New Technology High School is an exemplary twenty-first century learning school, employing project- and problem-based learning and outcomes-based assessment.

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Twenty-first century learning in schools: A case study of New Technology High School in Napa, California

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WE HAVE KNOWN for years what students need to know and be able to do in the twenty-first century. Starting with the Secretary's Commission on Achieving Necessary Skills (SCANS) report from the U.S. Department of Labor, *What Work Requires of Schools*, in 1991,[1] it was clear that twenty-first century learning was to be built on a foundation of basic knowledge, but went well beyond basics to include a significant set of twenty-first century skills.

SCANS anticipated the profound changes coming in the 1990s, including globalization and the increased role of technology in work and life. It was the first significant report that argued that students would need to be smarter and also better communicators, collaborators, and performers for the workplace and society of the future. SCANS said that future workplace know-how requires thinking skills, personal qualities (responsibility, self-management),

project management, interpersonal skills (teamwork, leadership), information skills, systems skills, and technology utilization skills.

In *Learning for the Twenty-First Century*, the Partnership for 21st Century Skills updated and enhanced SCANS.[2] *Learning* again builds on core subjects, but shows that twenty-first century learning includes information and communication skills, thinking and problem-solving skills, interpersonal and self-directional skills, and the skills to use twenty-first century tools such as information and communication technologies. But what sets *Learning* apart from all previous studies is its finding that assessment and feedback to students is the key to skill mastery.

In the United States and other countries, particularly Europe and Asia, leaders are grappling with designing schools that serve the needs of the twenty-first century. In Singapore, where the national slogan is "Thinking Schools, Learning Nation," Tharman Shanmugaratnam, the minister of state for trade, industry, and education, says that "one of the key adjustments under way is in the way we educate our young so as to develop in them a willingness to keep learning, and an ability to experiment, innovate, and take risks. Our ability to create and innovate will be Singapore's most important asset in [the] future."[3]

In the United Kingdom, the national government's $80 billion Building Schools for the Future program aims to rebuild every secondary school in the country over a ten- to fifteen-year period. Its mission is "Working together to create world-class, twenty-first-century schools—environments which will inspire learning for decades to come and provide exceptional assets for the whole community."

So while we and others have a good picture of what students need to learn and be able to do, key questions remain. How do they learn it? How do students know they know it? And what do schools look like where twenty-first century learning takes place?

Designing twenty-first century schools and learning starts with asking what knowledge and skills students need for the twenty-first century. But real design needs to go much further and address these questions:

- What learning curricula, activities, and experiences foster twenty-first century learning?
- What assessments for learning, school based and national, foster student learning, engagement, and self-direction?
- What physical learning environments (classroom, school, and real world) foster twenty-first century student learning?
- How can technology support a twenty-first century collaborative learning environment and support a learning community?

The key design issues might be illustrated this way:

Knowledge and Skills → Curricula → Assessments → Facilities→ Technology

Every country has done a good job of articulating the knowledge and skills that students need, but few have developed or identified the curricula, assessments, facilities, and technology that would foster twenty-first century learning.

New Technology High School: A case study of a twenty-first century school

Walk into a classroom at New Technology High School (NTHS) in Napa, California, and you will see students at work: writing journals online, doing research on the Internet, meeting in groups to plan and make their Web sites and their digital media presentations, and evaluating their peers for collaboration and presentation skills. Another teacher's students may also be there in a team-taught interdisciplinary course. These activities have a name and a purpose. This is project-based learning, and it is designed to engage students in learning deeply.

Despite its name, NTHS is not a technology school, although there is more technology at the school than most others. NTHS was founded in 1996 as a twenty-first century school. A task force led by the business community but including educators and civic

leaders studied best practices throughout the United States and launched a school with that aim.

In its first years, NTHS teachers defined the school's eight learning outcomes: content standards, collaboration, critical thinking, oral communication, written communication, career preparation, citizenship and ethics, and technology literacy. These outcomes map to the SCANS standards, which inspired them, and also to more recent articulations of twenty-first century skills. The New Tech teachers designed them not to be a wall poster or a compendium no one looks at. Instead, NTHS embeds these learning outcomes in all projects, assessments, and grade reports.

