

Excerpted from

Tablet PCs in K–12 Education

Edited by Mike van Mantgem

**With contributions by Dave Berque, Edward J. Evans, Tracy Hammond,
Kenrick Mock, Mark Payton, and David S. Sweeney**

Despite the many advantages of computer-aided instruction, standard notebook computers are restricted by their keyboard and mouse inputs. Not so with tablet PCs. Using the tablet PC—basically a notebook computer with an interactive screen—teachers and students can write, draw, and sketch directly onto any computer document, in real time, and at a fraction of the cost of hard copy documents.

Teachers can transmit lessons to student computers for their annotation. Students can respond in their own hand. A math teacher can show how a function changes over time. A Japanese language teacher can demonstrate the sequence of strokes to draw a character. Students can go home after school, go online, and review both lessons as they happened.

Introduction

DAVID S. SWEENEY

Director for Information Technology
Division of Student Affairs
Texas A&M University

This book is a practical guide for educators to use tablet PCs to instruct, communicate, and collaborate in the classroom. Throughout, you'll find examples and case studies taken from real teachers in real classrooms. Theory and research are included at the end of most chapters, for those of you who may be interested in these topics. However, the primary focus of this book is on the practical use of tablet PCs in the classroom.

We have assembled a team of knowledgeable contributors, many of whom are associated with the Workshop on the Impact of Pen-Based Technology on Education (WIPTe) and are, quite frankly, leading the dialog on the use of tablet PCs in education.

In Part I, you will be introduced to the tablet PC as a communication and computing platform. These chapters will describe some of the more common software applications used with tablets. Here, you will also find real-world examples of tablet PC use, key resources, and a glossary of this book's computing terms.

Part II moves from information about tablet PC computing and into educational applications. In these chapters you will see just how the tablet PC can improve personal productivity for both you and your students; how to use the tablet PC in single-user (that is, non-collaborative) settings; just how the tablet PC can revolutionize collaborative, 1-to-1 learning environments; and finally, how to implement tablet PCs in your organization. All told, Part II should prove invaluable for educators, administrators, and technical support personnel as they consider how to deploy tablet PCs in a classroom, across a school, or throughout a district.

Part III utilizes the knowledge presented in the previous two sections by offering real-world lesson plans optimized for the tablet PC.

I've been humbled to work with our contributing team during the course of writing this book. I would like to personally thank Kenrick Mock, Tracy Hammond, Mark Payton, Dave Berque, and Ed Evans for their contributions. Thanks also to Craig Colgan for his consultations. Mark Andrews at the International Society for Technology in Education (ISTE) was especially helpful. Our editor, Mike van Mantgem, who kept us on track, deserves many kudos. Having cold-called many of these fine professionals to collaborate on this book, I'm deeply gratified by their willingness to contribute, and I hope to work with them again.

Thank you.

How to Use this Book

The goal of this book is simple: To provide educators with a hands-on look at the tablet PC and to show them how to best utilize this technology in the classroom. Neither educators nor their students need to be technophiles to benefit from the information this book offers. To get the most out of this book:

- **Part I.** Consult the “Glossary of Terms” and the other information in chapter 1 to get acquainted with some tablet PC basics. If you are new to tablet PCs, you won't believe what you'll find.
- **Part II.** Discover the ways in which the tablet PC can increase your own personal productivity and improve the classroom experience for you and your students. The ideas in this section come from the world's leading tablet PC thinkers in education.
- **Part III.** Explore the lesson plans. Straightforward and easy to read, these content- and grade-specific lessons are designed for you to use and modify in your own classrooms. (See Lesson Plans: At a Glance on page 3.)
- Peruse the examples found in “Tablet PCs in the Real World” boxes throughout the book. You'll find the stories of other educators who have found a place for tablet PC technology in their own classrooms. Where they have gone, you can go, too. (See Tablet PCs in the Real World: At a Glance on page 4.)

Lesson Plans: At a Glance

Special Education

- Adding and Subtracting Fractions (*Mathematics; features extensions for K–2 and 3–6*)

Students map out the steps necessary for adding and subtracting fractions with uncommon denominators and then simplify the answer. Tablet PCs or PDAs are used to map out the solution with concept-mapping software. Lesson adaptations show how to use this strategy to teach other math concepts.

Grades K–2

- Animals of North America (*Science, Mathematics*)

Becoming virtual zoologists, students research, collect, and report data on the various animals of Canada, Mexico, and the United States. Students work independently or in groups to create a multimedia PowerPoint presentation on a North American animal.

- Brrr, It's Alive (*English Language Arts*)

Students write a riddle that gives clues about a cold-weather animal. Other students try to guess the animal's identity. The information gathered to create the riddle forms the foundation for writing a report about cold-weather animals.

Grades 3–5

- Exploring Wetlands (*Science*)

Students see videos of marsh and wetland areas and locate these areas on Google Earth. Then students research a wetland animal and create a riddle about the animal in PowerPoint. These riddles are posted to the school's wetlands Web site for other students to read.

- Fairytales Compare and Contrast (*English Language Arts*)

In a teacher-led demonstration, students differentiate story aspects of two versions of *Hansel and Gretel*, told from two different points of view. Independently, students read similar stories and compare and contrast fairytale characteristics using concept-mapping software.

