



## Windows Vista Customer Solution Case Study



### Overview

**Country or Region:** United States

**Industry:** Education: K-12

### Customer Profile

Located in northern San Diego, California, Torrey Pines High School has 2,890 students and 125 faculty members. The school's 600 computers are available for use in labs or among the classrooms.

### Business Situation

Advanced math teacher Abby Brown and her students beta tested the latest version of Wolfram Research's *Mathematica*; however, the school's aging mobile PCs were too slow for the new software.

### Solution

Torrey Pines partnered with Wolfram Research, Microsoft, and Lenovo to deploy 30 Tablet PCs running Windows Vista® to Brown's class in the school's first one-to-one computing pilot project.

### Benefits

- Improves *Mathematica* 6.0 user experience
- Provides new options for learning advanced math
- Increases teacher-student communications
- Engages students more enthusiastically with material



## Students Integrate Tablet PCs into High School Math Curriculum to Improve Learning

“In Abby’s class, we saw the teacher as a guide on the side. The Tablet PC gave her students the freedom to create, share, and engage with mathematics the way they wanted to. That’s empowered learning.”

*Brett Killeen, Principal, Torrey Pines High School*

Torrey Pines High School wanted to integrate Wolfram Research's *Mathematica* 6.0 technical computing software into its curriculum to answer the needs of its advanced mathematics students. Microsoft and Lenovo partnered with Wolfram Research and deployed 30 Tablet PCs running the Windows Vista® operating system for the students' full-time use. While beta testing *Mathematica* 6.0, students used the Tablet PC pen and touch technologies for a rich computing experience in manipulating the new program's interactive graphics and developing complex data models. The class created a series of *Mathematica* learning tools, which it uploaded to a new Web site for use by teachers, students, and others interested in mathematics. Torrey Pines shows how integrating technology into the classroom can foster creative thinking and create a rich learning environment with real-world relevance.



## Situation

Torrey Pines High School students come from the Carmel Valley, Solana Beach, and Rancho Santa Fe communities around San Diego, California. One of four comprehensive high schools in the San Dieguito Union High School District, Torrey Pines is a diverse school that serves students from a variety of cultural and socioeconomic backgrounds. The school's reputation for high academic standings, especially in math and science, is reflected in the 2,800 Advanced Placement (AP) exams Torrey Pines students took in the spring of 2007.

Many of Torrey Pines' mathematics students finish their AP Calculus program as sophomores and juniors. District administrators and school faculty worked with San Diego State University (SDSU) to develop an Extended Studies program where these students can take Calculus II, Calculus III, and Introduction to Linear Algebra in high school and earn college credits.

"These bright students need enriched course content to keep them engaged and motivated," says Rick Schmitt, Associate Superintendent of Education Services, San Dieguito Union High School District and former principal at Torrey Pines. "They need extra opportunities to learn at their advanced level, so we are challenged with providing them with those opportunities. We wanted to find a way to integrate technology into the curriculum to enrich the learning experience for these students."

The teacher responsible for providing that enrichment at Torrey Pines is Abby Brown, who has taught Algebra I and Geometry to students in grades 9 and 10 and is now teaching Calculus II, Calculus III, Introduction to Linear Algebra, and Advanced Topics to the students who have finished AP mathematics. A graduate of Torrey Pines, Brown earned a Bachelor of Science in Mathematics at

Harvey Mudd College and a Master of Arts in Mathematics from Claremont Graduate University, where she also qualified for her teaching credentials. "It's exciting to come back to Torrey Pines and to connect with students who show the same enthusiasm for mathematics that I had at their age," she says. "I understand how important it is to keep them challenged and excited about the subject to prepare them for college and their future careers."

## Using *Mathematica* in the Classroom

One way that Brown provides her students with additional learning opportunities is through her extensive use of *Mathematica* computation software from Wolfram Research. Since first using *Mathematica*, Brown has explored the possibilities of the program both as a student and, later, as an instructor of advanced mathematics.

"I began using *Mathematica* in teaching during my AP Calculus class to create three-dimensional graphs to demonstrate concepts and illustrate examples," she says. "I started writing instructions for the program for students to use in the computer lab for their own projects. In all my classes, each day I have students do presentations to review concepts. Soon they were following my model of teaching and using *Mathematica* to create graphs and illustrations and verify calculations they had done by hand."