Students graduate from NTHS demonstrating mastery of the eight learning outcomes through a digital portfolio. The portfolio, which New Tech calls a professional portfolio, is a public online document that is alive on the NTHS Web site throughout the student's career at the school. It is a work-in-progress until the end of the senior year, when it is submitted for graduation.

Project- and problem-based learning: Keys to twenty-first century learning

"We needed a new type of instruction that better reflected the goals we wanted each student to achieve, demonstrate, and document," says Paul Curtis, one of the original lead teachers at NTHS and now director of curriculum for the New Technology Foundation. NTHS teachers start each unit with a realistic or real-world project that both engages interest and generates a list of things the students need to know. Projects are designed to tackle complex problems, requiring critical thinking. NTHS's strategy is simple:

- To learn collaboration, work in teams.
- To learn critical thinking, take on complex problems.
- To learn oral communication, present.
- To learn written communication, write.
- To learn technology, use technology.
- To develop citizenship, take on civic and global issues.

- To learn about careers, do internships.
- To learn content, research and do all of the above.

This strategy can be built into the curriculum if students work on projects that are designed to elicit collaboration, critical thinking, written communication, oral communication, work ethic, and other critical skills while simultaneously meeting state or national content standards.

In traditional classrooms students typically work alone, work on short, noncomplex assignments that emphasize short-term content memorization, write for the teacher alone, and rarely make presentations. Project- and problem-based learning takes a different approach:

1. Put students into teams of three or more students, who work on an in-depth project for three to eight weeks.
2. Start the project by introducing a complex entry question, and scaffold the project with activities and new information that deepens the work.
3. Develop a time line for the project through plans, drafts, timely benchmarks, and presentations by the team to an outside panel of experts drawn from parents and the community.
4. Provide timely assessments to students on their projects for content, oral communication, written communication, teamwork, critical thinking, and other critical skills.

At NTHS some examples of projects include presenting a plan to Congress on solving the oil crisis, addressing economic issues as a team of the president's economic advisers, or inventing, under contract from the National Aeronautics and Space Administration, new sports that astronauts can play on the moon so they can get exercise.

Calendaring, that is, providing a time line, is crucial. Few students, or adults, can work effectively without a clear timetable and benchmarks. At NTHS, the calendar for each project, called the course agenda, is available online and linked to the project

briefcase, which holds all the project resources, calendar, and assessment rubrics. The project briefcase organizes all project materials for student access, action, and project management.

Project-based learning is often confused with projects, which are short activities injected into traditional education to liven things as a culminating event for the unit. Real project-based learning, by contrast, is deep, complex, and rigorous.

Many countries have had difficulties with project-based learning in the past, when curricula were not designed effectively and scaffolded to ensure that essential learning takes place. In Queensland, Australia, a new, major provincewide initiative in project-based learning is called "Rich Tasks." In 2005, fifty-six schools in Queensland offered programs from Year 1 to Year 9 based on the New Basics triad, which emphasizes what is taught (New Basics), how it is taught (Pedagogy), and how kids show they have learned it (Rich Tasks) (http://education.qld.gov.au/corporate/newbasics). In the United Kingdom, Homewood School in Kent calls it "Total Learning." Starting in 2005, Homewood revamped its year 7 and year 8 programs into a project-based, integrated thematic curriculum. Students at NTHS learn and master collaboration skills, a key twenty-first century skill, by working in project teams, with one student taking on the role of project manager. The team develops a contract outlining the scope of work for each student member. Projects culminate with team reports and presentations. After the completion of the project, each member of the team evaluates the other members through a peer collaboration rubric. At NTHS all teams have taken on a rule that a student who slacks can be voted off the team. The penalty is that the student must then do the whole project alone.

Assessment for twenty-first century learning

In a recent *Education Week* Commentary, Tony Wagner described a rubric that principals in Hawaii had developed to assess rigor in the classroom. The principals, Wagner writes, "began to realize that rigor has less to do with how demanding the material the teacher covers is than with what competencies students have

mastered as a result of a lesson."[4] The group determined to define the level of rigor by posing these questions to students: Why is this important to learn? In what ways am I challenged to think in this lesson? How will I apply, assess, or communicate what I have learned? How will I know how good my work is and how I can improve it?

