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Integrating IT in Schools

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Integrating IT in Schools

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Leadership Without Followers

Chris Dede

A visionary in educational technology describes the nature of true leadership.

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The concept of leadership is fraught with misconceptions. People often see leadership as a combination of meticulous management, adept political manoeuvring, and responsive facilitation of others activities. While each of these is important in advancing the field of educational technology. I believe the true nature of leadership is exemplified by the four attributes below.

Leadership Requires Envisioning Opportunities

One of the most important attributes that distinguishes leaders from managers is "vision" : the ability to communicate desirable, achievable futures quite different from where the present is drifting. Leaders create and convey compelling images of how our reach is much less than our potential grasp; they redefine people's paradigms about what is possible. In contrast, competent managers are adept at organizing operations so that an institution's efficiency in accomplishing plans is optimized. This is a vital task often neglected by leaders who do not understand management, to their later regret, for good administration involves both envisioning and operationalizing.

One of the most important attributes that distinguishes leaders from managers is "vision" : the ability to communicate desirable, achievable futures quite different from where the present is drifting.

At present, educational technology offers many opportunities for leadership because every aspect of its context is rapidly shifting. The information technologies are evolving very quickly: merging, adding powerful capabilities, decreasing in cost. The global economy is changing the skills American workers must have, emphasizing both technical excellence and intercultural design for the worldwide market. Simultaneously, the U.S. population is becoming more diverse, pluralistic — a salad bowl rather than a melting pot. Society's conception of the educational system's role is also in flux: at the heart of current movements for reform and

restructuring is a desire to move beyond fine-tuning present models to redefining the nature of schooling.

Over the next decade, all these external forces will combine to drive major shifts in the mission, curriculum, clients, and process of educational institutions (Dede, 1992a). Whether these changes actually improve learner outcomes will depend in large part on the quality of the visions we forge during the early 1990s. The challenges we confront require a new, better paradigm for schooling; the power of emerging technologies enables implementing models for teaching/learning unique in the history of civilization. A great American philosopher, Yogi Berra, once said that if you don't know where you are going, you are likely to end up someplace else. The opportunities for leaders in educational technology to invent innovative visions are boundless.

Developing motivating images that capture the essence of needed changes is important, but insufficient to make educational technology a driveshaft for reform. Leadership also involves creating stepping stones that bridge to a desired future from the current gridlock typical of many American schools. In evolving from its present state to a distant objective, an educational institution must progress stage by stage. Each step of evolution requires a critical mass of resources and must create a stable, desirable situation.

Trends and discontinuities driving major changes in our societal context can serve as the basis for stepping stones to the future. Some of these developments have a negative impact in the short-term, but over the long-term, open up possibilities for educational evolution. For example, society's immediate response to economic crises is to cut back on instructional innovations, but in the long run, financial hardship can drive needed changes by forcing schools to abandon ineffective approaches that have hardened into traditions.

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Other developments, such as advances in educational technology, create new possibilities for improving teaching/learning. As one illustration, digital video technology allows the synthesis of computer graphics and video images, enabling the television generation to see and manipulate visual representations of abstract, intangible concepts (Dede, 1992b). We can take advantage of these technological innovations, building on their impact to actualize new models for schooling.

Giving a balanced picture of where we are in history — both the good news and the bad news — is the best way to demonstrate that a hopeful image of the future can emerge from turbulent, uncertain, even dangerous times.

Constructing visions that transcend how emerging capabilities enhance conventional schooling to depict their implications for empowering new paradigms is vital. Ultimately, digital video is not simply a more powerful tool for teachers' presentations, but also enables inexpensive multimedia authoring by students. By building their own knowledge structures, learners gain a much deeper understanding than by simply assimilating a prepackaged multimedia experience.

A credible, desirable vision is based on both opportunities and challenges. Without levers for improvement, significant gains in educational effectiveness are unlikely: without troubles, society will not shift from drifting through the present to implement alternative paradigms for teaching/learning. Giving a balanced picture of where we are in history — both the good news and the bad news — is the best way to demonstrate that a hopeful image of the future can emerge from turbulent, uncertain, even dangerous times. This type of envisioning is central to leadership.

Leadership Requires Displacing Cherished Misconceptions

An important attribute of leaders is their ability to displace deeply held, cherished misconceptions with alternative visions that more accurately depict reality. Mistaken beliefs most people hold about teaching and learning form a barrier that blocks improving American education. For example, many in our culture have a subconscious image of the secondary school that is based on the following assumptions:

- despite coming from diverse cultural and socio-economic backgrounds and going through puberty, just below the surface teenagers have a strong work ethic and a fascination with intellectual pursuits.
- regularly attending PTA meetings and sports events, paying taxes, and electing dedicated school board members provides sufficient parental support for quality education.
- because they are deeply fulfilled by their impact on learners' lives, highly qualified teachers will enter and stay in the profession despite low salaries, marginal working conditions and little respect from the community.
- schools should be settings isolated from the real world in which learners are grouped by age and taught the academic disciplines as formal subjects.

- students are graduating into a future workplace in which mastery of the skills multiple-choice tests can measure will guarantee them a fulfilling, prosperous career.

- technology's utility in education lies in automating routine activities that underlie this model of schooling and in motivating learners via instructional formats analogous to video games and television.

Unfortunately, all these assumptions that underlie this image of the secondary school are fundamentally inaccurate (Dede, 1990a). As a result, intensively applying technology to improve this model of education (e.g. integrated learning systems and computer labs, multimedia-based teacher presentations, more elaborate testing) results in only small improvements in outcomes.

Shifting communities to alternative visions for education that are based on more realistic but less comfortable assumptions is a major leadership challenge. In abandoning the old model of secondary education, parents, businesses and teachers, and students must confront some unpleasant truths about our culture's current weaknesses. For schools to succeed, parents must provide time and effort as well as money; an excellent teaching staff may cost more than most communities are willing to pay; many students do not have middle-class values and aspirations; and the skills for future occupational success in the global economy are quite different from what can be conveyed by test-oriented, subject-centered group instruction in classrooms remote from real-world settings.

Shifting communities to alternative visions for education that are based on more realistic but less comfortable assumptions is a major leadership challenge. . .

Leadership requires packaging alternative assumptions and paradigms as part of a larger vision that inspires new roles for educational stakeholders. Scenarios can be an effective means of highlighting potential futures quite different from present models of schooling. Here is one example (Dede, 1990a):

Dr. Hari Grosvenor sat on the floor with his students in a circle. Three six-year-olds were trying to talk simultaneously. Each was somewhat impeded in the discussion by having to use Spanish (this part of the day was devoted to practice in a second language), but their enthusiasm was unhindered. To Hari's relief, only his handicapped student's instructional device was currently in the room; he hated information technology.

Hari felt that intelligent tools had their uses, but not in his classes. The foundations for his pupils' discussion had been laid by

Scenarios can be an effective means of highlighting potential futures quite different from present models of schooling.

technologies that trained them in the prerequisite knowledge, but only a human teacher could master the intricacies of teaching a seminar. His speciality was helping learners with low self-esteem feel capable, loved, motivated, and challenged. Hari reveled in the freedom he had: to teach anything he wanted in any way he chose, so long as his students' sense of personal worth increased. His ability to assess individual learning styles better than the most sophisticated diagnostic devices was being studied but he knew that a machine could never replace him.

From her vantage point at the far side of the circle, safely in the middle of her pressure pad. Ariel watched Hari deftly refocus the discussion. The scanner on top of her computer screen continually monitored Ariel's actions with her wooden blocks. Simultaneously, icons on the screen depicted her movements, text along the screen's bottom described her actions, and a synthesized voice in her earphones discussed what she was doing. Her congenital mental handicap was rapidly improving through this immersion in multiple representations of reality from concrete manipulations to abstract symbols — plus the care of her teachers. Still, she liked her machine best of all right now; no person was as oblivious to her handicaps.

