Plotting the Future: Mathematics As We Never Knew It

By Jane Damaske and Ann Davidian

The TI-Navigator Classroom Learning System is a wireless system for the classroom that uses TI graphing calculators and assessment software. Using it, teachers can see, in real time, what each and every student is doing and what each and every student understands. We (Jane is a middle school teacher while Ann teaches high school) are math teachers from different parts of the United States with more than 30 years of experience each who are very excited about the benefits we have achieved through integrating this technology into our classrooms.

The Activity Center

Probably the feature we use most is the Activity Center. The computer is hooked up to a projector; that way, the whole class can work individually yet see what everyone else is doing. When a student does graphing by hand or on a graphing calculator, he or she only sees his or her own work. Imagine seeing 25 or 30 results at once.

Using the Activity Center lets students work in real time on equations, graphs, and other mathematics lessons. It allows kids to learn through exploration as a class, and really understand what's going on. Rather than the teacher just doing an example and providing notes, the whole class works on the problem together and discovers as a group what happens. Then 25 people can each discuss the 25 things they just did. When the students actually see what's happening, it is incredibly powerful.

We were both really impressed by how potent it was for students to immediately see on screen if they were on track, and found students amazingly willing to adjust their work if they weren't. No one could have done that on graph paper. How often do we as adults have to adjust what we're thinking or doing because we're on the wrong track? It's not always easy. Our students learned that lesson by themselves.

The ability to see everyone's work on screen has changed our way of questioning from “What would you do?” to “What would someone do?” Anyone—whether right or wrong—can respond, which is good for the students who always had it right and had little patience for others. They can see how someone reached the answer differently. The learning no longer just comes from the teacher saying, “Here's how;” now it comes from other students. To see their excitement, and for them to understand the explanation, is incredible.

Teachers can divide students into groups to do an experiment, such as coin tossing. With 10 or 15 groups of students flipping coins, the instructor can combine all the results and work with aggregated data. The students see that mathematics is real; it's not just problems to be worked out. This kind of collaboration allows the class to interact and figure out what went wrong and what went right. As a result, they get more comfortable with mathematics. This technology frees the students up to talk about why they got the wrong answer.

TI-Navigator has pushed us to discuss why a problem turned out the way it did, what went wrong, and what went right. This has helped to instill a strong sense of community in our classrooms. These days, the students in our classes say “We did well” or “We did poorly” rather than “I did.” It was a gradual change, but it came about because we work more as a team when we use connected calculators. When we discuss wrong results, we'll ask, “What could someone have done to get this wrong?” Because it's all done anonymously, no one feels embarrassed. Even the students who were correct can often figure out where a peer might have gone wrong. Without a connected calculator system, teachers don’t always have the opportunity to discuss wrong answers because they don't have all of them displayed in front of them.

Quick Polls

Using TI-Navigator's Quick Poll feature, a teacher can send a question to the entire class and immediately see who's right and who isn't. Sometimes, the instructor thinks she's covered something very thoroughly and discovers that some of the students really didn't understand the lesson. With a connected calculator system, she can go back and explain it differently, without waiting for a test or quiz result. How many times have teachers introduced a topic and had a classroom full of nodding heads? Well, the Quick Poll isn't a formal assessment, but it enables students to demonstrate that they understand. And it gives both the students and teacher a sense of what they know.

Here's an example from an AP calculus class. Because Ann is the department chair, she knew what material was covered in their pre-calculus class. She began discussing a new topic and no one had any questions, which sur-
basics and they could visualize what they were seeing on paper.

TI-Navigator is easy to learn. We tell people to learn one part and go from there. Jane recently trained a group of math teachers to use the system. When she started on Monday, they had absolutely no knowledge. By Wednesday, they were whipping through the various features, and by Friday, they presented incredible lessons. They just ran with it.

Best of all, after spending a year with TI-Navigator the students are anxious to see what else there is for them in math. This product has made us sure of one thing: we will never teach the same way again.