Project- and problem-based learning does not work unless a learner gets feedback to "know how good my work is and how I can improve it." Current assessments do not do the job. State testing and accountability is aimed at schools, not individual student learning, and reports only once a year, after students have moved on to other teachers. Periodic assessments in managed curriculums are done once a month and mainly provide information to teachers. A student cannot get better or become the manager of his or her own learning without constant, real-time assessment and feedback. This is called assessment for learning, as opposed to assessment for school, district, or classroom accountability.

Assessment for learning starts with outcomes; proceeds with projects, products, and performances that map to the outcomes; and completes the loop with assessment and feedback to students:

Outcomes → Projects → Product and Performance → Assessment/Feedback

Most schools give students a single grade for a course, often losing important data about the skills and abilities of the students. At NTHS, student course grades are disaggregated into the component "learning outcomes." Instead of a single composite grade for each project, subject, or integrated course, the grade report for a project or a course shows separate and distinct grades for content, critical thinking, written communication, oral communication, technology literacy, and any of the other learning outcomes appropriate for the course. Students get a report card that reflects how well they are performing on twenty-first century knowledge and skills. In that way, they know exactly where they are performing well and where they are not.

At NTHS the gradebook is online, accessible by password, and "living": it is updated whenever there is new information, not just at the end of term. Students are thus constantly aware of their strengths and weaknesses and can target their efforts toward improvement. This continuous and just-in-time feedback is critical in supplying the information that helps students become self-directed learners. The assessment for learning feedback is also available online in real time to teachers and parents, who can also easily identify student strengths and weaknesses and offer support to students.

NTHS has developed unique ways to assess certain twenty-first century skills. At the end of every project, students assess every member of their project team using an online peer collaboration rubric. Scores go to a database, where a student, through a secure password, can see his or her scores, although the evaluations are anonymous. The student can then publish these scores as evidence for his or her digital portfolio. A similar process is followed with an online presentation evaluation rubric, which is scored by teachers and visiting community experts.

Schools as workplaces for twenty-first century students

If students are to be the workers, they need classroom learning environments that are workplaces for both individual and group work and are equipped with the technology and tools they need to do their work. Traditional school classrooms are typically 750 to 1,000 square feet for thirty or more students, providing an environment suited only to teacher-led instruction, particularly at the secondary school level.

Larger classrooms are needed that provide a students-at-work environment involving computers, group work, planning, presentations, team teaching, and other strategies. NTHS accomplishes this through double-size classrooms, 1,400 to 1,800 square feet, that house up to fifty students and two teachers in a team-taught interdisciplinary course. The room is divided into two general sections, either side-by-side or exterior ring to interior center. One section houses desktop or laptop computers,

one per student, wired or wireless (or both), for individual or small team work; the other section houses flexible tables for small group work and planning, and doubles as a space for student presentations and teacher-led planning activities or teacher lectures. Teacher lectures are rare but are delivered on what NTHS calls a "need-to-know" basis: when students express a need to understand concepts and content critical to their project work.

NTHS looks more like a modern high-tech office than a school. When one walks through NTHS's glass-walled corridors, one sees students at work. Enrollment is four hundred students for grades 9 to 12. The smaller size helps to establish a more personal environment and a culture suited for individual and group work.

Technology and the twenty-first century classroom

Technology plays a critical role in supporting twenty-first century learning environments. Providing one-to-one computing gives students and teachers the hardware and software tools to do their work. But even more profound, technology, through the school's network, provides a collaborative learning environment that houses curriculum, assessment rubrics, living gradebooks, and communication tools.

Many schools and states around the world are experimenting with one-to-one computing for students and finding the results lacking. The reason for these results is that they use a traditional curricular approach that fails to engage students as directors of their own learning. Project- and problem-based learning, by contrast, can bring one-to-one computing to life.