Having intervened to stop his seminar from coming to blows over who should serve as their representative on the school's governing board. Hari's thoughts wandered. He wondered how he should spend his merit bonus; once again, his innovation quotient had been the highest in the school. "Computers slow down those other teachers and stifle their creativity." he mused. "I'm glad the next stage in the master plan for our region calls for less reliance on instructional devices. Biotech prosthetic enhancers are definitely the best thing going."

Hari's merit bonus for innovation, his freedom to control content and methods as a way of building learners' self-concept and the participation of students in school governance exemplify assumption-breaking innovations essential for successful restructuring. Ariel's sophisticated technological aids, which serve as an external nervous system, provide a provocative contrast with Hari's "anti-technological" stance.

Incorporating humor into these vignettes provides a framework for discussing the obsolescence of current approaches in a motivating, rather than discouraging manner. These scenarios also depict new roles educational stakeholders might play without

bogging down in the immediate mechanics of how to bridge to these futures from the present; the intent is to provide a sketch rather than a blueprint. In counterpoint, however the "situation-comedy" classrooms portrayed on television convey opposite images that speak to cherished myths in our culture, so undercutting society's mistaken beliefs about teaching/learning is hard.

Since our society frequently uses gadgets as magical remedies in attempting to solve social problems, moving beyond a "silver-bullet" attitude toward educational technology is difficult. In our field, leadership requires developing both instruction-oriented technologies and technology-intensive learning-by-doing approaches; applying this combination of pedagogical strategies necessitates numerous changes in the organizational context of the classroom and the roles of teachers, parents, and students. Creating and conveying technological visions compelling enough to displace our culture's educational misconceptions is one of the most challenging aspects of leadership.

Leadership Requires Inspiring Others to Act on Faith

Inspiring a group to work toward a shared vision necessitates building trust: faith that this team of people can overcome all the obstacles that block creating a future quite different from the present. We often speak of visions as "dreams" because we do not believe they are possible; we doubt that they can be made real. Actualizing a plan for the future involves harnessing people's emotions as well as their minds, developing both understanding and belief.

The psychological stability of the present impedes our ability to emotionally invest in a future divergent from established trends and traditions (Dede. 1990b). We know that earth-quakes or assassinations, winning the lottery or scoring a sensational come-from-behind victory are statistically inevitable — but we are surprised when they happen because the commonplace nature of most events undercuts our belief in discontinuities. When someone can prove that a desired future is logical, rational, and inevitable, then any competent manager can persuade an institution to act. The challenge of leadership is to inspire individual and organizational faith in the seemingly impossible, developing a collective affective commitment that can move mountains of impediments.

Actualizing a plan for the future involves harnessing people's emotions as well as their minds, developing both understanding and belief.

. . . to encourage an affective climate that rewards risk-taking and that accepts occasional failures as an inevitable by-product of developing new approaches.

By evolving so rapidly that each new development seems almost magical, information technology provides a fertile medium for nurturing trust that educational transformation is achievable. The availability and affordability of tools powerful enough to reshape learners and schools can help create the emotional motivation to risk innovation. Leaders build on the enthusiasm that sophisticated technologies induce to encourage an affective climate that rewards risk-taking and that accepts occasional failures as an inevitable by-product of developing new approaches.

Building shared trust in a vision requires a type of emotional charisma that goes beyond having good ideas. By accomplishing apparently unachievable outcomes themselves, leaders instill confidence in their collaborators. By never wavering in commitment and in certainty that the goal will be reached, leaders inspire similar faith in others. Would-be innovators who rely solely on intellectual suasion reap applause, but not action.

This dimension of leadership keeps me humble about the impact I have through making speeches. However excellent and inspiring a talk — and a visionary address can have a considerable emotional impact — sowing motivating ideas about information technology's role in education is only the first step in achieving sustainable change. Because these activities reach a wide audience, visionary articles and conference presentations are good catalysts for innovation. However, the possibilities of lasting improvement are remote unless local leaders use these visions as part of an immediate infrastructure to provide both intellectual and emotional support for reform.

Shooting a few silver bullets and riding out of town is a seductive role, but comprehending the limited nature of the outcomes this behavior produces is important. Leaders understand that their success depends on combining faith and trust is essential in converting a group's understanding to shared, sustained accomplishment. This is particularly true with educational technology, since many hours of effort are required to realize the potential of sophisticated hardware and software. Despite the "plug and play" protestations of the vendors, developing technology-intensive educational strategies requires substantial emotional commitment and frequent leaps of faith into the unknown.

Leadership Requires Discouraging Followers

A destructive myth about leadership is that a visionary person gives directions to followers who execute this plan. Real leaders discourage followers, instead encouraging use of their vision as a foundation for other, better insights. True solutions to problems are always based on ideas from multiple perspectives; no individual, however capable can incorporate the full range of knowledge and experience needed to invent an educational system that fulfills the needs of a diverse community.

When leaders who surround themselves with followers fall from grace or move on, the innovations they have inspired collapse or wither. Sustainable transformations require stakeholders who fully understand the what and how of the vision and who act together — top-down, middle-out, bottom-up — to evolve dreams into realities. Technologists have often erred in setting themselves up as wizards who understand the magic in the black box. Instead, a leader in educational technology should inculcate others' visions, knowledge, and commitment to the point that all are jointly leading. This requires moving beyond the role of facilitator to acting as exemplar.

Emotionally, shedding the power and rewards of authority is very difficult. We all secretly long to be the superstar in front of the worshipping audience, to inspire awe and reverence. Like any other social movement, educational technology has generated some leaders who degenerated into gurus. Worse, many potential leaders have abdicated their responsibilities to instead assume the comfortable mantle of discipleship, blindly following someone else's vision. Condemning leaders seduced by power is easy and fun; recognizing the times each of us has avoided the difficult path of leadership to become a follower is hard and painful. Educational reform can achieve genuine, lasting success only when each stakeholder accepts the responsibility of leading.

In conclusion, leadership is a role fraught with difficulties, requiring both wisdom and maturity. Yet my goal in articulating the requirements of leadership is to encourage everyone to lead, always. If each of us were to act in the ways described above — every day, however imperfectly — educational technology could be the driveshaft for restructuring education and shaping a bright future for our society. ■

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References

Dede. C. (1992a). Education in the 21st century. *Annals of the American Association for Political and Social Science*, 522 (July), 104-115.

Dede. C. (1992b). The future of multimedia: Bridging to virtual worlds. *Educational Technology*, 32(5) 54-60.

Dede. C. (1990a). Imaging technology's role in restructuring for learning. In K. Sheingold & M.S. Tucker (Eds.). *Restructuring for learning with technology*. New York: Center for Technology in Education, Bank Street College of Education and National Center on Education and the Economy.

Dede. C. (1990b). Futures research and strategic planning in teacher education. R. Houston (Ed.). In *Handbook of Research on Teacher Education*. New York: Macmillan, pp. 83-97.

***Chris Dede**, Director, Center for Interactive Educational Technology, George Mason University, Fairfax, VA 22030.*

"The Virtual School" : *Project i.Learning* In Raffles Institution

Lee Tiong Beng

Introduction

With the rapid advancement of technology, the 21st Century will be characterised by a strong and pervasive IT culture. IT will permeate deeply into every aspect of our lives. How do we prepare our pupils for such a future?