Grades 6–8

- The Scientific Method (*Science*)

After studying the scientific method, students go through the process of developing a hypothesis, performing an experiment, showing findings, and analyzing results.

- Birthstone Project (*English Language Arts, Science*)

This lesson is an interdisciplinary project for an English/language arts teacher, an earth science teacher, and a technology teacher. Students learn about their birthstones—and minerals in general—through online research, writing, and development of an electronic presentation.

Grades 9–12

- Habitat Investigation (*Science*)

Using a custom-created Web site and supporting materials, students learn about a natural habitat in their community, including the geology, topography, plants, animals, and human activities.

- Lining Up Data (*Mathematics*)

Students make predictions based on real-world data. Students use the tablet PC to plot data and draw lines that fit the data they have graphed. They then use these lines to make predictions that extrapolate or interpolate the data. Students conduct additional research to find appropriate data sets, develop questions, and answer questions developed by other students.

Tablet PCs in the Real World: At a Glance

This book contains many illustrations and real-world examples of tablet PCs and their use in the classroom. Below is a quick index of where you'll find these powerful stories.

Personal Computing Made Personal. It's not so much a matter of what a tablet PC can *do*, but what a tablet PC *is*. Page 37.

Taking Notes: A Small Demonstration. A single demonstration was all it took for one educator to implement a tablet PC pilot program. Page 63.

Vermont Academy: The Personal Productivity of Students. Students at a small, rural independent boarding and day school use tablet PCs to increase their productivity. Page 81.

Colorado School for the Deaf and the Blind: Using Technology to Improve Student Learning and Build a Professional Learning Community. Educators use digital photography and tablet PCs to both aid in student learning and to better understand the learning process of their students. Page 83.

Ferryway School: Using 21st-Century Technology to Study the Technological Needs of Colonists in the New World. Students use modern technology to learn about the uses of technology at a colonial ironworks. Page 91.

St. Martin's Episcopal School: Teaching 11th- and 12th-Grade Pre-Calculus, Calculus, and Trigonometry. A Louisiana high school math instructor creates innovative video recordings of lectures. Page 99.

Goldenview Middle School: Teaching Eighth-grade Algebra and Pre-Algebra. An Alaska math instructor uses a tablet PC to post lecture notes and assignments online. Page 102.

DyKnow Vision in Action. An illustration of how a classroom teacher promotes in-class collaboration while teaching a basic math problem. Page 125.

Bishop Hartley High School: Partnering with Higher Education to Assess a 1-to-1 Tablet Deployment. One private school and a neighboring state university work together to bring tablet PCs into the classroom. Page 129.

Auburn City Schools: A Model Faculty Development Program in the Context of a 1-to-1 Tablet Deployment. A thoughtful approach to deploying a 1-to-1 tablet PC program generates a solid buy-in from teachers and enhances student engagement. Page 131.

Memorial Middle School: Quality Counts—Partnership with HP. Classroom teachers describe the extent that quality matters when a school chooses its technology partner. Page 141.

PART I

The Tablet PC Revealed

IN THIS SECTION

CHAPTER 1 • From Convertibles to Slates: More than a Notebook

Everything you've ever wanted to know about tablet PCs and pen-based technology is here, including a Glossary of Terms.

CHAPTER 2 • Simpler Is Better: Breaking the Keyboard Paradigm

The tablet PC is the natural result of a convergence of both old and new technologies. But what exactly *is* a tablet PC, and how does it fit into the world of education and the world at large?

CHAPTER 3 • Key Resources

Easy reference access to the many resources mentioned in this book.

The tablet PC is unlike any other computing device that has come before it. A tablet PC combines the computing power and versatility of a traditional notebook computer with the portability, inking ability, and ease of use offered by a pad of paper. It is small enough to carry anywhere, yet large enough to replace a desktop computer, filing cabinet, and a small library, essentially allowing a user to take the classroom on the road.

But what exactly *is* a tablet PC? What *exactly* does it allow users to do? Moreover, how does this technology fit into an educational setting?

Answers to these questions, and more, are here.

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From Convertibles to Slates

MORE THAN A NOTEBOOK

KENRICK MOCK

Associate Professor, Department of Mathematical Sciences
University of Alaska, Anchorage

TRACY HAMMOND

Assistant Professor, Department of Computer Science
Texas A&M University

With contributions from:

MIKE VAN MANTGEM

Editor, ISTE

What Is a Tablet PC?

In general terms, a tablet PC is a notebook computer with a display screen on which users can “write.” The computer’s operating system allows digital “ink” to be written or drawn on the computer screen by using a special pen. This process is called “digital inking,” and hand-drawn items can be saved like any other computer document. Handwritten text can also be saved “as written,” or it can be translated into typed text.



FIGURE 1.1. | The tablet PC

Microsoft Tablet PC

The term “tablet PC” was coined by Microsoft when it released its Windows XP Tablet PC operating system. Consequently, an official Microsoft Tablet PC is essentially a notebook computer with a touch- or pen-enabled screen (digitizer) running Windows XP Tablet PC Edition or Windows Vista.

Since digital inking is added to the normal functionality of a personal computer, applications that run on a personal computer (such as Word or PowerPoint) also run on a tablet PC.

At the time of this writing, Microsoft Windows devices dominate the market for tablet PCs. The technology has also matured since its introduction, as many tablet PC models are now entering their fourth or fifth generation. According to TabletPCReview.com, there are currently more than 20 manufacturers of tablet PCs encompassing more than 50 different models (TabletPCReview, 2007).

