

## INTEGRATING INSTRUCTIONAL TECHNOLOGY INTO ELEMENTARY TEACHER PREPARATION

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The way elementary mathematics should be taught is in a state of rapid change. The *Principles and Standards for School Mathematics*, a document outlining mathematics standards for pre-kindergarten to grade 12, states in its Technology Principle, "Technology is essential in teaching and learning mathematics; its influences the mathematics that is taught and enhances student learning" (NCTM, 2000). The use of technology in elementary mathematics classrooms is an expectation stated in Pennsylvania's *Academic Standards for Mathematics*: "Because our capacity to deal with all things mathematical is changing rapidly, students must be able to bring the most modern and effective technology to bear on their learning of mathematical concepts and skills" (PDE, 1999). New instructional technology tools have flooded the market for elementary teachers to use in classrooms. The problem is that most elementary teachers did not learn mathematics or learn to teach mathematics using these tools. As a consequence, they are unprepared to use them or they do not use them at all.

A potential solution to this problem is to begin to use these technological tools in pre-service mathematics content and methods courses so that students learn mathematics and learn how to teach mathematics using these tools before they finish their pre-service training. This approach will equip elementary teachers with necessary skills to use these tools to meet math and technology standards for teaching and help them gain positive attitudes towards the appropriate use of technology.

Dr. Robert Matulis, Dr. Bernie Schroeder, and Dr. Michael Wismer, three mathematics instructors at Millersville University, Millersville, PA, participated in a \$250,000, one-year grant from the Commonwealth of Pennsylvania to more effectively integrate existing instructional technology [namely, Texas Instruments Explorer-Plus™ Calculator] in our two-semester math content courses [MATH 104/105]. In addition, the instructors wanted to incorporate a diverse assortment of instructional technology tools for math education. These included

- Texas Instruments TI-73™ graphing calculator
- Texas Instruments Calculator-based ranger [CBR]
- Geometer's Sketchpad
- Spreadsheet software

Drs. Matulis, Schroeder and Wismer spent a portion of the summer 1999 deciding what skills students should be able to do with educational technology. The instructors used the

Pennsylvania *Academic Standards for Mathematics* as a guide for evaluating technology and developing appropriate learning activities. Existing activities developed for each instructional tool were explored and tested to see if they would be feasible to use in our classes. Activities were piloted during the 1999-2000 school year. Each instructor gathered his own observations and instructors gathered student surveys at the end of each semester to record student confidence and attitudes towards the technology.

During the 1999-2000 academic year approximately 300 students participated in MATH 104 and 105 courses where Drs. Matulis, Schroeder and Wismer used educational technology tools. All three instructors incorporated the Texas Instruments' Explorer Plus, TI-73, the Geometer's Sketchpad and spreadsheets into in the sections of MATH 104/105 they taught.

In MATH 104 the Explorer Plus, the TI-73 and spreadsheets were used. We found the Explorer Plus useful for its capacity to store an operation for repeated usage, its capacity to represent and calculate with fractions and its ability to calculate whole number division problems as a quotient and remainder. The TI-73 calculator possessed these features and has a window display. This feature was used to help student see the result of operations with whole numbers and fractions on the same screen.

In MATH 105 the Explorer Plus, the TI-73, spreadsheets and the Geometer's Sketchpad were used. We found the TI-73 valuable when students were learning statistics because of it is able to store data (both numerical and categorical) in lists and generate numerous graphs of the data, especially circle graphs and box-and whisker plots. Students were also shown how to display data using various graphs and how to generate descriptive statistics using spreadsheets. We found the Geometer's Sketchpad a great asset when students were learning geometry due to its ability to present geometric concepts in a visual, dynamic, interactive environment. Specifically, students used the Geometer's Sketchpad when they were learning the properties of two-dimensional figures, how to do geometric constructions and in learning the geometric transformations of reflection, translation, rotation and dilation. Instructors used the Geometer's Sketchpad as a visual tool while teaching the geometry unit in MATH 105. The rooms where the course was being taught had a computer connected to a projection device that allowed instructors to do demonstrations of geometric concepts during the class.

We believe the activities we did with these educational technological tools meet specific standards stated in the Pennsylvania *Academic Standards for Mathematics* that all students (and teachers) must be able to do, namely:

- 2.2.5.F. Demonstrate skills for using fraction calculators to verify conjectures confirm calculations and explore complex problem-solving situations.
- 2.6.8.F. Use scientific and graphing calculators and computer spreadsheets to organize and analyze data.
- 2.9.5.E. Construct two-and three-dimensional shapes and figures using manipulatives, geoboards, and computer software.

- 2.9.8.A. Construct figures incorporating perpendicular and parallel lines, the perpendicular bisector and angle bisector using computer software.
- 2.9.8.I. Generate transformations using computer software.

In an initial analysis of student surveys, students responded favorably the activities in MATH 104/105 that used these technological tools. Students were especially impressed with the features of the TI-73 graphing calculator and the Geometer's Sketchpad and enjoyed learning to use these tools.

We observed that most students were familiar with working with technology and quickly picked up how to use the TI-73 and the Geometer's Sketchpad. We also noticed more students who chose to use the technological tools to complete projects once they knew how to use these tools. For example, MATH 105 students would do a geometric construction on the Sketchpad instead of doing the construction with a compass and straightedge. Students in MATH 105 also used spreadsheets to summarize and display data for statistics projects.

Two of the three instructors (one has retired) have continued using these tools in the MATH 104/105 courses, justifying the time spent teaching students how to use these tools an investment that will make these teachers better prepared to meet both state and national mathematics standards. However, the fact that we have only two 3-credit mathematics content courses limited the extent to which we could introduce these tools into our courses. For example, we had planned to use activities using a data collection device (Texas Instruments' Calculator-based Ranger [CBR]) in MATH 104/105, but we did not have time in the courses to implement these lessons. Students need time to work with these tools not only in mathematics content courses but also in mathematics methods courses and any other technology education courses with their undergraduate program.

#### **References:**

National Council of Teachers of Mathematics (2000). *Principles and Standards of School Mathematics*. NCTM, Reston, VA.

Pennsylvania Department of Education (1999). *Academic Standards for Mathematics*. PDE, Harrisburg, PA.

#### **Resources for Technology Tools:**

##### Texas Instruments TI-73 "Explorations™" Series:

Johnston, E.C. & Young, D.A. (1998). *Data Collection Activities for the Middle Grades with the TI-73, CBL, and CBR*.

Nast, M. (1998). *Discovering Mathematics with the TI-73: Activities for Grades 5 and 6*.

Johnston, E.C. (1998). *Discovering Mathematics with the TI-73: Activities for Grades 7 and 8*.

##### Key Curriculum Press Geometer's Sketchpad Series:

Wyatt, K.W., Lawrence, A. & Foletta, G.M. (1998). *Geometry Activities for Middle School Students with the Geometer's Sketchpad*.