In an attempt to answer such a question, *Project i.Learning* was conceived. The main proposal of *Project i.Learning* was the implementation of a week's worth of IT-based lessons from 28 Jun 99 to 4 Jul 99, using internet facilities. The exercise entailed all teachers, of all subjects at all levels, designing and delivering lessons, based on the syllabus coverage for the week. They developed lessons based on the self-learning mode, and conducted the lessons through the internet infrastructure. The pupils spent **a week away from school**, but working from home or any other internet access they may have, independently. It was a virtual school as students learnt without having to come to school.

The primary objectives of *i.Learning* were :

- to facilitate independent and innovative learning and teaching through a structured and coordinated school-based programme in line with the academic curriculum;
- to engage in a different mode of learning and teaching where students and teachers use IT-based lessons to focus on self learning;
- to encourage greater use of the IT technology like internet in learning and teaching;

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. . . accessible from anywhere in the school, home or even beyond Singapore.

- to initiate and induct the whole school community together into the IT world;

- to set in motion and facilitate another strategy whereby Raffles Institution becomes a community of thinking, independent and global citizens of the next millenium adept to changes;

- to provide opportunities for borderless or distance learning beyond the confines of RI and even beyond Singapore where possible for some RI pupils from overseas.

Organisation

In line with the objectives, the school deliberately created the circumstances whereby a classroom need not function like the traditional physical classroom. It was a virtual classroom, which was electronic, networked through IT and borderless, accessible from anywhere in the school, home or even beyond Singapore.

Since *i.Learning* involved the whole school community of 1700 pupils and 122 teachers and was experimental on a large scale in the first instance, it necessitated that the project ran for one continuous week as in a normal academic week so as to facilitate the effective learning and teaching.

Teachers were also allowed to be away from school during the *i.Learning* week, as they had spent the first week of the 1st semester holidays preparing lesson materials for *i.Learning*. One side benefit of this arrangement was that teachers were able to practice what they have learnt immediately after they have undergone the necessary IT training.

In the case of students, the first week of Term 3 was a school term week except that they were learning in a virtual classroom which did not require their physical presence in school. All in all, curriculum time was not compromised.

The time-tabling or format of the lessons for the one week virtual programme was different from that of a normal week. However, the number of periods allocated for *i.Learning* corresponded with what would have been allocated in the school's regular timetable.

Teachers were given the flexibility to combine all periods allocated for the week over a single duration as part of the teaching package to engage the pupils, or spread the teaching over a few periods like in the normal curriculum.

In general, a variety of activities through the many subjects were planned to cater to the different abilities of the teachers as well as to spread out the demand for Internet resources. As *i.Learning* is experimental in nature, teachers were advised not to be over-ambitious in planning the lessons for this project though they were encouraged to incorporate innovative ideas in designing their lessons. Teachers for the same subject within the respective levels shared resources and lessons to maximise returns and effort.

Technical Support

Teachers who had no experience in Web publishing were given training in May and a group of IT-savvy teachers were on-hand to provide the necessary guidance and support during the training and when teachers were preparing the *i.Learning* lessons.

There are also other technical constraints to overcome, chief of which was the performance of the Web server and the performance of the school's 192 Kbps leased line. A load test was carried out in early March and it showed that the existing IT hardware was insufficient to cater to the demands of project *i.Learning*. To overcome this constraint, we were grateful to have obtained the help of the National Computer Board and CommonTown to help host the *i.Learning* lessons on their Web servers.

The students were briefed about the project in March and they also participated in two load tests and an online survey in April. The exercises gave students a fore-taste of working in a virtual environment and it also enabled the school to collect valuable data about the students' preparedness for *i.Learning*. In May, the pupils were briefed about proper use of the Internet and trained on the retrieving and sending of the necessary materials.

Evaluation

The main evaluation tool used was the conduct of two surveys (one of which was online) for students and a survey for teachers. The numbers of student respondents were 300 and 288 (online survey) respectively and a total of 59 teachers took part in the survey for teachers.

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. . . the absence of classmates a main stumbling block.

Effectiveness of Learning

Only 13.6% of the students did not find *i.Learning* effective whereas amongst the teachers, only 1.8% of them think that effective learning has not taken place. It is interesting to note that the teachers were more affirmative that effective teaching has taken place as it could be attributed to the teachers' belief that they have prepared pedagogically sound and well-designed virtual lessons for their pupils. Another possible explanation for the discrepancy was that students were less clear of the learning expected than the teachers themselves. The teachers had the advantage of having assessed the work submitted by the students in arriving at their conclusion.

Amongst the students who were not able to learn effectively, 32.3% attributed the absence of teachers to clarify their doubts as the main reason whereas 13.0% found the absence of classmates a main stumbling block. Two other main reasons given were that lessons were too difficult (7.0%) and it was uncomfortable to read from the monitor screen (18.3%)

Task/Activity Set

The teachers set a variety of tasks for the students. The main activities are 'Presentation of given contents' (88.1%), 'Setting of written assignments' (79.7%), 'Answering of Multi-choice questions and quizzes' (37.3%), 'Carrying out research' (33.9%), 'Conducting of guided activity' (33.9%), 'Viewing of animation and video clips' (18.6%) and 'Group discussions' (13.6%).

Lessons Learnt by Teachers

In general, the teachers were very positive with this experiment and they had pleasant experiences with *i.Learning*. There were the inevitable hiccups and isolated problems encountered. Chief amongst the problems encountered were the technical difficulties teachers faced with regards to the uploading of files (28.8%) and the inadequate mastery of the software used (18.6%). However, many of the teachers became more confident in web publishing skills after the *i.Learning* experience. 79.7% of the teachers were now confident of planning and designing web-based lessons. 62.1% were now proficient in the use of a web-publishing software. In addition, 75.9% were able to use resources from the Internet when preparing their lessons.

Advantages and Disadvantages as perceived by students

The 3 advantages of *i.Learning* most cited by students were the 'Flexible learning hours' (85.7%), 'The comfort of learning from home' (73.7%) and 'Ability to learn at their own pace' (65.7%).

The 3 main disadvantages as perceived by students were 'No interaction with others during learning' (73.0%), 'It is time consuming' (39.7%) and 'There is a lack of set routine' (26.0%)

Conclusion

Project i.*Learning* was a resounding success. The teachers and students alike have benefited from the experience gained in the process of engaging in this innovative mode of learning. Most importantly, for the majority of the students, effective learning has taken place. Similarly, the majority of the teachers came through enriched by the experience. This backdrop serves as a good reference point for the school to implement a more comprehensive plan for virtual learning in the near future. ■

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Lee Tiong Beng *is a teacher and Head of Information Technology at Raffles Institution.*

A New Digital Literacy - A Conversation with Paul Gilster

Carolyn R. Pool

In Digital Literacy, you relate how you saw a hawk flying in the sky and you immediately went to your computer to find pictures of hawks. In fact, you take us through everything you did that day in your home office-including making a quick check of the stock market. Your purpose was to show how other people can do the same thing — how we can become digitally literate. What does this mean? And how is digital literacy different from the traditional concept of literacy?

The author of *Digital Literacy* reflects on journeys through cyberspace and asks, "How can we use technology to do something worthwhile for our culture and our society?"

Digital literacy is the ability to understand information and–more important–to evaluate and integrate information in multiple formats that the computer can deliver. Being able to evaluate and interpret information is critical. When I talk to teachers and librarians, I emphasize that you can't *understand* information you find on the Internet without *evaluating* its sources and placing it in context.

Dealing with information on the Internet is different for several reasons. First, it's not all text. Multimedia computers enable students and teachers to download video, audio, and photos.

Second, the way we find this information is different from the way we use a card catalog, check out a book, buy a magazine, or sit down to read on a rainy day. A multimedia computer with an Internet connection enables people to truly *construct* information from around the world. I found information about the hawk in a newsgroup I subscribe to, and I found pictures of many raptors in another newsgroup dedicated to digitized graphic material.