In Jane’s department, teachers use TI-Navigator in various ways that are compatible with their own teaching styles. What’s nice is that everyone can benefit from this technology and use it in ways that work for them. And the students? They absolutely love it. They’re involved all the time and see where they stand against their peers. This technology enables ordinary teachers to take their students to extraordinary new levels of achievement.

TI-Navigator helps us delve deeper into mathematics. We’re enthusiastic and have great students who enjoy mathematics, but this technology has made our classes more alive and, as a result, much more interesting.

Jane Damaske has taught math for 30 years at Lakeshore Middle School in Stevensville, Michigan, and served as department chair for 10 years. She’s been a T3 (Teachers Teaching with Technology) National Instructor and a member of the Content Advisory Committee for Michigan’s MEAP test.

Ann Davidian has taught mathematics in the Levittown School District in Levittown, New York since 1972 and has been the department chair since 2002. Her many awards include the Presidential Award for Excellence in Mathematics and Science Teaching, the Radio Shack National Teacher Award, and Nassau County Mathematics Teacher of the Year.

Other Features

One of the useful TI-Navigator features is Learning Check. With it, teachers can create and send an assignment or quiz directly to the students’ calculators. When teachers get their responses, they can use the Class Analysis feature to automatically grade students’ work and put their answers into a histogram. Teachers can see that five students chose A, 10 chose B, and so on. Teachers can also use Screen Capture to get a screen shot of what’s on each student’s calculator screen and be assured that all of the students are keeping up with the class.

Results

TI-Navigator helps us to truly teach students. Every year, Lakeshore Middle School gives an algebra prognosis test to eighth graders for classroom placement. Before Jane began using the system, her last group of students tested as seventh graders. When she gave them the same test after they’d used TI-Navigator for a year, their scores were amazing—we’d never seen better results. They said things like, “I know I took this test last year and it was so hard. Now it’s so easy!” Having a group-based system enhanced their understanding of the concepts and the

surprised her, because it was something she didn’t think they should have known. She used Quick Poll to ask them questions, and discovered that they actually understood the material. It turned out that their previous teacher had covered the topic out of sequence. Without such a system, Ann would have wasted two whole days re-teaching a topic that they had already learned.
Jumping Into Art History

The art students at East Broadway Middle School are getting into the works of famous artists—literally. By using digital cameras, Photoshop Elements, and the iLife suite (GarageBand, iTunes, iPhoto, iMovie, and iDVD [Macintosh only]), they are creating videos that share what they’ve learned about amazing artists such as Van Gogh, Picasso, or O’Keefe. When finished with their projects, students have completed DVDs that combine detailed information on each artist, examples of their work, and composite images of the students’ pictures embedded in the masterpieces of their selected artist.

Students, working in cooperative groups, select an artist to study and begin their research. They use sites such as the Artcyclopedia (http://www.artcyclopedia.com) and magazines such as Art Scholastic to locate information on their chosen artist and his or her particular style. They organize their discoveries on the research worksheet provided as a guide for the project, and discuss the images they find, determining which examples of the artist’s work they believe best represent the artist’s style.

Using digital images found on the Web, or images scanned from their art magazines, students then use Photoshop Elements and digital cameras to capture their own images and create composite photos. Some choose to hide inside an artist’s painting, as in this example using a work by Alfred Pellan. Others “jump” into the work, becoming part of the visual story. (Notice how the teacher is reaching for the cake in Janet Fish’s piece.) Students enjoy recording their voices, as they identify the elements of art in the pieces they have chosen, as well as recounting biographical and stylistic information about their artist. Finally, they complete their videos by adding titling and special effects. The classroom set (6–8 movies) of videos are combined to form one DVD, and copies are burned for students to take home.

Did you know that most computers have the ability to read text aloud? Think of students who would benefit from having dense text read aloud to them when they do research on the Web, or who would benefit from having their writing read back to them as part of proofreading. Text-to-speech gives students access to engaging content that is above their current reading level, providing access to age-appropriate or even advanced materials.