In 2002, Torrey Pines became one of a select group of high schools in the United States to acquire a site license for *Mathematica* software, which is commonly used within universities and research institutions. Meanwhile, Brown had also created resources for other high school teachers so they can use *Mathematica* in their classrooms. She posted these on her Web site, [www.abbymath.com](http://www.abbymath.com), which quickly gained a worldwide following. In 2005, after discovering web*Mathematica*, software that

allows users to compute and visualize results within a Web browser, Brown created another Web site, [www.mathrules.org](http://www.mathrules.org).

"I combined my passion for Web design and my joy of using *Mathematica* to create an interactive Web site where students could use the templates I created to work with *Mathematica* at home," she says. "I also created teaching resources, like a worksheet generator for fraction problems for elementary teachers to use to create problem sets with the solutions for their students. Over the years, I'd been sharing my Web sites and ideas with people at Wolfram, and in late 2005, they asked me what I would like to do next."

#### **Creating a Projects-Based Math Class**

It was a fortuitous question for two reasons. Brown and Schmitt, then principal at Torrey Pines, were wondering what to do about the growing number of students in the junior year who were already taking SDSU courses and who had room for another mathematics class in their schedule.

"It has always been my dream to create a project-based math class where students would use software like *Mathematica* to do independent work on topics of their choice, but with a community-service component built in," recalls Brown. "I thought of offering those students who were looking for an extra math class an opportunity to re-create the kind of work I had done for my Web sites, building and sharing their *Mathematica* projects over the Internet as resources for other teachers and students."

By this time, Wolfram Research had developed *Mathematica* 6.0, the company's latest version of its flagship software, and added many new interactive capabilities ideal for the high school educational environment. The company had begun to think about where it could test the beta version.

"I first met Abby at a technology conference in 2005, and I was impressed with what she and her students were doing with *Mathematica* 5.2," says Theodore Gray, Cofounder and Director of User Interfaces at Wolfram Research. "We were already developing version 6.0, and I could see she was struggling to do things with the old version that we had made easy with the new. This was valuable information, indicating that we were right on target with our goals for version 6.0."

When Brown talked about her idea with Gray, he was eager to participate. "We envisioned version 6.0 as being very interesting for high schools owing to its ability to take those solutions and very easily turn them into interactive models and graphs that can be manipulated by the student. These interactive models, or 'demonstrations,' are a wonderful way of illustrating mathematical or physical concepts in an engaging way for high school learners. Abby's idea to have her students create these demonstrations for uploading to a Web site where other teachers could access and use them for their students was a brilliant one. If we were going to release a product that would be relevant to high school education, Abby Brown and her students would provide us with valuable contributions and feedback."

Gray understood that Brown would need a steady resource at Wolfram Research to assure that the project was fully supported. He enlisted the help of Joy Costa, Director of Partnership Programs for this coordination. "Abby's enthusiasm is contagious, and her commitment to the project made our affiliation undaunted against any obstacle," says Costa.

So in August 2006, as the only high school class beta testing *Mathematica* 6.0 in the United States, Brown, her students, and their parents, all signed a nondisclosure

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Abby Brown, Math Teacher, Torrey Pines High School

agreement. With the first semester of Advanced Topics in Mathematics II, 21 students began a new chapter in mathematics instruction at Torrey Pines.

By January 2007, Brown and Torrey Pines' Principal Brett Killeen decided the school needed to find a new set of personal computers for the Advanced Topics class with improved performance and built-in capabilities for three-dimensional graphics. He reasoned that the students could use the new computers to better evaluate the potential of the beta software, improve their *Mathematica* skills, and increase their understanding of advanced mathematics.

### Solution

Even before this point, Brown had a clear idea of what hardware she would prefer. "My dream was to get Tablet PCs for the students," she says. "I've used a Tablet PC for three years, and I knew that as soon as they got a taste of what the Tablet PC could do for writing equations on the screen, and for note taking, color coding, and drawing graphs, they would be thrilled."

### Choosing the Tablet PC

Brown approached Costa, who set in motion a series of meetings that brought in two new partners and culminated in the perfect match of hardware and software for her class. Ian Hojnicky, User Interface Developer at Wolfram Technologies, attended a Microsoft® Windows Vista®, Mobile PC, and Tablet PC Features Developer Lab. The two companies began to communicate about the Torrey Pines advanced mathematics students' need for new computers, reasoning that the Windows Vista operating system, with built-in Windows® Tablet and Touch Technology, enhanced graphical capabilities, and a revolutionary new glass screen, would be the perfect operating system for *Mathematica* 6.0 running on a Tablet PC. Microsoft then

brought Lenovo on board to deploy 30 ThinkPad X60 Tablet PCs to Brown's class. The ThinkPad X60s have MultiTouch screen technology that enables interaction with the Tablet PC through touch or digitizer pen. The Tablet PC deployment represented the school's first one-to-one computing project, where students were given their computers for full-time use at school and at home. It was an instant hit with the students.