Third, being digitally literate is multi-dimensional and interactive. If I found a picture I liked, I could not only view it but also save it to file on my own computer, use it in a hypertext creation of my own (being careful of copyrights, of course), print it out, or send it to a friend by e-mail. Or I could discuss it on another newsgroup, talk about it on a chat group or online forum, or e-mail the artist or photographer. And all this is almost instantaneous.

And part of this new literacy has to be knowing how to find those resources.

Yes, that's a major thing. Unfortunately, searching the Internet on the surface is deceptively simple. Type in a keyword and presto! A software "spider" scurries through thousands of files looking for it. But getting 30,000 hits after a search is not going to help you find important information. Teachers and students need to learn sophisticated search techniques–so they get only 50 hits or fewer per search.

I recommend using one Web search engine exclusively at first–such as Alta Vista, Excite, or HotBot–and learning all you can from that tool. Then you can explore other engines and their databases.

Is this part of virtual instruction? What are the benefits and disadvantages of such instruction?

Virtual instruction includes a broad range of activities, and it can supplement traditional teaching. I use the word supplement deliberately. Computers are never going to replace the teacher in the classroom. Computer-mediated instruction allows us to engage networked resources in ways that are profitable for students.

For example, I recently participated in an online "Australian Adventure" in which I "talked" with Jim Malusa, who was bicycling across the Australian Outback with his laptop computer and digital camera, sending daily reports and photos back to home base by plugging his modem into a pay phone.[1] I could locate the cyclist's position on the clickable map as the days progressed. Some of Jim's reports were serious, some were whimsical-pictures of what he ate for dinner and unusual natural phenomena he saw as he biked. The site also included audio clips and hypertext links constructed by experts on Australian wildlife.

Projects like this have the sense of immediacy that appeals to young people. A 6th grader in a class studying Australia would have found this project very engaging-particularly the opportunity to communicate with experts across the world.

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[1] *Jim Malusa's adventures were hosted by Discovery Channel Online (http://www.discovery.com/area/travel/travel.html), which currently sponsors several other adventures.*

We still need the very best teachers we can find: We still need to teach essential skills in reading, math, listening, and thinking.

Virtual instruction also allows for an integration of knowledge in many fields–geography, language arts skills, biology...

Exactly. Through projects like this, we pull together different disciplines and make them available to students; and we tie everything together through written language. I find it interesting that people worry so much about the survival of text and reading when children spend a lot of time on computers. But skeptics may discover that the Internet is providing us with a way to use language again. I know many people today, students as well as people who are long out of school, who had simply gotten out of the habit of writing and who now find themselves using e-mail all the time.

Of course, not everything on the Internet is necessarily positive for education, but the integration of knowledge and the emphasis on communication are powerful tools. Teachers can use these resources to present new kinds of experiences to their students.

What are some disadvantages of virtual instruction?

We have to be very clear-headed about computer-mediated instruction. It disturbs me that many people assume that what's wrong with education can be cured by technology; we just need to spend enough on machinery. That's a dangerous assumption. We still need the very best teachers we can find: We still need to teach essential skills in reading, math, listening, and thinking. I see computers as supplements; tools-in-education.

Here's one major problem: The Internet provides us something like a library of information online, though I'm hesitant to use the term library. A lot of very bad information floats in cyberspace. Anybody can be a publisher – from *The New York Times* to neo-Nazi groups who say the Holocaust didn't happen, to the kid next door with his Web page commenting on yesterday's soccer game. Internet publishing tools are free or very cheap. What do we do with the glut of information that results?

And rumor has it that one-fifth of all Internet traffic is to sexually explicit sites.

Well, the last number I saw that I trusted was 4 percent. But I won't stand by that number because I don't really know. And nobody really knows how big the Internet is. Even if total traffic to the porno sites is only 4 percent, I'm concerned as a parent. A lot of parents have this legitimate concern.

And this is one of the big objections that people have about allowing student access to the Internet.

I have a lot of sympathy for that objection. I also find it frustrating to hear a certain knee-jerk reaction in the Internet community that dismisses all these concerns and says "Oh, no, the Internet has to be totally free, leave it alone, all you want is censorship." My answer to that is to think of the children – and more and more children are finding these tools exciting and motivating. Parents come to me and say, "You know, the library now has Internet access. Should the libraries have completely free and open access?" My response to that question is *no*.

For publicly supported institutions like libraries and schools, we need to develop good filtering tools, much better than the ones we have today. Software like NetNanny and Surfer Guard is in its infancy, but companies are fast developing ways to customize filters – so you won't eliminate Shakespeare or studies in genetics, for example. New services will not only eliminate stuff we don't want but will find information we consider valuable and deliver it to us.

For publicly supported institutions like libraries and schools, we need to develop good filtering tools, . . . will not only eliminate stuff we don't want but will find information we consider valuable and deliver it to us.

Just as important, we need to be teaching students how to use the Web properly and how to be critical. We all need to learn that skill.

What are some tips that might help us all learn to use the Internet wisely?

The first tip is to check your source. Let's say that a Web page you find has information that you want to use. It sounds right, but you don't know much about the author or the organization behind that page. Enter the name of the organization on a search engine and see what you find out. Search engines are not just for concepts or keywords. If you find no name or organization, that's a red flag.

We need to use search engines as a sort of Better Business Bureau or a set of personal references for some of these Web pages. When you do one of these searches, you will often see postings on newsgroups that tell you what other people have to say about that organization or that person.

The second tip is to check out the hypertext links on a Web page before you explore them. If all the links point back to internal pages of the site, be aware that you may not have objective

. . . basic Internet etiquette – Netiquette. We should treat e-mail just like any other social situation.

information. If the author is really saying something worthwhile – especially if it's controversial – he or she should be willing to show me information to back it up and to listen to alternative viewpoints. If you look at the neo-Nazi or revisionist history sites, you find that they surround themselves with a convincing display of related content until you look closely and realize they don't connect to any viewpoints other than their own.

The third tip is to communicate with the author of the Web site by e-mail. Students should do this sparingly, under the guidance of their teachers; but if you find it difficult to verify a source's information, most reputable authors are happy to answer.

Here's a polite query a student could send: "I'm researching this topic. I'd like to know more about it, and I want to use your material, but I need some information about your background and where I can find further information."

Students who do this often tell me, "You know, lots of times they don't write back." And my answer to that is if they don't respond in some way, do not use the information.

Do you think teachers should encourage students to e-mail authors and participate actively in newsgroups?

Yes, with qualifications. The main one is basic Internet etiquette – Netiquette. We should treat e-mail just like any other social situation. You don't necessarily pop up unannounced at somebody's door and expect to get an hour's worth of free material from that person.

Newsgroups, on the other hand, are open to anybody. Students can join them, ask questions, become active participants, leave them, and join others. On a newsgroup, if you are impolite or show that you don't know what you're talking about, other participants will soon let you know – and sometimes none too politely (thus, the infamous flaming).

How does virtual instruction help students and teachers construct knowledge? What is the role of the teacher in what you call "knowledge assembly"?

You hear a lot of talk today about the teacher becoming a facilitator, as opposed to the old model of the teacher up in front of the class. Now let me say from the outset, I don't go for the facilitator definition. I have taught classes where I've had a room

full of people with computers; and any teachers who've tried it know . . .

Nobody listens to you.

Right. Almost immediately you begin to lose eye contact. And pretty soon you realize they're doing stuff on-screen. Are they doing what they're supposed to be doing? You don't know – unless you want to walk around and find out.

We have an ancient and well-established model of learning that has worked since the beginnings of civilizations. This is an *apprentice model*, where people who need to learn go to people who know more than they do. Those people then lecture, teach, demonstrate, and help apprentices learn more. I think that model is healthy. What's wrong with education has nothing to do with that model. What we need to do is figure out how to integrate the interactive, Internet-based approach into that model. We need to teach students about knowledge assembly.