Make It Talk

Text-to-speech is an instructional strategy that can be used in a number of ways. A student who struggles with decoding may increase comprehension as a result of an auditory pre-reading and/or post-reading. Some students, including English learners, may find specific words difficult and will only need to hear these words. Some programs highlight each word as it is read aloud, offering the reinforcement of reading and listening together. All students will be able to listen as many times as needed.
Rene Steingraber, a fine arts teacher at East Broadway, notes that objectives in this mini-movie making project cover the Ohio Department of Education Standards for the area of Visual Art. These standards have changed from the studio classroom of the past. The students are now required to “analyze and discuss elements of artwork, explain and defend their personal beliefs regarding what they see, and explain factors that affect artists.” These projects address those issues, as well as numerous National Educational Technology Standards, including NETS-S 3, 4, and 5.

Savilla Banister is an assistant professor of classroom technologies at Bowling Green State University and the L&L curriculum specialist for visual arts. Dr. Banister is a former K–8 music and art teacher, who partners with local K–12 teachers in integrating multimedia technologies into their curriculum.

Rene Steingraber is a seventh and eighth grade visual arts teacher with nearly 20 years’ teaching experience in the Toledo Public School system who regularly uses digital technologies in her classroom.

Many teachers are surprised to find that popular software packages such as Kid Pix Deluxe, Inspiration, Kidspiration, Adobe 7, and StoryBook Weaver Deluxe have tools, buttons, or menu selections that allow text to be read aloud electronically. Text-to-speech features built into some specialized software programs allow students to set the speed of speech, type of voice (male/female, adult/child), and select highlighting by word or by sentence, to read text documents, Web sites, and text in other documents. Within Windows XP, Office 2003 can read text in Microsoft Word or Excel, and there are free or low-cost utilities available online. The Macintosh operating system provides speech for most applications. Find details on getting the software you already have to talk, and find utilities under “Audio” at WestED’s Using Technology to Support Diverse Learners site at http://www.wested.org/tdl.

—Lisa Wahl and Julie Daffield, WestEd, San Francisco, California
As most teachers do, I have expectations concerning the appearance of student papers. I have found that early in the school year, lessons in word processing and teaching things as basic as margins, alignment, justification, font and form etiquette, bulleting, salutations, and outlining make both the students’ jobs and mine much more meaningful and effective. My students are ELD Level 4 students—English language learners almost ready to be mainstreamed in the regular English classes. Listed below are a series of four lessons that I always start the year with in the computer lab before we do anything else.

Because not all students have ready access to a computer or are allowed to experiment with the family machine, I felt it was best to start at the beginning and assume that students knew nothing. I even back-tracked just a bit and started with computers turned off.

Beginning Word Formatting Lessons
For thorough understanding by students, I recommend you have access to a computer, a projector, and a screen for modeling as you work with the students. After each lesson, we also return to the computer lab to practice our newly developed skills before we learn yet more techniques.

Lesson 1
• Word software
• Opening a new word document
• Saving a document
• Margins
• Font—standard fonts include Comic Sans, Arial, Times New Roman, size 12
• Paragraph spacing
• Right justification (alignment) for name, date, instructor’s name, and title of assignment
• Center justification for titles
• Indentation—setting the indentation marker or using the tab key instead of counting in spaces
• Printing
• Closing document and shutting down computer

For this assignment I typically use a rough draft prompted writing sample. Students are always expected to be working off of a rough draft paper rather than typing as they go. I want their focus to be on where to put the words and letters on the page, not what those words and letters should be.

