

*"In the Backpack.NET schools, we've seen much more interaction between the teachers and the students and a great deal of collaboration, both within and outside the classroom."*

– Dr. Philip Wong, head of the Backpack.NET Centre at the National Institute for Education, Singapore





## Singapore

# The Classroom of the Future, in Schools Today

*Singapore's education system has a long history of quality and efficiency, backed by a track record of high student achievement in math and science. Yet this prosperous city-state is always looking for new ways to ensure that its students are even better prepared to participate in societal and economic advances. This spirit of continuous improvement has inspired the Infocomm Development Authority of Singapore (IDA) and Microsoft to initiate Backpack.NET, an ambitious five-year program that aims to encourage inquiry, creativity, and student-centered learning through advanced applications of ICT. This Partners in Learning initiative includes the use of Tablet PCs by hundreds of students throughout the city and the seeding of an ecosystem of innovative new education software companies.*

At Crescent Girls' School, students are accustomed to carrying around large backpacks weighed down with textbooks. But their backpacks are a bit lighter these days; each student now has her own Tablet PC, loaded with a suite of specialized applications developed by local software companies. Digital multimedia textbooks have replaced hardcover versions in many subjects, including English, math, and science. Most of their class schedules, syllabi, and assignments are stored on the school's Web site. The students are just as likely to send their teacher an e-mail or instant message as they are to raise their hand in class. And instead of taking notes on paper, they're using their Tablet PCs to draw visual "mind maps" to help understand the subjects they're studying.

All of this looks like what many governments, educators, and technology companies talk about when they envision the future of education, although for these students, it's just another day in class. That's because Crescent Girls' School is one of the four "pioneer schools" for Backpack.NET—an ambitious program that aims to push the boundaries of new technologies and make the "classroom of the future" a reality in Singapore's schools. This five-year initia-

### KEY IMPACTS OF PIL IN SINGAPORE

- ◆ Students and teachers throughout Singapore are leading the way in the use of Tablet PCs in schools, pioneering new approaches to personalized learning.
- ◆ In close collaboration with educators, a growing ecosystem of local software companies is developing innovative new educational software and exporting it to the world.

tive is driving the research, development, and testing of innovative technologies in the classroom with US\$13 million in support from Microsoft, IDA, the National Institute for Education (NIE), industry partners, and participating schools.

BackPack.NET complements a broader evolution of Singapore's education system—which is shifting its focus from achievements in examinations toward a more flexible curriculum, a more holistic approach to assessment, and an increased focus on nurturing creative and critical thinking. At the same time, educators throughout the country are being empowered to adopt new teaching methods that encourage experimentation, collaboration, and other skills that are increasingly valuable in the global economy.

*BackPack.NET is at the leading edge of innovation, systematically developing and testing new technologies in a real classroom environment.*

BackPack.NET supports a shift toward student-centered learning through the use of Tablet PCs, digital inking applications, and other innovative technologies in the classroom through four areas of investment:

- A series of pilot initiatives that put some of this advanced technology into students' hands today
- A learning environment to showcase education scenarios 5 to 10 years in the future
- Support for a software developer community focused on building innovative teaching and learning applications
- Research that explores the relationship between technology and pedagogy

### Advanced Technology, Homegrown Tools

All 1,600 students at Crescent Girls' School have their own Tablet PC, which connects to a broadband wireless network and centralized classroom management software built on Microsoft Learning Gateway, a technology framework for education software. Paid for by parents, with some discounts from manufacturers and scholarship support for lower-income students, the computers are outfitted with Microsoft Office and a number of specialized education applications developed by local software companies. To address concerns about theft, loss, and damage, Principal Lee Bee Yann has provided each parent with a contract they can sign with their children that outlines the appropriate "care and feeding" of their computers.