What are the basics–and cautions–of knowledge assembly?

Knowledge assembly is an activist way of gathering and evaluating materials, integrating network material with traditional materials, and then creating a finished project. It's like a term *paper except it might well have multimedia aspects to it, and it* incorporates many different sources of information.

One source is a personalized news service that delivers the information you want automatically. Other sources include chat rooms, newsgroups, mailing lists, the World Wide Web, and e-mail. Then there are graphic and radio archives. Finally, we must not neglect traditional sources of information–books, newspapers, journals, even television and movies. Integrating them with Internet materials is really the key.

The Internet gives us the ability to focus tightly; but we must also maintain a sense of context. For instance, information we find in a chat room is usually not as reliable as that found on a Web page sponsored by an authoritative source. Critical thinking skills are extremely important in evaluating what you find.

Other cautions are like those I give to students writing any term papers: Using Internet sources, particularly, it's very easy to simply find lots of discrete items of information and cut and paste, producing a cobbled-together collection of quotes or multimedia

We need to teach students about knowledge assembly. Knowledge assembly is an activist way of gathering and evaluating materials, integrating network material with traditional materials, and then creating a finished project.

We need a computer on every *teacher's* desk. We need to encourage teachers to become digitally literate–to evaluate content they find on the Internet.

items. Students need to learn how to assimilate the information, evaluate it, and then reintegrate it.

Now for the tough question: What of equity issues? Many schools in high-poverty areas don't have the bright, high-tech environment of some wealthy suburban areas.

It's a worrisome issue. A school just opened in Raleigh to great press fanfare about the computers on every classroom desk. And across town are plenty of schools with very few computers. I think the answer to that issue is a reevaluation of our national policy toward technology in the schools. We don't need a top-down decision to put a computer on every student's desk. We need a computer on every *teacher's* desk. We need to encourage teachers to become digitally literate–to evaluate content they find on the Internet.

Of course, we should expose students to computers. Schools should have computer labs and as many other computers as possible. But we can't create equity by putting a computer in front of every student, nor can we afford to do this. Much of the equipment will become obsolete within a few years, anyway. And we still need to fund traditional school needs: library books, teacher salaries, staff development, and so forth.

Equity within the United States is one problem; how about global equity issues?

It gets even worse if you start looking in other parts of the world. The distribution of computers in Africa and Latin America, for example, is minuscule. But some people are coming up with creative solutions.

In one project, 5,000 educators and volunteers are fanning out in Central and South America to instruct local farmers in computer skills and in finding ways to finance their own computers for both businesses and schools. Now there is an intelligent use of money and technology. This project is sponsored by the International Fund for Agricultural Development, a United Nations project based in Rome. The idea is to electronically link 500,000 poor households in 3,600 different Latin American communities, to set up sales channels for farmers with excess crops. The fund doesn't buy computers; it pays teachers to empower the local people in ways to improve their lives. Projects like this have great potential to benefit local communities.

What do you see in the future for technology in schools?

In the next five years, – I see a bit of a backlash against technology. A lot of people are upset about the state our schools are in. They say, "You know, we've spent X many millions on computers. Where are the results?" It's dismaying to find that so many of the positive studies tend to come from technology companies and people who have a vested interest in technology. It's very hard to come up with the really impartial studies that show a huge increase in student learning. Even Steve Jobs of Apple said computers are great in education–as long as you remember that they alone won't solve the problem. A backlash might be productive because it will make us re-examine how we use technology in the classroom.

Ideally, technology sets up wonderful possibilities for multimedia projects. The beauty of new technology, within 10 years, is that we're going to have very broad bandwidths and thus much faster connections. A school's best teachers can become available to anybody on the Net. In Internet-based instruction, you can attend class at 3 a.m. if you want to–whether it's a high school or a college class. You can communicate with class members and the teacher through e-mail, chat lines, and electronic forums. Video-conferencing will enhance the "live" aspects of virtual instruction.

What the Net's going to give us is the ability to turn our educational facilities loose–to distribute education. That's provocative because it points to lifelong learning. Now that doesn't mean we'll do away with classrooms–or teachers. But it does mean reenfranchising a whole class of people in the work force who would like to learn more–get a high school diploma or a college degree. That's very exciting. ■

What the Net's going to give us is the ability to turn our educational facilities loose–to distribute education. That's provocative because it points to lifelong learning.

References

Gilster, P. (1997). *Digital Literacy.* New York: Wiley.
Gilster, P. (1997). *The Web Navigator.* New York: Wiley.

***Paul Gilster** is a writer and educator in Raleigh, North Carolina. Address correspondence to him at 5008 Yadkin Dr., Raleigh, NC 27609 (e-mail: gilster@mindspring.com.).*
***Carolyn R. Pool** is senior Editor of Educational Leadership.*
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Integrating IT, Thinking and Teaching

Ang Wai Hoong & Betsy Lim

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Infusing technology into the curriculum will generate innovative ways in teaching, learning and assessing.

INTRODUCTION

The 21st century is expected to be one of intense competition, rapid advancement in technology and perpetual changes at work, in society and at home. Nurturing and equipping our young to lead productive and meaningful lives in the global arena is a challenging and exciting task.

The young of the future must acquire a strong motivation to learn and be equipped with learning skills. This will enable them to be independent learners and to continue learning throughout their lives. They need thinking skills so that they can make meaningful use of their knowledge and be innovative and creative.

There is great potential in education technology to facilitate and enhance student learning and thinking. Students will tap into an exploding wealth of resources outside the school. Infusing technology into the curriculum will generate innovative ways in teaching, learning and assessing.

Values to be taught in a curriculum are equally important. How these are taught in classrooms require all the teachers' knowledge, skills and their modelling of these values.

TEACHERS' SELF-DEVELOPED TEACHING MODEL

All teachers have to plan their lessons, incorporating appropriate teaching strategies, challenging learning activities and varied resouces. Over time, they develop their own teaching models to prepare lessons for teaching. Singapore teachers are very fortunate as they have acquired the basic teaching models from their initial teacher training. In service, they have opportunities to learn many of the recent developments in effective learning and teaching models/teaching strategies. They also have acquired skills to use information technology (IT) and have been provided with the resources and support to use IT in their lessons. In view

of the new imperatives, teachers have to up-date their teaching models to prepare their pupils for the 21st century.

Our session with you today presents an easy-to-use framework for teaching that incorporates our understanding of learning styles, elements of Dimensions of Learning, brain-based research teaching strategies, co-operative learning strategies, Madeline Hunter's effective teaching strategies and thinking skills. We will also introduce appropriate IT resources to support these strategies. Teachers may wish to use this framework as one of the references when they reflect on and up-date their own models for teaching.

A FRAMEWORK FOR TEACHING A TOPIC/SUBTOPIC/ LESSON

This section proposes to structure a teaching model based on the 4MAT Learning Styles cycle. The conceptual framework of the textbooks published by the Curriculum Development Institute of Singapore [CDIS] was based on the 4MAT Learning Styles cycle. This conceptual framework provides activities to cater to various learning styles of pupils. Since most teachers make use of CDIS textbooks, they are not unfamiliar with the model even though they might not know the name of the model they are using.

The proposed framework is for teaching a topic/subtopic/lesson and consists of four quadrants of activities. The duration of teaching a topic depends on the complexity of topic. It is not necessary that every lesson follows the whole cycle but it desirable that when we teach a topic that we use the whole cycle. The time needed to carry out each quadrant of activities is decided by the teachers according to the needs of their students.

The First Quadrant.
Addresses the students' question: Why learn?

