

Connecting the Bits

A reference for using technology in teaching and learning in K-12 schools

Lessons from *The Road Ahead*: An Educational Technology Program of the National Foundation for the Improvement of Education

Today, almost every school in America is connected to the Internet. Increasingly, individual classrooms across the country have their own access to the rich resources of the information superhighway. What is more, this remarkable accomplishment has been achieved with amazing speed.

In 1995 the World Wide Web was a new concept, and technology was slowly making its way into education. Teachers were struggling, often alone, to figure out how hardware and software—often balky and unreliable—could improve student learning.

As the Internet grew from a military and academic research tool to a broad-based network of resources and communications, it significantly increased the potential for contributing to improved student achievement. The Internet increased the need for insights into integrating technology into the curriculum, providing a clear mandate for educational professionals and technology experts to collaborate.

To that end, the National Foundation for the Improvement of Education and Microsoft created *The Road Ahead*. The collaborative program focused on student-centered activities to demonstrate how multimedia and telecommunications technologies could facilitate both formal and informal teaching and learning.

The Road Ahead

The mission of *The Road Ahead* program was to help teachers develop and implement multidisciplinary initiatives that went beyond traditional teaching. The goal was to learn lessons that all teachers and students could apply in developing an understanding of what a “connected learning community” might really mean. In response to a request for proposals, NFIE received 348 applications and selected twenty-two projects in fifteen states. The program was supported by Bill Gates, chairman of Microsoft, Inc., with the proceeds from his book, *The Road Ahead*.

Twenty-two pilot
Road Ahead projects

Each school site team and a community partner set out to test the new concepts and integrate new resources into the classroom and informal learning settings. Each site worked with a different configuration of technology and set of objectives. Each project had its own plan as well as particular methods for integrating technology into teaching. Projects ranged from learning local history in cooperation with a senior citizen center to developing environmental programs and reclaiming waterways. Schools partnered with museums, libraries, research centers, and community-based organizations.

NFIE and Microsoft designated six essential components for the projects. These were

Essential components of
the pilot projects

- **school-community partnerships developed by five-member teams that included at least one public school teacher, an administrator, and a representative from a community-based organization, including libraries and museums;**
- **\$30,000 spread over two years;**
- **three NFIE-sponsored professional development conferences;**
- **twenty-two teacher mentors, with backgrounds relevant to specific sites;**
- **an educator-moderated online network to facilitate communications;**
- **a large amount of Microsoft software and two Compaq computers.**

The experiences that occurred as sites combined technology, teaching and learning, partnership-building, professional development, and technical support gave rise to several clear conclusions. Based on *The Road Ahead*, NFIE makes the following recommendations in designing a technology-based effort:

- **Start with what you want to achieve. Let desired student outcomes guide technology selection and use. Clear academic goals should govern, so that the focus is on outcomes and achievements rather than on dazzling technological tools.**
- **Innovative programs need three to five years to show results.**
- **Investment in technology requires investment in professional development, continuing teacher-defined and teacher-led training, and student-led training.**
- **Technology supports critical thinking, which should be a focus of the effort.**
- **Success requires the involvement of many stakeholders, the inclusion of administrators at every step of the way, and the work of experienced teams for systemic and long-term planning.**

Conclusions and recommendations from the pilot projects

The Road Ahead program results are a strong endorsement of technology as a worthwhile investment for public education. The results also emphasize that simply placing computers in classrooms does not guarantee improved student achievement. This brief overview discusses many of the outcomes of *The Road Ahead* and highlights those lessons that are critical for program success.

Student Learning

The object of technology-based teaching is improved student learning. Results of *The Road Ahead* for students, as documented by the program's evaluator, the International Society for Technology in Education (ISTE), included

Improved student learning is goal

- **increased technology capability and skill;**
- **a surprisingly strong emergence of students as teachers;**
- **increased motivation for learning (focused around the introduction and initial use of technology);**
- **improved achievement in core subjects as measured by test scores in some cases, and grades or student products in other cases.**

Project-based; team-based; aimed at higher-order skills

The types of learning that information technologies can support—project-based and team-based (both aimed at critical thinking skills)—become better understood. Traditional, lecture-based classroom roles are changing, as educators and students work collaboratively in more open-ended teaching and learning experiences. This combination of elements can sometimes transform uninvolved, at-risk students into active and invested learners. This motivational aspect of technology is a principal reason that educators try so hard to master and apply technology tools.

