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“Improving Calculus and Linear Algebra via Multiple Web Based Computer Tools”

In the past two years at the College of New Jersey, we have introduced a number of web based tools into our Linear Algebra and Calculus courses. These tools have greatly changed these courses and have made a great difference in students’ understanding and performance in the courses.

There are three different types of computer tools that we have used. First, as part of an NSF CCLI Adaptation and Implementation Grant, we introduced the use of ATLAST computer modules and a computer laboratory into our Linear Algebra course. The ATLAST modules are a set of NSF developed exercises that emphasize real-world applications of linear algebra. Exercises are based upon real world examples and involve linear systems involving more than the usual two or three variables. To facilitate the calculations, students use Matlab. They begin work on the computer exercises during a weekly computer lab and then finish the exercises later at home via the Web or at another computer lab. Our experience has been that the exercises and the use of Matlab promote student understanding by eliminating the difficulties of messy algebraic calculations and allowing students to see the underlying ideas behind the applications.

Secondly, we have used two different computerized homework grading systems. Last year, we used the Calculus on the Web (COW) homework system at Temple University in some of our linear algebra and calculus classes. This year, we have adopted the Webwork computerized homework grading system in these courses. While we have had different experiences with the two systems, with both having their own advantages, with both systems, we have observed increased student understanding. In particular, the Webwork computer grading system has completely changed the character of our introductory Calculus course. Student participation and involvement in their own learning has greatly increased with the use of Webwork. The college is in the midst of an overhaul of its curriculum and the Calculus sequence has been transformed from a four-semester sequence to a three-semester sequence. The use of Webwork has quickly become an integral part of the success of this transformation.

Finally, we have successfully used a number of computer demonstrations that are available on the web in the Linear Algebra and Calculus classes. Most notably, we have been making extensive use of the demonstrations that are a part of the Visual Calculus course materials developed at the University of Tennessee. These demonstrations are animations that quickly communicate to students the gist behind many calculus ideas. For most students, we have anecdotally experienced an enormous benefit in their Calculus understanding from the use of these demonstrations. There are fewer such demonstrations available for Linear Algebra, but we have successfully used several of them to quickly communicate the ideas and strategies of row reduction, linear combinations, and linear independence, for example.

In our talk, we will review and demonstrate these Web based tools while discussing their advantages and disadvantages and the differences they have made in the teaching of our courses.