Teachers create a conducive environment to learn, ensuring comfort and order in class, establish good rapport with students and provide activities to engage their emotion to learn.

To gain students' attention, teachers can use agreed signals (e.g. raising of a hand, a clapping hand pattern, etc.), various teaching aids & multimedia materials (e.g. hold up an interesting object, interactive CD ROM snippets, a video clip, etc.)

Teachers create a conducive environment to learn, ensuring comfort and order in class, establish good rapport with students and provide activities to engage their emotion to learn.

. . . teach declarative and procedural knowledge and each kind of knowledge should be taught differently.

To stimulate students' interest on content, teachers can discuss relevance or importance of the topic by referring to experience of students, using novelty or introduce a discrepant event.

To prepare students' mind for learning, state lesson objectives, provide itinerary for lesson or help students to recall relevant prior knowledge findings from brain research show that unless students' positive emotion is engaged, no learning takes place. Hence, it is necessary to create a reason to learn a new topic. The activities in this quadrant are addressed in Dimension One in Dimensions of Learning.

The Second Quadrant

Address students' question: Learn what to remember?

Teachers deal with two main types of knowledge. They teach declarative and procedural knowledge and each kind of knowledge should be taught differently. Declarative knowledge includes facts, concepts, ideas, etc. Declarative knowledge requires that students remember the information or at least be able to identify at some later date. Procedural knowledge includes skills and processes. Procedural knowledge enables students to perform skills which take time to learn but which they subsequently are able to perform without much effort.

Declarative knowledge.

Constructing Meaning

Teachers help students tap their prior knowledge and use that knowledge to guide students to understand new knowledge.

Some strategies:

What you **Know**- What you **Want** to know- What you have **Learned** (KWL)

Concept formation

Brainstorming

Semantic webbing

Reciprocal teaching

In presenting information to students, it is important to remember the memory space in students of different age group. According to brain research findings, 13 years old students have 5 plus or minus 2 memory spaces. This means that teachers have to provide time for students to process five elements of information or to chunk information before

proceeding to give more information. Otherwise the information provided would be forgotten. The 102 principle reminds teachers to give students 2 minutes of processing time after providing information (talking, audio or video, multimedia, etc) for 10 minutes. The teaching strategies like 3-Minute Pause, Think-Pair-Share, Interview Trio and other co-operative learning strategies provide students with active participation and make lessons more interesting and interactive.

Organizing (generating a semantic or symbolic representation of information)

Next, teachers provide time and guidance to students to organize their knowledge. Students may organize the knowledge in symbolic, pictorial or graphic forms. This enables them to interpret and put the information acquired into a coherent form, hence easier to remember. Symbolic representations are formulas, equations, etc Pictorial representation are pictures in different forms created by students. Graphic organizers in the forms of descriptive pattern, sequence pattern, process/cause pattern, etc.

Procedural Knowledge

Procedural knowledge is learned differently from declarative knowledge.

Constructing a model

Teachers often use the "think-aloud" model to help students to construct an initial model. It involves teachers describing what they are doing as they carry out a process or skill.

Shaping the model

Teachers then provide opportunities for students to shape the model in order to make sure that they have not acquired any conceptual errors. It is during this phase that students attend to their conceptual understanding of a skill or process.

The "guided practice" is a powerful instructional technique to help students to learn a concept at the initial stage. Students follow the initial model to carry out the process. Teachers check immediately. Students are often asked to explain what they are doing to make sure they understand the process. Teachers usually illustrate a variety of common errors students make so that they can understand the concept better.

. . . findings from brain research show that unless students' positive emotion is engaged, no learning takes place.

It is crucial for teachers to create an encouraging and safe climate for students to examine the new knowledge critically, seeking a deeper understanding.

The activities in this quadrant are addressed in Dimension Two.

Quadrant Three

Addresses students' question: How well?

Teachers provide time and opportunities for students to work with the materials.

Declarative knowledge

Storing - Teachers provide students time and guidance to use different elaboration strategies to *store their knowledge* so that they can be easily retrieved.

Elaboration involves making many and varied linkages between new information and the old. Besides the common verbal and written rehearsal elaboration strategies, there are others which are more powerful such as using a theme to remember sequence of events, mental images together with physical sensations and emotions associated with the information. Mnemonics, rhyme and songs, games, drawing, simulations, role play, debate, and reciprocal teaching are some powerful tools for storing knowledge in the long-term memory.

Skills for organizing and storing of declarative knowledge are crucial learning skills. Once acquired, students will gradually be competent to learn new knowledge on their own. All these learning activities take time but they are necessary. It is only when students remember what they have learned then they have acquired knowledge. It is crucial to be selective on what they need to remember. Information, not critical to their understanding of a concept or use, can be looked up when needed.

Refine and extend their knowledge.

(Critical thinking skills)

It is crucial for teachers to create an encouraging and safe climate for students to examine the new knowledge critically, seeking a deeper understanding. For declarative knowledge, teachers make use of activities like comparing, classifying, sequencing, reasons and conclusions, inducing, deducing, analyzing errors, experimental inquiry, constructing support, abstracting, analyzing perspectives, part-whole analysis, etc. Many teachers have found Thinking Maps developed by David Hyerle useful and easy to use.

Procedural knowledge

Internalization

Finally, students practise until they can carry out the process with ease. This phase of *internalization* takes place when students carry out the process or skill with speed and automaticity. The important principle to adhere is "mass practice and distributed practice". That is to practise as often as possible at the beginning of learning and to space out practice once the skill has been learned to maintain proficiency. Computer-based learning (CBL) is very suitable for student practice. CBL provides guidance for student practice with immense patience and gives students knowledge of results immediately. Students find this highly motivating.

The activities in this quadrant are addressed in Dimensions Two and Three.

Quadrant Four

Address students' question: For what?

Teachers create opportunities for students to make meaningful use of their new knowledge (creative thinking skills).

Teachers create opportunities for students to carry out activities such as decision making, investigation, experimental enquiry, problem solving, invention, etc. Computers can simulate scenarios for students to carry out these activities. Generally these activities fall into three categories, application-oriented tasks, long-term tasks and student-directed tasks. Students may present their results in the form of a written, oral or videotaped report or a concrete model. Students may post their report in a web-site to attract comments, queries and additional information through e-mail. Teachers provide collaborative projects for group work. Students learn teamwork and develop positive interpersonal relationship skills.

Besides infusing critical and creative thinking skills in lessons there is a need to teach these skills explicitly. It requires teachers to guide students through the thinking actively by using relevant sets of thinking questions and by using graphic organizers.

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CONCLUSION

Teachers are already doing most of the activities described in the framework. Some may be doing them in isolation without a framework. Being very knowledgeable and experienced, they are in a position to add on other strategies they have been using. Those activities they are not familiar with they can learn by attending in-service courses, reading or from another teacher. When teachers are helping students to develop learning skills to become independent learners, teaching critical and creative thinking skills, using educational technology to facilitate their teaching to increase student learning, they are preparing their students to face the challenges of the 21st century. ■

REFERENCES

Hunter, M. (1986) *Mastery teaching.* El Segundo, CA. TIP Publications. (Original work published in 1982.)

Hyerle, D. (1996) *Visual Tools,* ASCD, VA.

Johnson, D., & Johnson, R. (1994). *Learning together and alone: Cooperation competition, and individualization.* Needham heights, MA: Allyn and Bacon.

Marzano, R. (1992). *Teaching with Dimensions of Learning.* ASCD,VA.

McCathy, B. (1987). *The 4MAT system.* IL EXCEL, Inc.

Wolfe, P. (1994). *Translating brain research to classroom practice.* ASCD, VA.