At Nelson Middle School in Renton, Washington, both teachers and students needed to learn new technology skills. Nelson defined this as an opportunity and created an after-school program where students

and teachers learned alongside each other in formal training sessions and less structured activities. On certain nights of the week, the facility was open to parents, who both learned from and taught their children.

Students gain access to resources via the Internet. Software tools offer a variety of ways to manipulate these resources. Just as in business and higher education, schools suddenly can connect with information, data, and visual and audio materials in ways never before possible. This extraordinary expansion of the classroom and the interactive nature of finding and using information mean that the world can become the curriculum.

Motivation for learning is reinforced and students also come to terms with analyzing materials, comparing and contrasting ideas, using induction and deduction, synthesizing information, and taking informed action. Thus, project-based learning using Internet resources can jump-start even young students, effectively giving them tools once available only to scholars and researchers. By working in teams to create multimedia projects based on selected sources, students become better prepared for the modern world of work.

Expanded curriculum;
increased motivation

Working with technology also enables parents to understand their children's achievements and assess their progress more easily. Because of the variety of products and projects that engage students through technology, specific skills can be identified and encouraged. These include interpretation and manipulation of data, development of verbal and mathematical skills, and visual and graphic capability.

At Longfellow Elementary in Eau Claire, Wisconsin, third graders, many from the growing Hmong community, joined forces with senior citizens to learn the history of their country and create a hyperstack resource on local history, geography, and resources.

Student enthusiasm and skill skyrocketed. By the end of the project, the students were conducting presentations for the Board of Education, and some of the most effective presenters were students who had seldom participated in class work.

Parental involvement and support

What is more, parents can support their children's learning in many ways. They can connect directly into homework hotlines, check on assignments, contact the teacher, and even view what is happening in schools. Parental involvement and support for schoolwork can be as transformed as student learning.

Students as teachers

Finally, because of the ease with which young people master the operation of new technology, students are sometimes able to teach their teachers. The way that students and teachers teach and learn together when they use technology in schools is good practice for the adult world of work, which increasingly requires diverse individuals to work effectively in teams. Students learn to deal directly with adults in schools and in the community and to be part of a world that is becoming a community of learners.

Professional Development

The key to effective use of technology in schools is professional development.

As *The Road Ahead* program began, it was already clear that few schools were making the level of commitment to professional development that would be necessary. In 1995 the Congressional Office of Technology Assessment stated that in any school technology effort, at least one-third of total cost should be designated for professional development. Professional development was not only underfunded, but also the old models were not working. One-day workshops on the conceptual aspects of computers, training on generic technology, and training focused on hardware operations were simply not effective for integrating technology in ways that resulted in improved student learning.

At least one-third of funds
for professional development

The Road Ahead projects devoted, on average, 36 percent of their budgets to professional development and related staffing, such as substitutes. Intensive and continuing professional development was a hallmark of the program, and site teams credited this investment as crucial. NFIE directly provided the equivalent of nineteen days of training and workshops, a professional development investment roughly comparable to a three credit-hour graduate course.

The dominant site model of professional development was teachers teaching teachers. Staff-run, hands-on workshops, classroom demonstrations, and just-in-time help sessions were frequent. The teams learned together and supported one another steadily. They trained on the equipment they were using and learned by developing their own products, approaches, and methods. Because they worked closely and became so comfortable with technology, some *Road Ahead* team members eventually became technology leaders for their school districts.

Teacher teams and a focus on practical applications

Both peer-coaching and supporting students as trainers strengthened professional development at all the sites. New skills were learned when needed and were reinforced through daily use. The focus was always on practical applications. As projects grew and involved other classrooms, *The Road Ahead* teams obtained “buy-in” from other educators by sharing skills and knowledge. In fact, the constantly changing nature of modern technology means that there is always something new to learn, so old barriers of “who knows” and “who learns” simply dissolve. Everyone is eventually in both categories.

Online mentoring worked extremely well in a few cases, moderately well with regard to early plans and strategies in many cases, and not at all in others. A clear finding from this experiment is that while online mentoring can be efficient and extend resources, the mentor must establish some personal relationship to the project team and the site through visits. Help is more easily given and received when people have connected in the real world.