As the teachers and students use their Tablet PCs in class, they're supported by researchers and local software companies that monitor their use and collaborate to develop new applications that further enhance teaching and learning. One such application is *Fun with Construction*, an interactive tool developed by a local software company, HeuLab, that provides students with virtual rulers, protractors, and graph paper to explore math and geometry concepts. Using the Tablet PC stylus, students use the tools to draw, manipulate shapes, and

analyze maps. By working onscreen rather than on paper, students can quickly understand difficult concepts such as geometric loci and linear graphs and get instant feedback on their work. “If I want to see if I’ve done something correctly, I don’t have to wait two days for the teacher to grade my paper,” says geometry student Karen.

*Fun with Construction* was inspired by teachers at Crescent Girls’ School who began working with HeuLab in 2004 to brainstorm an application that could automate their geometry lessons and enable students to work independently and share their work with peers. “This was the first tool we developed in collaboration with Backpack.NET schools,” says HeuLab Deputy CEO Lim Soon Jinn. “And once they saw the value of applications like this, they came back with more and more new ideas.”

The teachers’ next idea was a little more ambitious: a personal notebook that can collect all of the information students need for their lessons and give them a new way to take notes and structure their thinking. That application, called *Fun with Mindbook*, includes a specialized note-taking tool that enables students to create “mind maps”—visual representations of the connections between concepts and ideas—and take layered sets of notes around a rich library of images, such as anatomy drawings or diagrams of musical instruments. It also includes calendaring and organization tools that help students keep track of their tasks and easily store Microsoft Word, Excel, and PowerPoint documents alongside their notes and digital textbooks. “I’m not the kind of person who can memorize a whole chapter of words, so *Fun with Mindbook* helps me summarize all the more important points in one place,” says science student Min.

HeuLab sees its close collaboration with teachers and students as the key to creating effective learning applications. Far too many educational software programs have been created with little or no engagement with teachers or classrooms, and the frequent result is technology that doesn’t really work in the classroom. “Every single one of our applications is designed in collaboration with teachers so we can design something that will meet the needs in today’s classrooms,” says Lim.

HeuLab also worked with Backpack.NET schools to address a significant obstacle to student-centered learning: the ability to keep order in the classroom while giving students the flexibility to explore on their own.

“Before there were laptops or wireless networks in schools, students might sneak a comic book over their textbooks, and that was a distraction,” says Dr. Philip Wong, head of the Backpack.NET Centre at the NIE. “But now, with wireless technology, they can surf on the Internet. I think it’s important for teachers to feel comfortable with that—some students might get distracted for

#### SINGAPORE QUICK FACTS

- ◆ **Population:** 4.5 million
- ◆ **Education System:** 355 schools serving more than 530,000 students
- ◆ **Challenges:** Deploying advanced technologies in the classroom; catalyzing local innovation in educational software
- ◆ **Key PiL Programs:** Backpack .NET, Microsoft–Ministry of Education Professional Development Awards (MMPDA) for innovative teachers

5 or 10 minutes, and that's fine, but teachers should be able to help them focus on their work."

### Innovative Software Solutions for Teachers

To help address this challenge and make other classroom management tasks easier for teachers, HeuLab developed *Fun with Virtual Classroom*, an innovative solution that allows teachers to monitor student work—even “peeking” at individual students’ screens—and conduct guided lessons by remotely controlling every Tablet PC in the classroom or dividing students into groups and coordinating their work. Additionally, it automates many common classroom tasks, such as taking attendance, scoring quizzes, and tabulating grades.

Teachers can even project individual students’ screens onto the classroom projector to showcase exemplary work, and administer pop quizzes to the class if they want to check on students’ progress. The software not only facilitates an ongoing feedback loop regarding students’ progress; it also gives teachers greater confidence that they can let their students explore. Knowing that their teacher can check up on them at any time tends to keep students on task.