Ang Wai Hoong *is Senior Fellow of the Psychological Studies Division, School of Education, National Institute of Education, Nanyang Technological University.*

Betsy Lim *is the Assistant Director of IT Training Department, Educational Technology Division, Ministry of Education.*

Technology and Education: The Current Debate

Barbara Means, Laura Schuhmann, Judy Conger & Pi A. Irwin

In this issue, we focus on technology - specifically, computer technology - and its potential to transform education. Clearly, technological literacy has assumed a significant position on the national educational agenda. Policymakers and members of the general public agree that the acquisition of key technological skills is imperative as the nation's schools prepare their students for the workplaces of tomorrow. As a result, school leaders and school staff suddenly are confronted with a myriad of issues as they plan to integrate technology into their classrooms, schools, and districts.

In our opening essay, we delineate and discuss some of the most urgent questions schools confront as they consider investments in technology that could revolutionize instruction and learning. We ask: How does technology fit into the broader picture of education reform? In the absence of a large and convincing research base that shows direct positive effects on student achievement, what potential does it contain to transform teaching and learning? In what ways will school leaders and staff need to use technology in ways that enhance learning and improve planning and management? Finally, what basic guidelines can school leaders and communities employ as they seek adequate resources to ensure that their investment in technology will be cost-effective over the long term?

We follow our essay with the views of four individuals chosen from research and practice, beginning with a researcher at the forefront of technology and project-oriented teaching and learning: Barbara Means. Means, who discusses her work examining technology in project-oriented schools and classrooms, explains how technology can become a powerful tool to further constructivist teaching and learning-although she sounds some cautionary notes. We follow Means with the experiences and observations of three practitioners: Laura Schuhmann, Judy Conger, and Pi A. Irwin. Through this blend of expertise and experience from both research and practice, we intend to inform

. . . the acquisition of key technological skills is imperative as the nation's schools prepare their students for the workplaces of tomorrow.

Both physical considerations - such as where computers are placed in schools - and staff autonomy and input in technological decision-making are key.

the current discussion and debate about technology as an educational innovation that could power project-oriented teaching and learning and thus advance the goals of the education reform movement.

We follow these four views with a self-evaluation tool for school leaders and school staff that focuses on the primary issues raised in our essay. The issue concludes with a selected bibliography and other resources chosen to extend the knowledge base of our audience.

Barbara Means : Technology and Constructivist Learning

Who controls technology and how will it be used to further teaching, learning, and education reform? This, to Barbara Means, is one of the most significant questions facing educators as they move to integrate technology into schools and classrooms. It also is a question that could be overlooked by educators and parents enamoured with the raw power and potential of technology – as if its presence alone is sufficient to transform schools and classrooms.

"Is the student controlling the technology and making the decisions?", Means asks, "or is the technology making the decisions with the student providing responses on demand?"

This is an acute distinction she believes, and if it is kept in the forefront as educators plan for technology in their schools and districts, many potential problems can be avoided. "It certainly is possible for both students and adults to waste a lot of time with technology," Means says candidly. "I have seen some estimates of millions, if not billions, of dollars wasted in offices as people browse aimlessly on the Internet."

In schools, she has observed examples of equally random and unproductive time spent on computers-remarkable for quantity rather than quality. "I've seen students spend hours editing the color covers for their research reports, literally pixel by pixel, before they even begin to write the report," she adds. "Or they may spend a lot of time playing or developing computer games with no obvious intellectual content."

Both physical considerations - such as where computers are placed in schools - and staff autonomy and input in technological decision-making are key, she believes. For example, if computers are housed solely in separate labs, there is a greater risk that

they will remain separate, detached from daily classroom instruction. Or if teachers do not view technology as a support for the instructional life that occurs in their classrooms or do not believe technology can have a positive influence on teaching and learning, a significant investment can be wasted. "Resources also can be wasted in places where technology is mandated," she warns, "or where the teacher doesn't have strong instructional goals. In such schools, students often are monitored on whether they are using the technology, but not on how they are using it, or what they are learning from the experience."

These cautionary notes aside, Means is encouraged by technology's potential not only to transform the quality of instruction and learning-but also to tilt education reform in a positive direction. When used to enhance project-oriented learning, she argues that student-developed products can take on new meaning and depth.

In fact, student enthusiasm for real-world applications and uses of technology is one of its greatest strengths, she say. "We interviewed students in focus groups in our research," she notes, "and they speak about power when they discuss technology. When they use technology, they are able to amplify the effects of their own actions to turn their schoolwork into real products.

"Using technology leads to greater pride in their work, in their classrooms, and in their schools. Having it as a part of their classrooms provides considerable motivation to work and engage in learning."

Laura Schuhmann : Northbrook Middle School: Technology for High-Needs Students

Northbrook Middle School (NMS), located in Houston, Texas, serves a student population of 852: approximately 78 percent Hispanic, 9 percent African American, 6 percent Caucasian, and *the remainder Asian and Native American. A high percentage-* approximately 280 students are English language learners and are enrolled in ESL (English as a Second Language) classes as part of their academic program. Northbrook Middle School embraced technology as a tool to enhance its teaching and learning as part of its complete renaissance and reopening. Closed in the mid-1980s due to declining enrollments, strategic planning and a vibrant academic mission distinguished Northbrook's reemergence on the educational scene. In 1990, Susan Wolf was appointed Northbrook's Principal and charged

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A commitment to the principles of constructivist teaching and learning, a vision for technology as a means to aid in that vision for learning, and a strong emphasis on site-based management have all suffused NMS's ethos and mission.

with the mission of creating both a model middle school and a technology demonstration school for the Spring Branch District in Houston. A year of planning preceded the reopening of the school in 1991, with ample amounts of staff development focused on technology as a tool for project-based teaching and learning.

When NMS reopened, it did so with a staff specifically selected to fit the school's mission-a combination of experienced teachers and enthusiastic newcomers. A commitment to the principles of constructivist teaching and learning, a vision for technology as a means to aid in that vision for learning, and a strong emphasis on site-based management have all suffused NMS's ethos and mission.

In addition, the design and appearance of the school were considered integral to furthering its academic vision-with the goal of making it homelike and welcoming for students, parents, and staff. A country theme permeates the school; standard concrete blocks are warmed with wreaths, decorations, and Americana.

Northbrook Middle School's experiences highlight the following principles for school leaders and staff:

- Site-based management, if infused into the ethos of a school, can ensure that teachers participate in key decisions about both the instructional vision of the school and technology's use to enhance and achieve that vision.
- Students help create and produce their own learning; technology serves as both tool and motivator.
- Poverty and level of proficiency in English are not viewed as negatives, but as realities with which teachers must work in a positive, proactive manner.
- How and why technology is used-to supplement teaching and learning-is much more important than technology itself.

The spokesperson for Northbrook Middle School is Laura Schuhmann, who was appointed its principal in 1996 following the death of Susan Wolf-a school leader she credits for keen vision, energy, and intelligence. Prior to becoming principal, Schuhmann was assistant principal at NMS and elsewhere in the Houston Independent School District (HISD); earlier in her career she was recruited by the HISD to teach reading, language arts, English, and speech in Houston's inner-city schools.

When Laura Schuhmann describes how technology fits into the educational mission of Northbrook Middle School, she

emphasizes with crystalline clarity that technology is not an empty concept or meaningless slogan to the school's teachers, students, and parents. Instead, technology is a lively and carefully crafted portion of Northbrook's entire academic vision-a powerful engine to accelerate active, project-oriented teaching and learning.

Exactly what is that vision? "We want all students." Schuhmann emphasizes, "to have the opportunity to be successful. Our expectations for students achievement are very high. And if technology becomes the vehicle that heightens student achievement, then we want to use that vehicle."