Lesson 2
• Review of Lesson 1 (margins, justification, font style and size, indentation, spacing, saving)
• Bold, italics, and underlining
• Undo and redo
• Numbering, usually using something like our spelling words (this is a great review too!)
• Bullets using impromptu wish lists of various items
• Cursor keys (so students learn they don’t have to backspace to fix a mistake and erase all that they’ve typed since the mistake)
• Highlighting and learning to drag the mouse
• Cut, copy, and paste commands
• Page numbers
• Headers and footers

For this assignment we typically use a current list of spelling words to get started. We work together with the model being displayed and projected from my computer onto a large screen, moving at the same pace. Usually I demonstrate what I’d like them to do, and then they do it. By this time, they have developed many skills and have learned a great deal so that if more time is needed with a few students still trying to perform a task, other students entertain themselves by experimenting with what they’ve just learned. They feel the power of knowledge and their own capability, and are already impressing themselves with what they see and what they have created by themselves.

Lesson 3
• Review of Lessons 1 and 2 and what we’ve learned.
• Tables

For this exercise we go step-by-step. We make a table, usually of students’ families, where standard information is input.

This assignment is mostly a review with the addition of making tables at the end. Students first watch the procedures on the projection screen, then do it on their computers. Many times, students have picked up the knowledge and move quickly through
the lesson. They have gained so many skills by now, many can move effortlessly, making changes or modifications as they go.

**Lesson 4**

Here, students are allowed to be creative with the formatting that they have learned. They develop a flyer for a choice of a family reunion, a birthday party, or another special event. In this assignment, the students’ work does not all have to look alike. Details such as place and time are included, allowing them to use centering, italics, bold, font size and style, and other new skills. The students’ flyers are then displayed in the classroom where they can enjoy looking at each other’s work.

Colleen S. Larson Hutchison is a seventh grade language arts and social studies teacher at Washington Middle School in Vista, California. Currently she is attending California State University, San Marcos to receive a master’s in education specializing in math, science, and technology. She has been teaching for five years and enjoys the energy and enthusiasm she sees in her young, growing students.

**Feedback at Your Fingertips**

CHEMiCALC is a chemistry program that has two modes of operation. In the element mode, it provides a variety of information about the chemical elements. In the formula mode, it performs stoichiometric calculations. In element mode, students used CHEMiCALC in the following ways:

- as a flashcard system for memorizing chemical names and symbols
- as a reference for data on chemical elements
- to produce graphs of trends in physical properties among elements in the periodic table.

In formula mode, students used CHEMiCALC to provide feedback in checking their work for a wide range of calculations involving chemical equations and stoichiometry. In addition to using the handhelds as tools supporting collaboration, we made extensive use of CHEMiCALC software. Students became self-directed with regard to CHEMiCALC when balancing equations and solving stoichiometry problems.

**Resources**


—Jeff Hansen and Robert Curtright are chemistry teachers at Lincoln Northeast High School in Lincoln, Nebraska. David Brooks is a professor of teaching, learning, and teacher education at the University of Nebraska-Lincoln. Kent Crippen is an assistant professor of curriculum and instruction at the University of Nevada Las Vegas.
Online Tools for Sharing and Collaboration

It has never been easier for educators to use online tools to enhance and extend their classroom activities and to forge valuable communication links with students and parents. For years I have searched for and tried many tools for online sharing and collaboration. One year I set up a PHP Bulletin Board on my Web site and my students discussed relevant topics and homework. Another year I created a class site that included interactive quizzes and a basic online chat facility to be used after hours to explore homework topics in real time. More recently I have used weblogs as a publishing medium for digital portfolios and to foster online discussion forums.

The Internet has evolved into a less static and more dynamic and interactive medium. Along with this evolution, a number of useful and easy-to-use tools have emerged that can promote sharing of resources and online collaboration. See how easy this can be for you and your students!

Bloglines

Bloglines is an online service for finding and subscribing to other online content. You may have heard of RSS (Really Simple Syndication). Don't be put off by the acronym. Put simply, instead of having to open up individual Web sites to see new postings or events, you can “subscribe” to your favorite blogs, news sites, or other content feed and be able to access all of them simply by opening your Bloglines account on one Web page. Bloglines uses RSS, which allows you to know when a site has been updated—and therefore has something new to read. It also provides an easy interface for viewing and opening the sites.