*Using e-mail, instant messaging, and online discussion forums, the students are often more willing to participate and share their thoughts than in the classroom.*

Software developers aren’t the only ones coming up with innovative ways to use the Tablet PCs at Crescent Girls’ School. The students themselves are finding plenty of creative new ways to put the technology to work. For example, Kathy uses the Tablet PC’s Music Composition Tool to write her own songs

by drawing the notes directly onto virtual sheet music paper. She also uses it to explore and learn from the works of famous composers. “By manipulating their notes on screen and adding my own, I can better understand what it’s like to create a great piece of music,” she says.

Min uses her Tablet PC to draw—and let out her frustrations: “I find ArtRage [a popular Tablet PC-based drawing tool] very helpful to relieve stress. I can just draw what I’m angry or anxious about, and then I feel better,” she says. Several students have used ArtRage to create a series of *manga* (comic book) characters based on the girls at their school as well as printed posters that decorate the walls of the campus. They’ve even started a small business, selling the posters to parents and fellow students. “I didn’t even know they were doing this until one of my students offered to sell a poster to me!” says Principal Lee. And, of course, the girls are on their Tablet PCs constantly to chat with friends, plan a night out at the movies, and play their favorite games.

Educators at Crescent Girls’ School have found that the Tablet PCs have facilitated richer interaction between teachers and students and created more incentives for students to reflect on and discuss their work. Using e-mail, instant messaging, and online discussion forums, the students are often more willing to participate and share their thoughts than in the classroom.

“Many students use the forums to ask questions they wouldn’t bring up in class,” says humanities teacher Phyllis Pham. “Sometimes this is because they’ve had time to reflect and think through the matter, which leads to more high-level questions about the topic. Other times, the students are just too shy to raise their hands. Either way, I find that they’re more spontaneous and ask more thought-provoking questions when they’re online.”

This pattern is not unique to Crescent Girls’ School. “In the Backpack .NET schools, we’ve seen much more interaction between the teachers and the students and a great deal of collaboration, both within and outside the classroom,” says Dr. Wong. “We see many students collaborating on projects outside of class, even when they’re not physically together. They are more likely to work at home—they might be on the couch watching TV, but they’re also on MSN with their classmates, still working on pieces of their projects together.”

### The Leading Edge of Classroom Innovation

Because Singapore has been investing in technology for the classroom for more than a decade, it is an ideal place to pioneer a program such as Backpack .NET. Every school in the country is equipped with broadband Internet access and well-stocked computer labs. The government provides funding to support a student-to-computer ratio of 5:1, and many communities make additional investments in technology to further enhance teaching and learning in their schools. Additionally, Singapore is rolling out a wireless network that aims to cover the entire city-state by late 2007.

With their infrastructure issues largely solved, teachers are now developing new teaching methods that take full advantage of technology—making the curriculum more flexible and dynamic and moving further from a teacher-led classroom environment to learning that is centered on the students. Microsoft Partners in Learning supports these efforts through Backpack.NET as well as other programs such as the Microsoft–Ministry of Education Professional Development Awards (MMPDA), which highlight the work of innovative teachers and give them opportunities to attend regional and global Innovative Teachers Forums.

Under the Ministry of Education’s current five-year technology plan, schools will have greater autonomy and flexibility in the use of funds for ICT, and they are exploring a wide range of technology programs—including robotics, digital art and music, blogging, and podcasting. “There’s no specific recipe for how schools should use technology,” says Dr. Wong. “The aim is to use whatever means they can to equip our students with new skills.”

Backpack.NET is at the leading edge of this innovation, systematically developing and testing new technologies in a real classroom environment and then taking that knowledge and applying it to new kinds of learning applications and teaching techniques that can be extended to other school systems.

This work is also important because it is helping kick-start an ecosystem of local software companies, such as HeuLab, which are beginning to export their work elsewhere in Singapore and around the world.

“Singapore has a very advanced education system, and our country has a strong drive for continuous innovation and improvement,” says Microsoft Singapore Academic Program Manager Chua Horng Shya. “It’s a great environment in which to pioneer new technologies, and our hope is that the improvements we’ve achieved here can be exported to the rest of the world.”