From Punch Cards to Digital Ink

A Brief History of the Tablet PC

In 1968 the UNIVAC 9200 computer ran on punch cards, had a memory of 16,386 bytes, and cost \$1,000 per month to rent. Despite the prevalence of these room-sized mainframes, in 1968 computer scientist Alan Kay envisioned a computer that could be used effortlessly by untrained users. He proposed a device called the Dynabook, which was lightweight, could communicate wirelessly, and could electronically store notes written with a pen. His vision was partially fulfilled by many devices built in the 1980s and '90s, including the Apple Newton and the Personal Digital Assistant (Meyer, 1995). Kay's vision was fully realized with the introduction of the tablet PC in 2002.

Why Use a Tablet PC in the Classroom?

If using notebook computers in a classroom is a good practice, then employing tablet PCs represents a revolution.

Despite the many advantages of computer-aided instruction, so-called normal notebook computers are restricted by their keyboard/mouse inputs. A keyboard has its limits, and a mouse is very difficult to use for sketching—it does not have the natural feel of a pen, nor does it provide a pen's accuracy.

Because students and teachers alike can write, draw, and sketch with freedom directly into a tablet PC, they can:

- Tap directly into their creative brainstorming thought-processes;
- Simulate, correct, and perform sophisticated editing commands with the ease of a pen-stroke; and
- Easily share their creations with others in real time, using a variety of applications (described at the end of this chapter).

Tablet PCs place these technologies into the hands of students, creating a more effective active learning environment. If the traditional computer allows for a functional understanding of instructional material to students, then it follows that the natural feel of a pen-input interface can actually encourage creativity. The tablet PC thus allows students to work seamlessly between two different types of pedagogical visualizations (Hammond, 2007a).

Glossary of Terms

What follows are essential tablet PC computing terms. Familiarity with these terms will greatly enhance your ability to think about, talk about, and teach about tablet PCs.

Tablet-Specific Terms

Notebook Computer. Also known as a laptop computer, a notebook computer is a computer designed primarily for portability.

Tablet PC. A notebook computer that allows users to input information on a digitizer with a pen, or stylus.

Display. In this context, a screen that shows a computer's output information.

Digitizer. The technology located in a tablet PC's display (screen) that allows it to determine the location of a device writing on the display. A passive digitizer uses touch (a touch-screen). An active digitizer detects electromagnetic signals from a special pen. A hybrid digitizer combines the passive digitizer's convenience of touch with the active digitizer's superior handwriting-recognition capabilities.

Pen. Resembling a traditional ink pen, a Pen is a specialized input device that allows users to write directly on the screen (digitizer) of a tablet PC.

Stylus. A stylus is a type of pen that typically does not "ink" a tablet PC's screen. Rather, a stylus is used in place of a finger to interact with a touch-screen.

Digital Ink; Ink. Data put directly onto the tablet PC's digitizer. The process of inputting data in this manner is called "digital inking."

Pen Flicks. Gestures that users make with their tablet PC pens to perform quick navigation tasks (drag up, drag down, move back, etc.) and utilize shortcuts (copy, paste, undo, etc.). Using macros, a single pen flick can be made to perform a customized sequence of computing functions.

PUTTING IT TOGETHER

Since a Tablet PC is essentially a special type of notebook computer, it shares the same hardware features as a typical notebook computer with the exception of the digitizer that enables pen input.

Macros. A computing rule or pattern that specifies how a certain input sequence should be mapped to an output sequence.

TIP. Short for Tablet Input Panel. A Windows control that translates the user's ink strokes into typed text.

Lasso. A drawing tool that allows users to draw a freehand perimeter around a section of the screen; then, to select and manipulate that portion.

Vectoring. An occurrence of when a user's palm touches the screen of a tablet PC and triggers an unintended "click."

Hardware Terms

Form Factor. This term refers to the overall design of something. In the case of a tablet PC, the two most common form factors are the slate and the convertible.

Slate. The slate form of a tablet PC resembles a large PDA, or writing "slate." This form of a tablet PC does not have an attached keyboard.

Convertible. The convertible form of a tablet PC resembles a traditional notebook computer, except that its screen can twist and rotate such that the display is facing out when it's folded down over the keyboard.

Multi-Touch PC. A computer that allows multiple users to simultaneously manipulate objects on the screen by touch.

Ultra Mobile PC (UMPC). An Ultra Mobile PC, or UMPC, is a small-form tablet PC that is designed to fit into pockets or small bags.

Personal Digital Assistant (PDA). A PDA is a hand-held device that is used to organize personal data. PDAs typically include some computer functionality and can have multimedia capabilities. As of this writing, Apple's iPhone is the latest showcase of PDA technology.

USB-Connected Pen Tablets. Light and portable tablets that allow pen-to-computer input, but do not provide display capabilities.

Interactive Whiteboard. A touch-sensitive screen technology that allows users to manipulate data directly on a digital display. In a classroom setting, an interactive whiteboard can take the form of a touch-sensitive large screen display that connects to a computer and digital projector. Users can control computer applications directly from the projected display, write notes in digital ink, and save their work.