By having their own computer and Internet access, students at NTHS can research any topic, communicate with experts and teachers, write journals and reports, develop presentations through PowerPoint and video, and take responsibility to develop their professional digital portfolio demonstrating evidence of their mastery of the school's twenty-first century learning outcomes.

In theory, technology is not needed for project-based learning. However, it enables students to research, plan, and communicate.

Moreover, NTHS goes beyond one-to-one computing and provides a technology platform that serves as a collaborative learning environment for students and teachers. This environment, the New Tech High Learning System, comprises the curriculum, standards, assessment tools, and reporting tools of New Technology High School, all online on a common IBM Lotus Notes technology platform.

The learning system is an enterprise solution for the whole school. For students, it is the medium through which they work and learn. It enables them to self-manage their work, collaborate with others, and see their assessments and grades daily. All projects include a course agenda or calendar, where teachers enter deadlines as well as activities for each day, including links to resources and daily assignments.

The learning system also immediately and dynamically publishes all the project materials to the Web for access to the curriculum anywhere, anytime, by students and their parents. And because all projects are housed online, they are available year-to-year even if teachers leave. Moreover, the projects can be shared by teachers within a school and between schools. Currently there are fourteen schools nationally that are based on the New Technology High School model and sharing projects. The network schools will increase to twenty-eight in 2006.

Twenty-first century learners

NTHS is a different kind of school and it produces a different kind of student. Students report feeling safer, better known, challenged, more engaged, and more motivated for postsecondary learning. A study that surveyed the school's eight graduation classes strongly suggests that students feel New Tech High's use of project-based learning and focus on twenty-first century skills were important in preparing them for college, careers, and citizenship.[5] Ninety-eight percent of NTHS's seniors report postsecondary enrollment plans, compared to 67 percent that the Napa Valley Unified School District reports. California and the United States graduate 67 percent and 71 percent of high school students, respectively, of which 32 percent in California and 34 percent nationally are deemed college ready.

Furthermore, the alumni study found that 40 percent of all NTHS graduates and 37 percent of graduating girls either pursue college study, complete college study, or work in science, technology, engineering, or math careers, compared to 7 percent nationally. Women today constitute 45 percent of the workforce in the United States, but hold just 12 percent of science and engineering jobs in business and industry.

NTHS's twenty-first century learners are articulate, powerful, and self-directed collaborators and entrepreneurs.

The globalization challenge

Globalization is flattening the world and challenging the United States as never before, as Tom Friedman points out in *The World Is Flat*.[6] Students in the United States and other advanced countries must lead a new era of global cooperation as twenty-first century learners. Societies need citizens who are smarter, more creative, and more capable of leading, managing, collaborating, and networking with productive people around the world.

Schools need to be totally redesigned to enable and facilitate twenty-first century learning. New Technology High School is one way of getting there. Countries need to upgrade their educational standards to world-class standards, moving curriculum to 100 percent in-depth project- and problem-based learning that involves teamwork, critical thinking, and communication skills; authentically assessing for learning all these skills for immediate and active feedback to students; redesigning and reconstructing facilities and classrooms to enable a students-at-work environment for individual and collaborative work; and finally, using technology to bind this collaborative learning community together.

Notes

1. U.S. Department of Labor (1991). What work requires of schools: A SCANS report for America 2000. Secretary's Commission on Achieving Necessary Skills. http://wdr.doleta.gov/SCANS/whatwork.

2. Partnership for 21st Century Skills. (2003). *Learning for the twenty-first century: A report and MILE Guide for twenty-first century skills.* Washington, DC: Author. http://www.21stcenturyskills.org/images/stories/otherdocs/P21_Report.pdf.

3. Borja, R. R. (2004, May 6). Technology counts 2004. *Education Week.* 2004. http://counts.edweek.org/sreports/tc04/article.cfm?slug=35singapore.h23.

4. Wagner, T. (2006, January 11). Rigor on trial. *Education Week.*

5. Rockman *et al.* (2006). New Technology High School postsecondary student success story. http://www.newtechfoundation.org/Articles/NTF_StudentSuccessStudy.pdf.

6. Friedman, T. L. (2005). *The world is flat: A brief history of the twenty-first century.* New York: Farrar, Straus and Giroux.

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