Online mentoring: successful when paired with personal contact

<p>Teachers at Rice Creek Elementary in Columbia, South Carolina, wanted an in-depth course at the start, not short workshops. A professor from the University of South Carolina agreed to teach a graduate-level course in the Rice Creek computer lab, where twenty-five people</p>	<p>met weekly for three hours. The Rice Creek team defined this event as creating “the critical mass of trained teachers who supported each other.” Rice Creek’s principal, who was in the class, gained credibility as a leader and as a man who made good on his commitment.</p>
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Technology Issues

Professional development is the key to effective technology use, but there are even more fundamental requirements: The technology must be in place; it must be connected; and it must work.

Technology system support:
crucial at both building
and district levels

As *Road Ahead* projects moved to implementation in the fall of 1995, each project had designed a technology system and planned its use. In more than one school, however, extraordinary delays meant that projects fell far behind. Vendors failed to produce promised software that would support in-school networks. School districts changed leadership, encountered budget problems, or for other reasons did not meet long-standing deadlines for installing equipment. Difficulties with local service providers made Internet connections seem like a dream.

At some sites, technology was installed, but keeping it in operating condition was a constant drain on the project. From the early period of vendor-provided technical support, most school districts have moved to hiring their own support personnel, and some schools have done the same. Increasingly, students are taking the lead in providing technical support for maintenance and upgrading.

Difficulties with technology underscore the necessity for having building and district leadership commitment. Some *Road Ahead* schools were able to recruit their district superintendents for the NFIE summer intensive programs. This level of participation translated into strong support for projects. Although technology is evolving rapidly and becoming easier to use, it is still difficult for a classroom or a school to try and go it alone.

At Romig Junior High in Anchorage, Alaska, plans were delayed a year due to changes and barriers in district technology policy and the failure of software chosen to support the computer pen pal component,

despite many attempts to make it work. Changes in admission at the partner senior citizens' home increased the proportion of residents with advanced dementia. The team persevered and overcame these difficulties.

Once the technology is installed and working, professional development must be available, as discussed above, but beyond training, teachers and teams must work together to develop a base of experience for integrating technology into teaching. While easy to describe, this integration is not easy to achieve. Trial and error, relearning, and redefining characterize *The Road Ahead* experience.

Fortunately, this experience is cumulative, and as teams developed knowledge, they were able to create better and better techniques. This level of experience, plus the newness of the strategy, is one reason that technology efforts must be understood as part of a long-term commitment. If the expectation is that a school will go from zero to integrated learning in a year or so, with provable results in student achievement, the expectation is unrealistic.

Integrated learning requires long-term commitment

Systemic Change

Technology changes the conditions of teaching and learning. Based on *The Road Ahead* projects, two years of intensive work at twenty-two sites covering a wide range of students, technologies, and projects, NFIE can identify some aspects of schooling that fall into the category of systemic change.

In this instance systemic change means two things: In order to use technology well, these changes will be necessary; and if technology is used well, these changes will be inevitable.

Effective use of technology and systemic changes are mutual and simultaneous

Time

Time has long been a major concern for educators. There is never enough time for planning, teaching, assessing, revising, and implementing. It is impossible to put technology into the classroom effectively without allotting substantial amounts of time for team training and other types of professional development.

Additional time, flexible scheduling necessary

Road Ahead schools opened blocks of time by shifting school hours, scheduling late openings, employing substitutes extensively, and allowing teachers to travel and work together. Even with major adjustments in scheduling for professional development, teachers still worked very long hours and gave massive amounts of uncompensated time.

Technology allows for delivery of extraordinary resources, but it also requires much time and effort. Technology often becomes an incentive for block scheduling or some other reorganization of the school schedule, so that longer instructional periods become available for teamwork and project efforts that need sustained concentration.

Roles

Changing roles: teachers as coaches and facilitators; students as directors of their own learning

Teachers acquire new roles as they use technology. They naturally move toward the roles of coach, facilitator, and mentor, as more of the resources for learning become directly available to students.

Teachers are no longer required to provide all the information and knowledge that students need. Teachers continue to nurture and guide students, but they do it in a different way. Teachers also increasingly acquire professional skills desired by the world outside the classroom, and they become web designers, technology leaders, software designers, and information managers.