Says Grade 12 student, James Che, "For a hustling, bustling busybody like me, a person constantly needs to be connected with the virtual world of technology—I was bestowed with the miraculous feature of wireless Internet connections, and this opened a vast frontier of available knowledge. I could access e-mail virtually anywhere I work, and I could be in touch with the flurry of extracurricular activities."

Another student reports: "I have made extensive use of my Tablet computer outside of class."

"We've always been impressed with Wolfram Research, and meeting Abby Brown was an inspiration," says Mike Schmedlen, Education Industry Executive for the Americas at Lenovo. "As part of our ThinkPad University program, we are in many schools and universities that use *Mathematica*, but this was the first time we collaborated with Wolfram from the outset on a deployment for only one class to meet the specific needs of a single school."

### The Tablet PCs Arrive

The Tablet PCs arrived in February 2007, preinstalled with the Windows Vista® Ultimate operating system, Microsoft Office Professional 2007, Microsoft Encarta® 2007 Academic online encyclopedia, and the latest build of *Mathematica* 6.0. Because it is built to run on Windows Vista, *Mathematica* 6.0 offers a significantly improved interactive

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Brian Alford, Grade12, Torrey Pines High School

computing experience thanks to the transparent glass design of the Windows Aero™ user experience, which enhances graphics with dynamic reflections and smooth animation. “With Windows Vista, you are guaranteed a good *Mathematica* experience with crisp three-dimensional graphics and fast performance,” says Hojnicky. Windows Vista also has built-in Tablet PC functions that the students can use to work more dynamically with *Mathematica* software. New touch-screen support means students can use their fingers to do many of the things that they would normally do with a mouse or a tablet pen. Pen precision is enhanced with a new cursor for the Tablet PC that makes it easier to target small items such as controls or points on a *Mathematica* diagram to resize or reposition drawings. Students can also use the Snipping Tool that comes with Windows Vista to highlight and save portions of their diagrams, or even send them in an e-mail to a friend or their teacher.

James concurs: “I was bombarded with the magnificent qualities of the Tablet PC’s special features, namely its functionality with the stylus. I found the computerized pen very efficient and the computer could easily decipher my horrendous handwriting. All in all, my collective adventures with my Tablet PC, whom I have named Hamlet, have enlightened me in the world of technology and allowed me to accomplish the unthinkable, the remarkable, and the extraordinary.”

Scott Medwar, Southern California Territory Account Manager for Lenovo, was with Brown and her students the day the Tablet PCs arrived. “The excitement level was very high, and the kids were thrilled to get their hands on the new computers. They intuitively took to using the pen and the touch technology and were proud to show me their work. A couple of the kids asked me if I would like to write a

few logarithms, but I had to respectfully decline.”

James recalls the day: “It all started with the catchy tune of the Windows Vista startup screen. I began my epic journey in the valleys of *Mathematica* 6.0. I was astounded by the incredible computational speed of the mathematical software. It could render that which I thought impossible with ease: three-dimensional objects with degrees of opacity.”

Brown was impressed with the Lenovo Tablet PC’s performance. “I liked the pen’s sensitivity and the eraser at the end of the pen,” she adds. “The mobile docking station with additional USB and projector/monitor ports and a CD-ROM drive is very useful for class presentations.”

“Ever since the new computers arrived, our class has been a flurry of activity,” says Brown. “The Tablet PCs have provided an endless source of items to explore along with tools and tips to share. The kids knew right away that they were on to something great!”

## Benefits

With Microsoft fostering the collaboration between Lenovo and Wolfram Research, this is a unique story based on the fortuitous interplay of three different products that work together brilliantly. Now Torrey Pines can integrate cutting-edge technology into its curriculum to provide enriched learning. *Mathematica* 6.0 has vastly improved manipulative and dynamic graphics that are designed to appeal to a high school audience eager to learn by interacting with their material. The Tablet PC offers intuitive, natural computing, and Windows Vista provides built-in Tablet and Touch Technology that also supports interactive learning.

The Tablet PC deployment in Brown’s Advanced Topics mathematics class is the

Figure 1: Brown uses the Tablet PC to problem solve in real time with her students during Instant Messaging online study sessions.

first time that computers have been deployed to students for their full-time use at Torrey Pines. It is also the first time they have been used daily in a core academic course. So far, the pilot project has been a resounding success. From an initial enrollment of 21, there are more than 30 students signed up for Brown's Advanced Topics class for next year. "Students from Torrey Pines are submitting work to Wolfram's Demonstrations site ([demonstrations.wolfram.com](http://demonstrations.wolfram.com)) that features projects from journalism, art, and linguistics courses," says Gray. "It's not just about Math and getting their homework done. These kids are having fun."