Configuration. This term describes the summation of the devices associated with (and/or connected to) a given PC. Typically, these items include the computer (meaning, the internal hardware that comprises the computer), monitor, keyboard, printer, and so on.

CPU. Central Processing Unit. The brain of a personal computer.

RAM. Random Access Memory. This memory type allows computers to load and run programs or otherwise use data on a temporary basis. As a general rule, the more RAM a computer has, the more quickly it can process information.

x86-Compatible. This term refers to the compatibility among types and brands of computer microprocessors with the family of Intel microprocessors (e.g., Intel 486, Pentium, Intel 8086, etc.).

PUTTING IT TOGETHER

A common convertible tablet PC configuration today might include 1 GB of RAM, a 100-GB hard disk, a DVD/CD drive, assorted ports, and an x86-compatible CPU running Windows Vista.

Bit. The fundamental unit of computing information. A bit has only one of two values, either the binary digit 0 or 1.

Byte. A sequence of 8 bits, combined into a single unit of information.

Gigabyte; GB. 1 billion bytes. Used as a measure of data storage capacity or computer memory capacity.

Hard Disk. A rigid magnetic disk used for storing computer data. Also called a hard drive.

DVD/CD Drive. A device that reads (and writes to) both high-density compact discs (DVDs) and compact discs (CDs). When this device is built into a computer, it is often called an integrated optical drive.

Port. A distinct connection area on a computer that allows other devices to attach to, and communicate with, that computer. A USB (universal serial bus) is a type of port.

Operating System. Often referred to as an “O-S,” this is the software that runs a computer. Popular PC operating systems include Windows (XP, Vista, etc.), Linux, and Mac OS (8, X, etc.).

Communications Terms

802.11. A set of standards for wireless local area network (WLAN) computer communication. As of this writing, 802.11n is the latest standard on the market.

Bluetooth. A short-range radio frequency standard that allows wireless communication among devices such as computers, cell phones, printers, digital cameras, and the like.

Cellular Networks. An interconnected system of mobile telephone transmitters. Each transmitter covers a distinct geographical area, or cell.

Client. A piece of software that resides on a user’s computer (a client). This software accesses services from another piece of software on another computer (a server).

EV-DO. Evolution-Data Optimized. A telecommunications standard for transmitting data through radio signals.

IM. Short for Instant Messaging, a real-time communication software that allows two or more users to exchange typed text. The text is conveyed via computers connected over a network.

Internet. Small computer networks that link together to form a larger computer network. The Internet is the largest network.

LAN. Local Area Network. A communications network that covers a small area (e.g., a school building, a coffee shop, or an individual home).

Network. An interconnected system of computing devices. These devices transmit and receive data to and from each other.

Skype. An Internet telecommunications software, Skype allows users to make telephone calls from their computer to other computers, landlines, and cell phones.

PUTTING IT TOGETHER

With an emphasis on mobility, virtually all tablet PCs include support for wireless networking. More recent devices include support for wireless WAN over cellular networks, making it possible to access the Internet in any location where there is already cell phone coverage.

WAN. Wide Area Network. A communications network that covers a large geographic area.

WiMAX. Worldwide Interoperability for Microwave Access. A technology designed to provide wireless data transmission across long distances.

Wireless Network. A computer network where devices transmit and receive data without any physical connection between sender or receiver.

The Tablet PC: A Machine for Every Occasion

It is no accident that tablet PCs are not created equal. The dynamic nature of the technology behind these machines allows for a variety of uses that, in turn, meet an even wider variety of needs. The more you know about tablet PCs, the more informed you will be when thinking about and using tablet PCs in a classroom setting.

Passive Digitizers

To use a passive digitizer, one simply touches a PC's screen with a finger or stylus. This is the equivalent of a mouse click at the pressed location. An advantage of the passive digitizer is the ability to use one's finger or any stylus to interact with the device. A special pen is not required.

This form of interaction is particularly useful for screen navigation—it is more convenient and often feels more natural to “click” a button or scroll down by simply touching the screen or moving your finger, versus getting out a stylus and tapping the screen.

However, the convenience of a passive digitizer has several drawbacks:

- Writing on a passive digitizer can result in an effect called *vectoring*, which occurs when a touch on the screen triggers an unintended “click.”

- The computer has no way to tell where the pen is located unless the pen touches the screen. When a pen is used for navigation, the result is a mouse cursor that jumps from touch-point to touch-point. This effect can make a presentation difficult to follow.
- Since a “click” is the only input (and is mapped to a tap), secondary functions such as right-clicking are more difficult to perform. Microsoft’s operating system, for example, requires a user to tap-and-hold the stylus for right-click options.
- The resolution and accuracy of a passive digitizer is usually lower than that of an active digitizer. As a result, handwriting with a passive digitizer may appear “blocky” and “erratic” instead of smooth and free-flowing.

Active Digitizers

Most tablet PCs incorporate an active digitizer. This technology requires a special stylus to write on the display. The digitizer emits an electromagnetic signal from the display that is reflected by the stylus. The reflection is then used to determine the precise location of the stylus. This technology eliminates the vectoring problem, since touch is not used at all to determine the pen’s location. In addition, the distance of the pen from the display can be tracked. This precise tracking allows for a “hover” mode in which the pen controls the cursor, but a click does not occur unless the pen makes contact with the display.

