

Technology in Support of the Classroom

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In the early 1990s, technology in the form of graphing calculators, spreadsheets, and computer algebra systems (CAS) was introduced to college math classes in the hope that it would transform and improve instruction. It was embraced with enthusiasm by some, rejected as dangerous by others. Data collected by the Conference Board of the Mathematical Sciences has shown that the use of computers and graphing calculators surged during the '90s, then fell back sharply in the first five years of this century (see "Reform Fatigue," www.maa.org/columns/launchings/launchings_06_07.html). A second wave is now approaching in the form of clickers, online homework systems such as *WeBWorK*, and course support software. How should individuals and departments respond?

There is a distinct difference between these waves. The first consisted of technologies that could "do mathematics." The second, while often incorporating sophisticated tools such as *WeBWorK*'s ability to recognize symbolic expressions in many different forms, has provided more general course support with less potential for supplanting technical expertise. It thus has produced less backlash. Nevertheless, the lessons learned from the first wave do tell us much about how to approach the second.

If there is anything that we learned from the first wave, it is that classroom technology, in and of itself, is never an answer. The technology is rather an opening to new ways of thinking about teaching and an invitation to re-examine how we teach. It was through the opportunities made possible by computers in the classroom that I learned the importance of constructing lessons that force students to engage with the basic concepts behind the mathematics I am teaching, exploring its connections and building a framework within which these concepts make sense and can be applied. Technology is not necessary to accomplish this. In fact, over the years, I have tended to move away from technologically intensive explorations because interacting with the computer adds an additional layer of complexity, but computers still provide tools that I rely upon as needed. For certain explorations, they are absolutely essential. The technology enables us to rethink and refresh our pedagogy by expanding what is feasible.

This is clearly the case with clickers, those personal classroom voting machines that I discussed in "Should Students Be Allowed to Vote?," www.maa.org/columns/launchings/

[launchings_03_09.html](http://www.maa.org/columns/launchings/launchings_03_09.html). While anything that increases student engagement in class has some benefit, the real power of clickers comes from their ability to facilitate peer instruction within large classes.

The same can be said for *WeBWorK*, the online homework system for which MAA runs a wiki site (webwork.maa.org). It enables immediate feedback for homework and mechanizes its grading and recording, something that is certainly useful. But its importance comes from how it enables the instructor to structure the way in which each student interacts with a given lesson outside of class. My April *Launchings* column, www.maa.org/columns/launchings/launchings_04_09.html, explores what we know about *WeBWorK* and its effectiveness.

Course support software brings other opportunities. Part of my use of *Moodle* is to facilitate Reading Reflections (see "Getting Students to Read," www.maa.org/columns/launchings/launchings_5_08.html), short online answers to questions about the section we are about to study so that students are forced to read and reflect on it *before* class, giving me advance warning of the points they find confusing.

Technology gives us opportunities, not solutions. To take advantage of these opportunities takes thought, work, and often a fair amount of experimentation. We need individuals who will take on the task of exploring these opportunities. We also need departments that support and encourage such individuals. This includes providing mechanisms for them to share their insights with their colleagues. It also includes setting up procedures that can lead to departmental adoption of the practices they discover that facilitate learning for the students at their college. 🍷