"A program going into its second year where you get a third more students is a compliment," says Schmitt. "Based on the success of Abby's class, we would love to expand the program within the district. With the Tablet PC and *Mathematica*, we could provide more options and program choices for learning advanced mathematics, and that's a really big deal in our district. These kids are primed for this kind of learning, and it's up to us to continue to give them opportunities to excel."

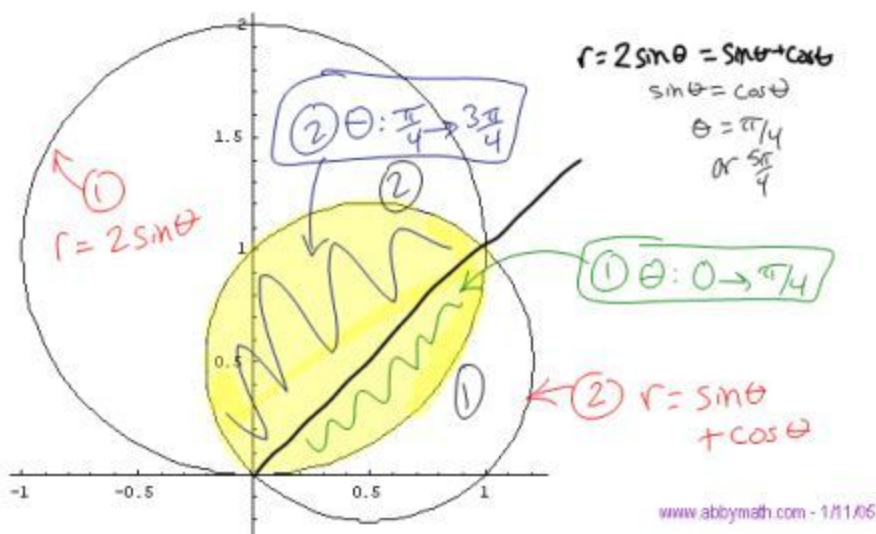
Using the Tablet PC and *Mathematica* 6.0, which was released in May 2007, the students have engaged with their subject in a way that Brown hasn't seen before. "The Tablet PC is the best computer for my students to learn math, and it's my first

choice as a tool to help me teach," she says. "We are all better organized, more interactive, and more collaborative in the classroom. My students laugh when I get hyper using *Mathematica* on the Tablet PC, but I tell them how wonderful it is to finally have a tool I can use to share with them mathematics as I see it inside my head."

### Improved Teaching with the Tablet PC

Brown has used her Tablet PC to more productively create materials and resources for her classes for three years. Typing the equations and diagrams is impractical and time-consuming, and now she has a collection of course notes that are editable and reusable each semester. She posts them on [www.abbymath.com](http://www.abbymath.com) as PDF files. "The notes have examples and definitions, but there are blanks that we fill in during class," she explains. "That way we are spending more time discussing concepts and learning why things work, than copying lines of algebra or diagrams."

Brown also uses the Tablet PC as a way to facilitate student communications outside of class. She uses the Tablet PC's built-in audio functionality to record lectures and a program called ScreenFlash. ScreenFlash captures the action and sound from any part of a PC running Windows Vista and saves it to a Macromedia Flash movie file. Brown inserts the videos into the notes as attachments to the PDF file, which she finds useful for days when she knows she will need a substitute, and she also posts them on her [www.abbymath.com](http://www.abbymath.com) Web site. To help her students prepare for exams, Brown will also designate a time that she will be online and available for help using Instant Messaging. "I hooked the Tablet PC up to some Web programming and created a white board where I could work out the problems and it would appear to the students on their own screens at home." (See Figure 1.)



“Tablet computing is valuable in education because it provides tactile interaction with the student’s work and ideas.”

Mike Schmedlen, Education Industry  
Executive for the Americas, Lenovo

In her classes where students do not have Tablet PCs, Brown presents her course notes by using an overhead projector shining onto a white board. She stands in front of the class and fills in the blanks as the students solve problems together. She uses another computer that runs *Mathematica* to illustrate concepts when needed. However, in the Advanced Topics class where all the students received Tablet PCs, Brown’s teaching style quickly evolved into the more collaborative, project-based learning environment she prefers. For example, she put the California State Standards, (standardized lists of topics that students are to learn in each subject) for Algebra I, Geometry, and Algebra II in a box and had each student draw a standard for which they would build a *Mathematica* demonstration. They could work either alone or in pairs. The goal was to upload these demonstrations onto a new Web site, [www.MathematiClub.com](http://www.MathematiClub.com), for other teachers to download and use in the classroom or for students to use at home. “Every day, we did presentations to show our progress on the demonstrations,” adds Brown. “The students just plugged in their computer, and they were as much the teacher as I was.”