Digitizers in the Real World

The Wacom digitizer is the most common form of an active digitizer. If you have ever used a digital pen and pad to sign your name when making a credit card purchase, you are already familiar with how this technology works in the real world.

Using an active digitizer and a pen is similar to using a traditional mouse. The pen tip is easy to track while writing. Likewise, when giving a presentation, an audience can follow the pointer with ease.

Other advantages of an active over a passive digitizer include more nuanced pressure sensitivity (e.g., pushing the pen harder results in a thicker or darker line), superior precision, smoother ink, side buttons for more right-clicking options, and—using the top of the pen—a digital eraser.

The main disadvantage of the active digitizer is its reliance on a special pen. If the pen is lost, then the tablet's functionality becomes inaccessible. Additionally, active digitizers tend to be inaccurate near the borders of the display. Periodic calibration is also necessary to accurately track the pen's location.

Hybrid Digitizers

The hybrid digitizer combines the passive digitizer's convenience of touch with the active digitizer's superior handwriting capabilities—an all-in-one device. A button or switch on the computer enables the user to select which digitizer is preferred. Alternately, the computer has the option to sense if the active digitizer's pen is near the surface of the display, in which case the active digitizer is enabled and the passive digitizer is disabled. When the pen is not detected near the surface, the passive digitizer is enabled and the active digitizer is disabled.

Forms of Tablet PCs

The type of digitizer is an important consideration for tablet PC use in the classroom. An equally important consideration is the form of the computer itself. The two most common forms of tablet PCs are slate and convertible. The different design styles of tablet PCs are often referred to as form factors.

Slate

The slate tablet PC resembles a large PDA or writing “slate.” This form does not have an attached keyboard. These systems are designed for mobility, and the exclusion of a keyboard reduces the size and weight of the device. For these reasons, slates typically exclude integrated optical drives. Slates also come in a variety of sizes with diagonal screen measurements ranging from approximately 8 to 15 inches, with most slates in the 10- to 12-inch range.

For extended use at a desk, slates can be docked to a traditional monitor, keyboard, and base station. Slates have grown in popularity in a number of vertical applications, such as field sales, field service, and health care. For outdoor use in the field, slates are also available in a “ruggedized” package. These systems are designed to withstand impacts, drops, wet conditions, and extreme temperature ranges. They also have a screen that is viewable in direct sunlight. (Most tablet displays are designed only for indoor viewing.) The degree of ruggedness is usually reported in terms of military standards. For example, MIL-STD 810 requires the device to withstand repeated three-foot drops onto plywood over concrete and

function in wind-blown rain, with a rain rate of four inches per hour. Rugged slates are generally larger, heavier, and more expensive than slates designed for indoor use.



FIGURE 1.2. | A ruggedized slate tablet PC

Convertible

The convertible tablet PC resembles a traditional notebook computer. However, its screen can twist and rotate so that the display can fold down over the keyboard, facing out. A convertible is a best-of-both-worlds computer—it is a traditional notebook computer that can be folded to create a slate-like tablet PC.

By definition, a convertible must include an attached keyboard. However, some systems feature a detachable keyboard that enables the machine to convert into a true slate.

Convertible tablet PCs range in size from 9 to 15 inches, measured diagonally across the screen, with most devices in the 12- to 14-inch range. To reduce weight and increase portability, many convertibles also exclude integrated optical drives.

Computer manufacturers are currently producing more convertibles than slates. In 2007, Hewlett-Packard, Lenovo, and Toshiba produced only convertibles, while Fujitsu and smaller manufacturers such as Motion Computing and TabletKiosk produced slates.

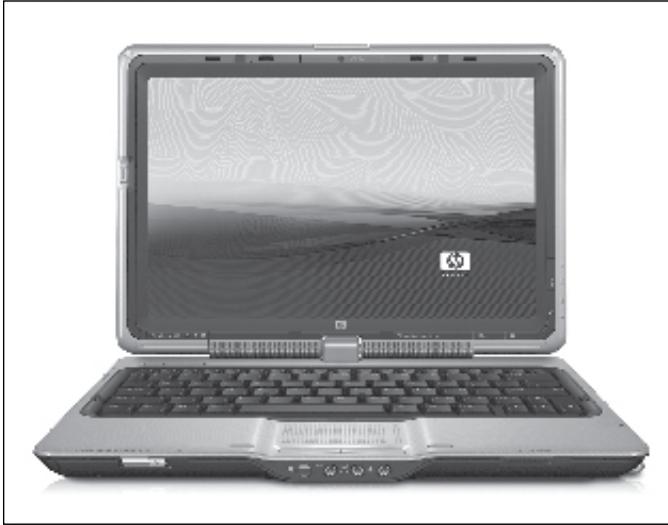


FIGURE 1.3. | A convertible tablet PC

UMPC—Ultra Mobile PC

An Ultra Mobile PC, or UMPC, is a small tablet PC designed to fit into pockets or small bags. Previously known at Microsoft as the Origami Project, UMPCs range in size from a notepad to a paperback book. They generally have touch- or pen-enabled screens that are 7 inches or smaller. The smallest devices have approximately 5-inch screens and weigh around one pound. Some UMPCs are slates while others feature small keyboards intended for thumb typing.