Students change roles as well, taking on more responsibility for their own learning and acting as trainers and teachers for other students and for adults. All these changes require sensitivity, the involvement and understanding of parents, and the support of the community.

The team at South Mountain High School in Phoenix, Arizona, held regular staff training sessions after school from 4 to 5 P.M. for eight weeks. The team also gathered every Friday afternoon to stay in touch and encourage one another.

Infrastructure resources

Advances in global internetworking will only increase in pace and in scale. School districts and educational policymakers must prepare for and work toward this, so that schools are not left behind. This change will require online connections for schools, community centers, and other education partners and the provision of resources within schools and among students in an equitable manner. The 1990s computer labs will take a back seat as classrooms are directly linked and well-equipped with workstations, peripherals, and ever-smaller and more powerful equipment.

Districts, parents, and community: partners in technological connections for education

A lesson of *The Road Ahead* program is that educators must work to ensure that school districts take advantage of all means to make these changes, including developing community support, parent involvement, and relationships with businesses and organizations. Means such as the E-rate must be provided and maintained to help those schools in communities where available resources are simply inadequate to serve student needs equitably. Further, school districts, parents, and educators must strive for flexible approaches and solutions to teaching and learning in a world of constant technological change.

The Road Ahead project at Lakeside Elementary in Manistique, Michigan, was a catalyst for tremendous change in the school district and the community. Because of the project,

- all elementary and high schools in the district have installed Internet connections;
- the district is shifting its junior high curriculum to better integrate technology;
- the district has established a technology committee;
- team members have become an important resource for district decision-makers;
- the community has established a Family Tech Center, offering training led by the school staff.

Conclusion

Information technology as a tool for enhancing teaching and learning can expand the horizons of education around the world to enrich the resources of knowledge. While the promise is great, so, too, is the commitment that is necessary for its realization.

Changing traditional roles

Over time, ample connectivity in every classroom is likely to become a reality. But for ready access to translate into improved student learning, the traditional roles of teaching and learning will need to undergo significant change. Professional development, how and what students are taught, and the very climate and structure of education must be transformed.

Life-long collaborative learning

Lecture-based models should give way to collaborative learning, where knowledge and skills are shared among teachers, students, parents, the community, and beyond. Through project-based learning, students should take an active role in their own learning and increase critical thinking abilities. Learning should become a collaborative, life-long enterprise, as the barriers of “who knows” and “who learns” simply dissolve. At-risk students especially should benefit, as intellectual achievement is driven through problem solving, research, analysis, and synthesis of authentically posed ideas and knowledge. In addition, educators should use technology tools diagnostically to improve student assessment methods.

Necessity of teacher professional development focused on student learning

Teachers must have high-quality, job-embedded professional development, taking on roles as coaches and mentors to their colleagues. Old models of one-shot training workshops will not result in changed attitudes and beliefs about teaching or in desired student outcomes. High-quality professional development

- **must have student learning as its focus;**
- **must be designed and directed by teachers themselves;**
- **must be rigorous, collegial, and extend over time.**

This kind of professional development requires a substantial portion of the overall educational technology dollar.

Integrating technology effectively requires building strong and stable partnerships that include teachers, administrators, parents, and others who share a significant interest in enhanced student learning. The contributions of individuals and groups beyond the classroom become invaluable assets. Businesses, cultural organizations, and higher education institutions extend both the resources and the reach of support.

Systemic change ensures that schools have the ability to achieve and sustain educational technology's effectiveness. It is necessary for educators, policy-makers, and public agencies to assure that both infrastructure resources and the necessary policy supports, such as time for professional development, are available. It is also important to build time for coaching, collegial learning, and team training into schedules and to be patient.

System-wide change in time allocation, infrastructure, and policy supports

Technology efforts are long-term commitments and require at least three to five years to demonstrate increased student performance.

Technology is rich in its potential for preparing today's students for adulthood in the new millennium. Technology is a tool, however, and much work remains in order to achieve the goal of integrating technology effectively into teaching and learning. It is a goal toward which educators must strive, for its attainment holds the promise of readying all America's children in the twenty-first century.

"Lessons from *The Road Ahead*" is one of several papers included in *Connecting the Bits, A reference for using technology in teaching and learning in K-12 schools*, issued by the National Foundation for the Improvement of Education in 2000, and available at www.nfie.org.