Principal Killeen had a similar impression when he visited Brown’s class recently with the district superintendent. “We go into classrooms to see if kids are engaged,” he says. “They could be engaged, and you still have the teacher up in the front, driving the learning. In Abby’s class, we saw the teacher as a guide on the side. The Tablet PC gave her students the freedom to create, share, and engage with mathematics the way they wanted to. That’s empowered learning.”

#### **Improved Learning with the Tablet PC**

Brown’s students quickly incorporated their Tablet PCs into their everyday lives, taking the computers to all their classes and home at night.

It didn’t take long for the students to begin using Microsoft Office programs in all their course work. One student used the Microsoft Office PowerPoint® 2007 presentation graphics program for a class project in AP Biology. He simply plugged his Tablet PC into the docking station and used the Tablet pen to make notations and click through the slides.

Many students use Microsoft Office OneNote® 2007 note-taking program, and all report an improvement in their note-taking capabilities. Brian Alford, a senior, wrote about himself in the third person and says, “The stylus and writing features of the computer are awesome. It turns taking notes in classes into a walk in the park. One student, Brian, was initially skeptical about taking notes with a computer, because he felt the kinesthesia of writing would facilitate his learning.... But some people keenly pointed out that with the new computer he would still get the same experience as writing it out, just with a lot more benefits. Now he could easily rearrange the information to make more sense logically, even with teachers that tended to jump around a lot during their lectures.”

However, it is the interactive, natural computing experience of the Tablet PC that these math students could use to their best advantage. Math concepts are more easily explained when students can visualize them using a program like *Mathematica*. This learning is reinforced with a technology tool that students can use to control and interact with their subject matter. “Tablet computing is valuable in education because it provides tactile interaction with the student’s work and ideas,” says Schmedlen.

“I really enjoyed being able to actually write on the Tablet computers instead of having to use the small red button,” agrees senior Kenneth Leung.

## For More Information

For more information about Microsoft products and services, call the Microsoft Sales Information Center at (800) 426-9400. In Canada, call the Microsoft Canada Information Centre at (877) 568-2495. Customers who are deaf or hard-of-hearing can reach Microsoft text telephone (TTY/TDD) services at (800) 892-5234 in the United States or (905) 568-9641 in Canada. Outside the 50 United States and Canada, please contact your local Microsoft subsidiary. To access information using the World Wide Web, go to: [www.microsoft.com](http://www.microsoft.com)

For more information about Wolfram Research products and services, call (217) 398-0700 or visit the Web site at: [www.wolfram.com](http://www.wolfram.com)

For more information about Lenovo products and services, call (866) 458-4465 or visit the Web site at: [www.lenovo.com/us/en](http://www.lenovo.com/us/en)

For more information about Torrey Pines High School, call (858) 755-0125 or visit the Web site at: [www.tphs.net](http://www.tphs.net)

“We hear a lot about technology in the classroom,” says Killeen. “It takes committed, inspired educators to bring out the best in technology within a learning environment that helps kids problem solve and engage in critical thinking while doing work that’s relevant to the real world. Abby is setting a wonderful example about how empowering technology can be for learning.”

For her part, Brown is thrilled with the progress her Advanced Topics mathematics class has made in just a few months working with the Tablet PCs and *Mathematica* 6.0. “My dream was to create a Web site where my students would take materials that they have generated and share them with the world, and we did that,” she concludes. “I can hardly wait until next year!”

## Windows Vista

Windows Vista can help your organization use information technology to gain a competitive advantage in today’s new world of work. Your people will be able to find and use information more effectively. You will be able to support your mobile work force with better access to shared data and collaboration tools. And your IT staff will have better tools and technologies to enhance corporate IT security, data protection, and more efficient deployment and management.

For more information about Windows Vista, go to: [www.microsoft.com/windowsvista](http://www.microsoft.com/windowsvista)

### Software and Services

- Windows Vista
- Microsoft Office
  - Microsoft Office Professional 2007
  - Microsoft Office OneNote 2007
  - Microsoft Office PowerPoint 2007
- *Mathematica* 6.0

### Hardware

- Lenovo ThinkPad X60 Tablet
- Intel Low Voltage Core Duo processor, 4 GB RAM