My educational uses of Bloglines include:

- Keeping up with global educational technology developments on a daily basis
- Subscribing to other educators blogs for cutting edge comments and news
- Subscribing to my students' blogs and saving time by accessing their pages only when updates are available

Protopage

Protopage is a “free personal start page.” It provides access to one or more Web pages that contain floating widgets—windows that can be moved, resized, and edited. Content for each widget can include sticky notes (text and hyperlinks), photos, RSS feeds, bookmarks, and other personalized content. You can elect to share the content with anyone or keep it private. The page(s) can be further personalized with color choices for wallpaper and panels.

Protopage has a number of great uses for education, including:

- As a personal reminder and information page (can be set as homepage on your browser) to store day-to-day notes
- As a class page to record immediate or long-term objectives.

Writely

Writely allows collaborative online editing of word processing documents. It provides for starting a document from scratch or uploading a file and allows the user to invite whom they choose to help edit the text. It maintains a secure and private online environment for publication for you and your students. It also uses a simple WYSIWYG editor to format the text. A rollback facility allows different versions of the document to be viewed and downloaded to the desktop in a variety of formats.

I am currently using Writely to:

- Collaborate with two other educators in different parts of the world to write a proposal for an international award
- Help my class collaborate and write a research paper on the digital divide. In groups of three the students have started a Writely account. They are working through the research, planning, and development of the actual essay. I look in a few times a week to check on progress and give direction.

By Julie Lindsay
During a two-week period, students in a K–2 special education class engaged in an authentic problem-based activity in which they used The Graph Club to collect and graph information about the daily success of their school’s food drive. Pairs of students worked collaboratively to count the number of cans collected that day in each teacher’s food bin and then, using the classroom’s computer, they entered the data into a table, generating a bar graph that was then hung in the classroom. For each graph generated, students discussed the data, making observations, and noticing trends. At the completion of the activity, the inservice and preservice teachers featured this real-life data collection activity on their class’ home page (http://edweb.tusd.k12.az.us/gharty/cannedfood.htm).

The inservice teacher noted that although this same activity could have been done manually, the software “saved us much time in the creation of graphs” and enticed her autistic students to “stick to” completing the activity and “kept them from getting frustrated at their less-than-perfect graphs.” Instead, they could “look at their perfectly created graphs and compare them” allowing them to “demonstrate the concept of more than and less than.” Furthermore, “The students worked on objectives in the areas of communication, motor skills, math and language arts as they gathered, sorted, and graphed the cans.” The preservice teacher who assisted in the implementation of this activity commented how the software provided the students the opportunity to “collect, compare, and quickly analyze the data mathematically, something they wouldn’t have done as fast on their own.” She further commented how the “software caught the kids’ attention and the visual stimulation assisted them in getting involved and staying involved in the learning process. … I would have thought that the students would have had the most difficulty understanding the mathematics, but I think they got it. I think the software helped.”

Standards: NETS•S 3 (http://www.iste.org/nets/)
—Robin A. Ward, Assistant Professor, Department of Teaching and Teacher Education, University of Arizona, Tucson

Resources
Bloglines: http://www.bloglines.com
Protopage: http://www.protopage.com
Writely: http://www.writely.com

Julie Lindsay is Head of Technology at the International School Dhaka in Bangladesh, a member of the ISTE International Committee, and I&E’s curriculum specialist for ICT. She recently completed a Master’s degree in Educational Technology Leadership at George Washington University. Her curriculum specialties are ICT, e-learning, digital literacy, and technology leadership.

Engage Students with Graphing Software

All of these online tools can help you implement and develop integrated learning experiences. They are flexible and adaptable and provide opportunities for sharing between teachers and students and the wider school community both locally and globally. Did I also mention they are freely available on the Internet?

Standards: NETS•S 3, 4; NETS•T II, III, V

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