker, H. J. (1999). *Internet use by teachers: Conditions of professional use and teacher-directed student use. Teaching, learning and computing: 1998 National Survey*. (Report #1). February. Center for Research on Information Technology and Organizations, University of California, Irvine, and University of Minnesota. Available at: <http://www.crito.uci.edu/tlc/findings/internet-use/text-tables.pdf>.
- Becker, H. J. (2001, April). *How Are Teachers Using Computers in Instruction?* Paper presented at the 2001 Meeting of the American Educational Research Association.
- Chan, T., Roschelle, J., Hsi, S., Kinshuk, Sharples, M., Brown, T., Patton, C., Cherniavsky, J., Pea, R., Norris, C., Soloway, E., Balacheff, N., Scardamalia, M., Dillenbourg, P., Looi, C., Milrad, M., & Hoppe, U. (2006). One-to-one technology-enhanced learning: An opportunity for global research collaboration. *Research and Practice in Technology Enhanced Learning*, 1(1), 3-29.
- Cotton, K. (1989). *Educational Time Factors*. (School Improvement Series, Close-Up #8). Portland, OR: Northwest Regional Educational Laboratory. Retrieved March 31, 2006 from <http://www.nwrel.org/scpd/sirs/4/cu8.html>.
- Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.
- National Center for Education Statistics. (2001). *The nation's report card: Mathematics 2000*. (No. NCES 2001-571). Washington DC: U.S. Department of Education.
- Norman, D. A. (1998). *The Invisible Computer: Why Good Products Can Fail, the Personal Computer Is So Complex, and Information Appliances Are the Solution*. MIT Press, Cambridge MA.
- Pea, R. D., & Maldonado, H. (2006). WILD for learning: Interacting through new computing devices anytime, anywhere. In K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (pp. 427-441). New York: Cambridge University Press.
- Penuel, W. R. (2006). Implementation and effects of 1:1 computing initiatives: A research synthesis. *Journal of Research on Technology in Education*, 38(3), 329-348.
- Roschelle, J. & Pea, R. D. (2002). A walk on the WILD side: How wireless handhelds may change computer-supported collaborative learning (CSCL). *The International Journal of Cognition and Technology*, 1(1), 145-168.
- Schmidt, W. H., Wang, H. C., & McKnight, C. C. (2005). Curriculum coherence: an examination of US mathematics and science content standards from an international perspective. *Journal of Curriculum Studies* 37(5): 525-559.
- Sharpe, W.P. and Stenton, S.P. (2002) Information appliances, in J.A. Jacko and A. Sears (Eds). *The Human Computer Interaction Handbook*. New York: Erlbaum.
- Sheingold, K., & Hadley, M. (1990). *Accomplished teachers: Integrating computers into classroom practice*. New York: Center for Technology in Education, Bank Street College of Education.
- The Human Computer Interaction Handbook. Schmidt, W. H., Wang, H. C., & McKnight, C. C. (2005). Curriculum coherence: an examination of US mathematics and science content standards from an international perspective. *Journal of Curriculum Studies* 37(5): 525-559.
- Vahey, P. & Crawford, V. (2002). *Palm Education Pioneers Program Final Evaluation Report*. Menlo Park, CA: SRI International.