UMPCs versus PDAs

UMPCs are not the same as Personal Digital Assistants (PDAs). PDAs typically run an operating system that is different from that of a desktop computer. Likewise, the applications each uses are usually incompatible. Even so, data stored on a PDA can be synchronized with data on a desktop computer. Popular touch screen PDAs today include the Palm line of handheld devices and Apple's iPhone.

USB-Connected Pen Tablets

Pen tablets are light and portable tablets that allow pen input, but do not provide display capabilities. The pen tablets connect to a regular laptop or PC using a USB interface, providing tablet-like interaction while using a computer that does not otherwise have this capability.

Its operation is simple: users write on the pad-like board at their side and watch their input on a screen. The size of a pen tablet ranges from 4-by-5 inches to 12-by-19 inches.

As of 2007, the most notable maker of pen tablets, Wacom, has two versions available: Intuos and Graphire. These devices are considerably cheaper than standard tablet PCs and provide pen-input and pressure data.

Taking this idea in another direction, Smart Technologies created a wireless USB pen tablet, called Airliner. Unlike the Wacom pen tablets, Airliner technology allows multiple pen-tablet users to write, at the same time, onto a single interactive whiteboard.

Larger Displays

Although the focus of this book is on tablet PCs, there are many instances in an education environment when larger displays are useful. Larger displays are, of course, less portable than their tablet PC counterparts, but they are beneficial in three important circumstances:

- Where tablet PCs remain fixed, such that they are shared among many different classes and students;
- Where the instructor wants to present materials to an entire class; and
- Where the material presented requires a large drawing space and/or greater visibility to the students.

Large Drawing Screens

A large drawing screen is ideal for school computer labs, and it can work nicely as a second monitor in a dual-monitor setup. The screen can be rotated, inclined, and/or removed for lap use.

For example, Wacom's Cintiq 21UX drawing tablet provides a 21.3-inch high-resolution display, and it connects to any computer through a USB interface to provide pen position, pressure, and tilt data.

Multi-Touch PCs

A multi-touch PC allows multiple users to simultaneously manipulate objects on the screen by touch. An example of this technology is Microsoft Surface, which is a tabletop PC that projects a computer image from below to the surface of the table. Once gathered around the table, multiple users can write, gesture, and collaborate on a project.

This technology can have collaborative and educational applications for small groups of students. It is expected to be available near the end of 2007 for approximately \$10,000. Multi-touch PCs are not currently available in smaller form factors (such as a slate or convertible).

Interactive Whiteboards

Like an old school chalkboard or grease-pen whiteboard, an interactive whiteboard is a large display device. It is useful for instructors who wish to present information to students as a class. Using an interactive whiteboard, the instructor essentially projects a computer display from a PC to a large pen-input display.

One such display is the popular SMART Board. SMART Boards come in three basic styles: front projection, rear projection, and overlay.

The whiteboard overlay sits on top of an LCD (liquid crystal display) panel and provides a pen-enabled display of up to 60 inches. Because they function through the use of an overlay, there is a gap (about one-inch) between the pen tip and the pen mark.

Slightly less expensive than overlays, rear-projected whiteboard displays provide a 66-inch, pen-enabled screen with no gap between the pen tip and ink projection. These whiteboards include an integrated projector and can be mobile or installed in a permanent location.

As the least expensive version, front-projected SMART interactive whiteboards can be used with existing computers and projectors. They also feature larger display areas than the others.

SMART interactive whiteboard technology allows for the use of any writing implement, including a finger. This technology also features special software that utilizes the pen as either a mouse-input device or as a tool that can lay ink on top of the viewed image—such that the input information is not relayed to the underlying applications.

Benefits of Using Interactive Whiteboards

Recent research on pen-based instruction shows that lessons taught with the aid of interactive whiteboards provide three key benefits:

1. Brighter and clearer presentation of material.
2. Stepped learning and the ability to recall earlier material.
3. Rapid responses to interactive examples so that learning is reinforced or revised.

(SMART Technologies, 2006; Glover 2005)

Other research has shown interactive whiteboards to:

- Support students with many different learning styles, including students with hearing and visual impairments.
- Raise the level of student engagement in a classroom.
- Streamline teacher preparation.
- Reduce start-up time for digitally-enhanced lessons.
- Motivate teachers to include digital resources.

(SMART Technologies, 2006)

SMART interactive whiteboards do not come without disadvantages. For example, they currently do not relay pen pressure or tilt information to software applications, meaning they can only send simple mouse events. However, when students are provided with pen tablets (such as the Airliner), chalkboard and overhead displays pale by comparison in terms of their potential for student engagement.

Promethean, a popular interactive learning technology provider, offers another interactive whiteboard system. Promethean Activboard, an interactive whiteboard, can be combined with a computer and Promethean Activote, a Personal Response System (PRS). The PRS, a “clicker” that resembles a small remote control, can be passed out to each student. The buttons on the PRS allow students to answer multiple-choice or true-or-false questions. A question can be posed on the computer, projected on the screen, and each student can answer via the PRS. Statistics on how all students voted can be displayed back to the class. The data

displayed to the class is anonymous, although the students' names and a record of how they voted is stored on the computer for later analysis by the teacher.

Tablet PC Software

Even though a tablet PC is essentially a notebook computer, it nonetheless requires special software to run its pen-based functionality. This special software begins with the computer's operating system.

For a discussion of tablet PC software related to personal productivity, see the section “The Tablet PC: A Personal Productivity Enhancement Tool” in chapter 4.

