Learning in the Knowledge Economy: The Role of Technology

By Manuel Jaffrin, K12 Technologist, Sun Microsystems

The Knowledge Economy

For the last two hundred years, economics have recognized only two factors of production: labor and capital. This is now changing. Information and knowledge are replacing capital and energy as the primary wealth-creating assets, just as the latter two replaced land and labor 200 years ago. In addition, technological developments in the 20th century have transformed the majority of wealth-creating work from physically-based to "knowledge-based.".

Technology and knowledge are now the key factors of production. With increased mobility of information and the global work force, knowledge and expertise can be transported instantaneously around the world, and any advantage gained by one company can be eliminated by competitive improvements overnight. The only comparative advantage a company will enjoy will be its process of innovation--combining market and technology know-how with the creative talents of knowledge workers to solve a constant stream of competitive problems--and its ability to derive value from information. We are now an information society in a knowledge economy.

The power of the Internet

The Internet is bringing new means of communication. It is global, it is fast, and it is growing rapidly. Reaching each corners of the earth, the Internet is making the world at once smaller and more connected, transmitting information at nearly real-time speed. An estimated 400 million people are currently using the Internet. The World Wide Web is bringing rapid and radical change into our every day lives.

At the dawn of the 21st Century, Internet is changing the education landscape: it is now possible for more individuals than ever to access knowledge and to learn in new and different ways.

It offers a unique opportunity to use new educational materials that can link students' activities in school and at home. On the curriculum side, such materials should extend the demonstration, simulation, and information display capabilities of the teachers while, on the home and personal side, they should provide both individual and cooperative project work proposals for students, exercise and self-assessment tools, optional information and advanced learning ,and leisure resources.

It is enabling us to address some of the educational challenges, bringing learning to students instead of bringing students to learning.

It is allowing the creation of learning communities that defy the constraints of time and distance as it provides access to knowledge that was once difficult to obtain. This is true in the schoolhouse, on the college campus, and in corporate training rooms.

According to Market Data Retrieval's "Technology in Education 2000" study, more than 65 percent of all schools in the US report that the majority of their teachers now use the internet for instructional purposes.

The new learning paradigm

Education can no longer be viewed in terms of the delivery and absorption of content. Networked learning environment and constructivist models requires a new pedagogical approach.

We are moving towards a Student-Centric model where technology can be used in many new and exciting ways to enhance student learning. Multimedia presentations engage students with different learning styles. Electronic mail provides a more frequent and more timely interaction between teachers and students. Online chat rooms and discussion groups encourage student interaction. Advances in technology have made information much more available. Teachers will no longer have to function as storehouses of knowledge, keeping up with an explosion of information. Instead, teachers can help students use resources to evaluate information wisely.

The scale of current economic and social change, the rapid evolution of a knowledge-driven economy and the demographic pressures resulting from an aging population all demand a new approach to education and training,

based on the concept of lifelong learning. It can be defined as "all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence".

As communities around the world are setting educational objectives, the development of 21st century skills should be a key objective. In the rapidly changing economy there is a corresponding shift in the skills and abilities that students will need to have in the future. This includes:

Digital Age Literacy
1.Basic, Scientific, and Technological Literacy
2.Visual and information Literacy
3.Cultural Literacy and Global Awareness Inventive Thinking
4.Adaptability/Managing Complexity
5.Curiosity, Creativity, and Risk Taking
6.Higher Order Thinking and Sound Reasoning

Effective Communication
7.Teaming, Collaboration, and Interpersonal Skills
8.Personal and Social Responsibility
9.Interactive Communication

High Productivity
10.Prioritizing, Planning, and Managing for Results
11.Effective Use of Real-World Tools
12.Relevant, High Quality Products

Education is not anymore considered as a cost center but really as the first competitive advantage for any organization or community.

"Improving basic skills, particularly IT and digital skills, is a top priority to make the Union the most competitive and dynamic knowledge-based economy in the world. This priority includes education policies and lifelong learning as well as overcoming the present shortfall in the recruitment of scientific and technical staff."
European Commission, 2001

The role of technology

Any discussion of technology in learning should be driven by clear education objectives. After all, the main question is not about what technology is available or even what a student or teacher does with it, it is about the cumulative effect that technology and its appropriate use will have on individual student performance.

The true benefits of technology in education can only be attained when all Four Pillars of education and technology are present and integrated into the classrooms:

Hardware
Connectivity
Content
Professional Development

In the past, many experiences of deploying new technologies in schools have failed, always for similar reasons:

Lack of teacher's training
Not enough technical staff
Slow and un-reliable Internet access
Security and quality issues
High cost of technology refresh
No equality between schools

Successful educational technology efforts share a common element: a dedicated educator who champions the adoption and integration of technology with energy, enthusiasm and a clear set of educational objectives. Objectives, clearly defined and broadly adopted, provide the foundation for developing plans, making changes and achieving results.

Technology trends: the NetEffect

The exponential increase in Internet availability and bandwidth is becoming the pivotal development in computing. We can call the tremendous opportunity created by this phenomenon the Net Effect. Until recently, the dominant computing model was one of PCs and applications. In the past, PC computing was driven by advances in CPU technology. Now, advances in network architecture and technologies that maximize bandwidth availability, are driving computing. Going forward, computing will center around the network and services.

The Net Effect will generate more devices, more users, more data, more services - all of which multiply the value of the Internet for businesses and consumers.

* Applications becomes services on demand

Increased bandwidth and advances in network architecture are changing the way applications and services are delivered. In the past, applications were shrink-wrapped bundles sold individually or loaded on PCs and servers. Going forward, rather than talking about applications, we will talk in terms of "service grids" - collections of services brought together from across the network. Service grids will be composed of services that you'll need at a particular time - mail, stock feeds, word-processing, or flight information, for example. Each piece of the service grid will come from a source that specializes in that function so you'll always get a best-of-breed solution. Because each service is unconnected from the rest, it will be updated whenever the next version is available.

* Clients becomes Internet devices

The services that comprise these service grids will be hosted across the network by service providers. Because many of these services will no longer reside on the client, lightweight mobile clients or Internet devices will proliferate. As a result, PCs will lose their position as the dominant client as the number and variety of these devices attached to the network increases.

* The data center becomes the Internet DataCenter

The increased access to services from connected and wireless devices will place greater demands on the servers that house applications. These demands will not only be unpredictable, but come at all hours of the day and night. To support these new activity levels, hardware requirements will radically change. The result of this leap in scale will be the rise of the Internet data center - providers of enormous scale that offer continuous real-time availability similar to telecommunications companies today.

* The network becomes the information utility

All of these combined pressure points will cause us to rethink the network. Instead of separate, individual networks, this new computing model will be supported by the "information utility" - a merger of separate wireless or IP-based networks into one, dial-tone-solid, unified network for communications, computing and media.

The ABCs of Network Computing for schools

At Sun, we envisions a network-computing model for K-12 education in which teachers, administrators, students and communities will have access to the tools that enable access to information anytime, anyplace by anyone on any device.

This network computing vision is taking shape in K-12 classrooms around the globe. That vision, based on a model in which an open architecture delivers information to any device at any time, is reflected in the implementation of systems, devices, and educational content at schools using servers and clients. Call it the ABCs of K-12 network computing.

A is for Architecture that Works

The foundation of this network computing model is the concept of an always-available WebTone. Just as your telephone provides a dial tone instantly and without effort on your part, network computers and other devices can deliver Internet connectivity transparently. No more booting up or dialing out. In education, this means that students and teachers can focus on learning, rather than worrying about the nuts and bolts of the technology that

supports it.

B is for Browsers on Devices

This reliable infrastructure provides the back-end for a host of devices to access the Internet anytime, from any location. In the classroom, students will use thin clients and information appliances to tap into rich educational content on the Internet. These network computers are designed to be centrally managed They use a browser-based front-end to provide a consistent, easy-to-use interface that doesn't incur the administrative overhead of Pcs. Thin-client computing is sensitive to the unique issues of K-12 schools. The technologies are finally arriving to provide reliable, low-cost, computer networks for K-12 schools These advantages are in evidence at several big reference installations worldwide.

The benefits are two-fold. Students and teachers have easy access to networked resources, the Internet, applications such as the free StarOffice™ productivity suite, and educational software. The other benefit is financial. In an era of tight education budgets and limited availability of system administrators, reliable servers and appliances lowers total cost of ownership by reducing administrative overhead.

C is for Content is King

A reliable infrastructure and low-overhead devices are the building blocks of network computing, but they are only part of the story. The architecture isn't a goal unto itself -- it's a means of supplying users with anytime, anywhere access to the widest possible variety of services and content. For K-12 students and educators, this is where the excitement lies.

Traditionally, users have bought shrink-wrapped applications, such as e-mail programs or office suites and then loaded them on PCs, maintaining or upgrading the applications themselves. The ability to update a web site continually is one of its key advantages over either printed material or CD-ROMs. Soon though, we'll subscribe to software a la carte, much like we pick and choose among telephone and cable television options. Service providers will offer a menu of Web applications available to thin clients, handhelds, and other devices.

Through Education Service Providers (EduSPs), schools will have access to education resources from anywhere on the globe. Even the smallest elementary school will be able to tap into this best-of-breed content.

The future of network computing technologies promises greater diversity: we can finally move away from the current, one-size-fits-all model.

Conclusion and recommendations

Internet is not the panacea for every problem in education but we must realize that this is a great tool that can help us empower every student and elevate each individual to new levels of intellectual capacity and skills. Combined with specifics learning objectives, it will definitely change the face of education.

Technology is becoming an increasingly vital tool in our information society. More people are going online to conduct such day-to-day activities as business transactions, personal correspondence, research and information-gathering, and shopping. Each year, being digitally connected becomes ever more critical to economic, educational, and social advancement. Now that a large number of people regularly use the Internet to conduct daily activities, people who lack access to those tools are at a growing disadvantage. Therefore, raising the level of digital inclusion - by increasing the percentage of the population using the technology tools of the digital age -- is a virtually important national goal.

As a conclusion, here are some recommendations that can represent the first steps to bring Internet in the classroom successfully:

Invest in Bandwidth.

Put everything on the Net.

Invest in digital curriculum.

Build everything to open standards.

Take advantage of free software.

Create portals for your communities.

Move to a utility model of computing.

References

CEOForum 4th Annual report (2001) http://www.ceoforum.org
US National Educational Technology Plan (2001)
"The Power of the Internet for Learning"(2001)
"Internet in the Classroom and at Home: The Bridging Role of Publishers", Ferran Ruiz (2000)
IEEE Learning Technology Standards Committee, http://ltsc.ieee.org
Learning Technologies Workshop, http://www.cenorm.be/isss/workshop/lt
The Administrator's Role in Technology Integration *http://www.education-world.com/a_tech/tech087.shtml*
Education Technology: Digital Divide *http://www.ed.gov/Technology/digdiv.html*
US department of education *http://www.ed.gov/Technology/digdiv_resources.html*
The Net effect *http://www.sun.com/neteffect*
European SchoolNet *http://www.eun.org/eun.org2/eun/en/index_eun.html*