Microsoft Windows

Microsoft fully supports tablet PCs and has released the Windows XP Tablet PC Edition and the Windows Vista operating systems. Both operating systems feature handwriting recognition. However, handwriting recognition is improved in Windows Vista, and only Windows Vista can learn to recognize an individual user's handwriting.

For a more detailed look at this software, see the section “Software Features: The Power of the Pen” in chapter 4.

Linux

Many distributions of the Linux operating system can also be installed on a tablet PC. However, users may be required to install additional drivers to support the use of a pen and other hardware. Free and open source applications such as Jarnal (www.dklevine.com/general/software/tc1000/jarnal.htm) are available for taking notes and sketching.

Mac OS X

As of 2007, Apple Computer has not released a tablet Macintosh computer. However, Axiotron and One World Computing have announced an after-market

modification that converts a MacBook into a slate. Their solution, the Modbook, replaces the normal display with a Wacom digitizer. It was expected to be available in the second half of 2007.

Handwriting recognition on the Modbook is possible using Apple's Inkwell technology. Originally intended for use with external graphics tablets, Inkwell works equally well with an on-screen digitizer. This technology allows a user to write anywhere on the screen. This writing is converted to text that is then inserted into the active application. Inkwell is also able to process written commands and includes an InkPad application that can be used to handwrite sketches or notes.

At the time of this writing, relatively few pen-enabled applications exist on the Mac OS X platform, compared to the Windows platform.

Windows Applications

Many applications provide their own support for inking (beyond what is provided by the operating system). For some of these applications there is no need to translate handwriting into text—the application can operate entirely in the domain of the digital ink.

For more information about tablet PC software in a classroom context, see chapter 4, “Personal Productivity for Classroom Teachers.”

Microsoft Office

The Microsoft Office suite of products, starting with Office 2003, include built-in support for ink. With a tablet PC, a user can annotate Word files in ink. Users can also write on PowerPoint slides in both the design and delivery phases of a presentation.

Outlook

Although very usable on a tablet PC, Outlook currently does not have full support for ink (even so, ink can be used in e-mail, tasks, and calendar items). Office 2007 promises a fully pen-enabled utility, bringing it productivity benefits comparable to similar applications listed here.

Microsoft Journal

Microsoft Journal is a fully pen-enabled application (it is the ink equivalent of Notepad). Each Journal file is analogous to a notepad of paper, but in this case the notepad is stored digitally. The application allows users to write, erase, copy, and paste ink. Users can also select from a variety of pen styles, including different line colors and widths.

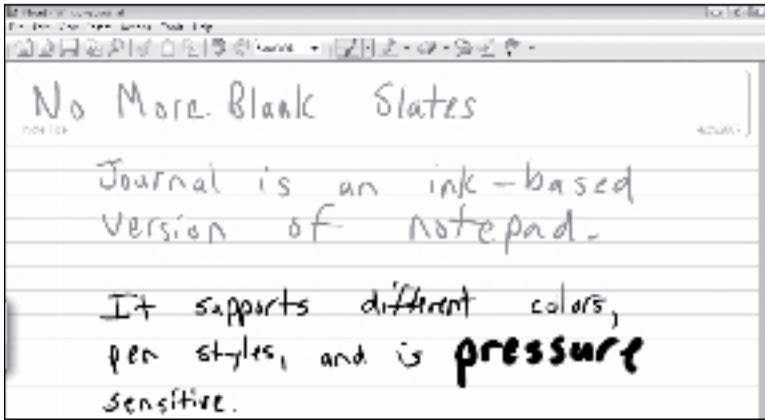


FIGURE 1.5. | Microsoft Journal in action

More sophisticated applications that extend the functionality of Microsoft Journal include Microsoft OneNote, EverNote, and Agilix GoBinder.

Ink-Enabled Software

Microsoft Office OneNote. A digital notebook.

<http://office.microsoft.com/en-us/onenote/>

Microsoft PowerToys for Windows XP Tablet PC Edition. This is a group of programs designed to enhance the tablet PC experience.

www.microsoft.com/windowsxp/downloads/powertoys/tabletpc.msp

EverNote. A software application that allows users to capture text notes, images, digital ink, and more.

www.evernote.com

StrokeIt. An advanced mouse gesture-recognition engine that lets users “draw” on their computer screen using a mouse.

www.tcbmi.com/strokeit/

MindManager. A visually-oriented information mapping software.

www.mindjet.com

Inspiration and Kidspiration. A graphics-oriented mapping software designed for K–5 learners.

www.inspiration.com

PDF Annotator. A software that allows users to annotate any PDF file using the mouse or a tablet PC pen.

www.ograhl.com/en/pdfannotator/

Adaptive Book Project. The tablet PC version of this project lets users create, organize, and share pen-based annotations.

www.cs.cmu.edu/~ab/

Windows Messenger. This instant messaging software supports ink within messages.

www.microsoft.com/windowsxp/using/windowsmessenger/

Trillian Astra. Like Windows Messenger, this instant messaging software also supports ink within messages.

www.trillian.im/

Course and Content Management

Moodle. A free, open source software package designed to help educators create effective online learning communities.

<http://moodle.org>

Sakai. A set of software tools designed to help instructors and students collaborate and communicate.

<http://sakaiproject.org>

GoCourse Learning System. An instructional and course management system.

www.agilix.com/GoCourse.aspx

GoBinder. A personal productivity application for students and professionals.

www.agilix.com/GoBinder.aspx

Blackboard Backpack. An electronic content management tool.

<http://backpack.blackboard.com>

Thinkwell. A producer of online textbooks and other interactive electronic courseware.

www.thinkwell.com

Illuminate. A real-time virtual classroom environment designed for distance education and collaboration with academic institutions.

www.illuminate.com

Adobe Connect. A flexible Web communication system, designed to help users create and manage e-learning courses and curricula.

www.adobe.com/products/connect/

FranklinCovey PlanPlus Online. An electronic version of this popular planning system.

<http://planplusonline.com>

Sketching Software: General

ScanScribe. A document image editor that allows users to manipulate sketches, handwritten notes, whiteboard images, screenshots, and scanned documents.

<http://scanscribe.com>

Geometer's Sketchpad. This software allows users to build and investigate mathematical models, objects, figures, diagrams, and graphs.

www.dynamicgeometry.com

Winplot. A general-purpose plotting utility that allows users to draw curves and surfaces.

<http://math.exeter.edu/rparris/winplot.html>

LaTeX. A document markup language and preparation system that automates many typesetting and desktop publishing tasks.

www.latex-project.org/intro.html

Sketching Software: Art and Music

ArtRage. A software that provides a simple blank canvas and a set of brushes, pens, and other tools that allow for complete freedom of expression.

www.ambientdesign.com/artrage.html

CorelDRAW. A popular graphics program that provides excellent pressure sensitivity and drawing capabilities.

<http://coreldraw.com>

Paint.NET. A free image and photo editing software.

www.getpaint.net

LADDER Sheet Music. A software that will allow users to score musical notes and replay them.

<http://srl.csdl.tamu.edu/musicscribble.shtml>

<http://srl.csdl.tamu.edu/posters/SRMusicPoster.ppt>

Sketching Software: Math and Science

FluidMath. A software that allows instructors to write equations and draw diagrams or objects. Equations are recognized mathematically and can be graphed using a special gesture with a tablet PC pen.

www.fluidmath.com

ChemPad. A software that translates standard two-dimensional drawings of molecules into three-dimensional structures.

<http://graphics.cs.brown.edu/research/chempad/home.html>

MathPad2. A mathematical sketching software that converts handwritten math formulas into free-form diagrams.

www.cs.brown.edu/~jjl/mathpad/

xThink MathJournal. A software that attempts to simplify mathematical formatting on the computer.

www.xthink.com

Recording Software

Camtasia Studio. Camtasia is a screen-recording software. Though not designed for use exclusively with tablet PCs, this software is designed to record on-screen activity. Camtasia's screen capture feature can record the instructor's pen interaction with presentation slides. Accompanying audio explanations can also be recorded. Students can then access these recordings for step-by-step review.

www.techsmith.com/camtasia/

Other similar PC-based screen recording software includes Adobe Captivate (www.adobe.com/products/captivate/) and My Screen Recorder Pro (www.deskshare.com/msrpro.aspx).

Collaboration Software

Tablet PC software applications specifically designed to enhance classroom collaboration constitute a small but growing segment of the software market. The applications highlighted here can provide profoundly positive classroom experiences for teachers and students alike.

DyKnow Vision. Designed for use on tablet PCs, interactive whiteboards, and non-tablet PCs, DyKnow Vision is collaborative note-taking software. Teachers can use this software to transmit their presentations to student computers for their annotation. Students can use the tools in this software to respond to a lesson in real time; then later replay that lesson step-by-step. This fully supported, scalable software is designed to work in fixed, mobile, and distance learning environments.

www.dyknow.com

Classroom Presenter. Classroom Presenter is software that integrates computer-generated slides and digital ink and then synchronizes those files on multiple computers. The result is a flexible, interactive learning environment where both instructor and students alike can write on a given slide in real time. Teachers receive a list of student submissions and can choose which submissions to display to the class. Moreover, teachers can lock student input to only the slide currently being worked on, or they can unlock the slides to allow students to browse ahead or go back for review.

<http://classroompresenter.cs.washington.edu>

Ubiquitous Presenter. Similar to Classroom Presenter, this tablet PC software enables teachers to annotate prepared class presentation slides in real time. The software then allows students to synchronize with the respective lesson and interact with the materials in real time. Conversely, student computers can be unsynchronized to the lesson, thus allowing students to view the presentation slides at will. The instructor's inking is archived online, stroke-by-stroke, and students can access and replay the lesson at any time.

<http://up.ucsd.edu/about/WhatIsUP.html>

Tablet PCs in K–12 Education

Mike van Mantgem has been writing and editing books about using technology since 1994. He earned his English/Language Arts teaching certification from the University of Iowa.

Dave Berque is a professor of computer science at DePauw University. Edward J. Evans is the interim executive director of IT Teaching and Learning Technologies at Purdue University. Tracy Hammond is an assistant professor in the Department of Computer Science at Texas A&M University. Kenrick Mock is an associate professor in the Department of Mathematical Sciences at the University of Alaska at Anchorage. Mark Payton is the director of information resources and technology at Vermont Academy. David S. Sweeney is the director for information technology in the Division of Student Affairs at Texas A&M University.

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