She adds, "But we don't use technology just to use technology. We use it as a tool to enhance what goes on in the classroom."

Northbrook Middle School's vision wants to see students taking an active role in their own learning, becoming discoverers of knowledge, and relying upon teachers as coaches to assist them as they explore new frontiers of information. Commonly known as constructivism-teachers and students constructing knowledge together-this view of teaching and learning can present particular problems for teachers either unfamiliar with its concepts or unreceptive to its potential.

What does constructivist theory mean in practice to Northbrook's teachers? How do they interpret it? Are they resistant to its principles? Are they wary? Are they enthusiastic?

Schuhmann first explains that viewing learning and teaching in a constructivist, project-oriented manner is essential if technology is to succeed as a tool to further school reform-and its concepts are woven into the fabric of NMS's daily life. "Constructivism," she says, "means that our teachers can give up some of their traditional control of the classroom and allow students individual opportunities for enrichment, for tutorials, or for individualized planning. This may mean that the computers at individual student stations are used; it may mean that the room is divided into teams using a lot of cooperative learning strategies. In that situation, the computer again becomes a tool with which the teacher can enrich, tutor, or provide individualized work with students."

. . . viewing learning and teaching in a constructivist, project-oriented manner is essential if technology is to succeed as a tool to further school reform

Judy Conger : Community High School: Schoolwide Technology and Project-Oriented Learning

Community High School (CHS), an alternative high school within the Ann Arbor Public Schools in Ann Arbor, Michigan, has a long

. . .
transformed its science curriculum into an innovative program that relies on real-world applications of concepts and scientific theory.

history of innovations in education. Now in its 26th year. CHS's original mission was to use the community as a classroom. Students were expected to earn credits through various projects and work in the community, e.g., internships, apprenticeships, or coursework at the University of Michigan. No classes were taught within the building; teachers served as monitors to ensure that credits students earned would meet state requirements for graduation.

Currently, CHS teaches most classes within school walls-but continues to emphasize the community as a primary resource. In fact, Community Resource classes compose an entire department within the school. Since CHS is located in the downtown section of Ann Arbor, it is within walking distance of the University of Michigan, libraries, museums, and shops-all of which serve as extended classrooms for its students.

Any high school student in Ann Arbor is eligible for admission to CHS – admission is determined by lottery – but over the years, a waiting list has grown. Today, CHS holds 400 students, approximately 19 percent minority, including African American, Asian, and Pacific-West Islanders.

Community High School's science department led the wave of teachers who began to believe that technology had the potential to help change instruction to a project-based approach. CHS's science teachers, with an infusion of resources and expertise from both the University of Michigan and the National Science Foundation, transformed its science curriculum into an innovative program that relies on real-world applications of concepts and scientific theory.

From the original technological infusion into its science programs, technology now spreads across content areas throughout CHS-and an evergrowing emphasis is placed on project-oriented teaching and learning. To accommodate this new emphasis, school structures also continue to be refined to fit CHS's new vision of learning.

Community High School's experiences with both project-based teaching and learning and its integration of technology throughout the school highlight key lessons for school leaders and staff:

- School staff view technology as a tool, not as a separate content area.

- While technology is infused into most content areas, it is secondary to a vision of learning that emphasizes student and teacher-created learning.
- Imagination and collaboration can result in mutually beneficial partnerships between universities, federal research agencies, and public schools.
- School structures are flexible and require continuous, judicious refinement to accommodate growth in the school's vision of learning.

The spokesperson for Community High School is Judy Conger, who has been its dean for four years. She has 20 years of educational experience, the last nine of which have been in the Ann Arbor Public Schools. Prior to her position at CHS, she served as assistant principal at Pioneer High School and held a variety of teaching positions.

A student-developed product that is received by an eager audience-Community High School's weekly newspaper, *The Communicator*, vividly illustrates the ways in which technology has integrated itself into the school's emphasis on project-oriented teaching and learning. Produced as part of a popular class, *The Communicator* has an enviable role: It serves as both student motivator and authentic student product.

Not only does this newspaper provide students with an authentic reason to learn, apply, and refine their use of technology, but it also forms the structure through which they experience real-life deadline pressure, collaborative work among peers, and development of ideas.

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Judy Conger points to this newspaper as one example of CHS's goals-both its vision of learning, which is proactive and project-based, and its effective interweaving of technology into real-life applications of what students learn. The enormous interest that the eight-page newspaper generates each week is one key to its success, she reports.

"When it is published each week, everything stops in its tracks," she says. "Kids are sitting all over the place immersed in it; teachers are reading it as well. It receives this intense attention because it is a very lively and interesting piece of work."

The technology used to produce the newspaper is sophisticated and well-planned, as is the structured-and necessary-collaboration between students. "A laptop computer goes home

. . . significant community input on the placement and use of technology in the district's schools also helps steer the district's passage as it anchors technology into the district's overall vision for constructivist teaching and learning.

with the editor each week; and the editor rotates each week," she explains. "Students post their stories in the computer lab and send them via e-mail to the editor, who assembles them. Finally, the actual newspaper is run on PageMaker, taken to an outside printer, and distributed throughout the school each Wednesday."

Pi A. Erwin : The Glen Ellyn School District: Implementing a District's Technology Plan

Located approximately 25 miles west of downtown Chicago, the Glen Ellyn School District serves approximately 3,100 students. grades K-8. Although for the most part its student population typifies many suburban districts-primarily white and middle-class-in recent years it has become more diverse and now includes students from lower-income households.

Its funding, however, does not match the relatively prosperous status of its students. At approximately 10 percent below the state average per child, Glen Ellyn's funding was affected by an Illinois state tax cap enacted in 1990. This funding level affects all expenditures, which becomes especially critical at a time when school districts are investing heavily in technology. Glen Ellyn's successful referendum in February 1997 provided the funds to put the necessary infrastructure in place in all its school building so that technology can infuse everyday school life as a multi-faceted tool, both for school staff and for students.

The spokesperson for the Glen Ellyn School district is its Superintendent, Pi A. Irwin, who has brought the district online with an ambitious and meticulously crafted plan to integrate technology into the district's curriculum and instruction. In particular, she has built partnerships with local institutions of higher education, including Northern Illinois University and the College of Dupage, a local community college. A strong partnership with the North Central Regional Educational Laboratory provides additional expertise.

Irwin believes that significant community input on the placement and use of technology in the district's schools also helps steer the district's passage as it anchors technology into the district's overall vision for constructivist teaching and learning.

The Glen Ellyn District's work to integrate technology throughout its K-8 curriculum highlights broad lessons for other districts:

- Build authentic partnerships wherever possible, particularly with local and regional institutions of higher education, regional educational laboratories, and city and county government.
- Develop an action plan with timelines while seeking additional resources to fund an ongoing investment in technology.
- Invest at least one-third of a district's budget into training for school staff; this investment is imperative and must be viewed as an integral part of any technological investment.
- Nurture those staff who are supportive of a vision for technology; this leads to the development of a critical mass of school staff who will push the innovation forward.

Irwin has been Superintendent of the Glen Ellyn Elementary School since 1993. Previously, she was Assistant Superintendent of the Tucson Unified School District in Tucson, Arizona, and also held a variety of administrative positions-including principalships at the elementary, middle, and high school levels-in that district. She holds an Ed.D. in Reading and Educational Administration from the University of Arizona.

If Irwin were charged with the task of convincing other school leaders that technology can increase student achievement and engagement, help bond students to school, and also advance an ambitious agenda for learning, she wouldn't hesitate to take on the challenge. Why is technology necessary-especially when research that demonstrates its positive effects on student achievement is skimpy or in the fledgling stages?

Irwin's reasoning is clearcut and logical: Educators, she says, need to come to terms with the relevance of technology to virtually every aspect of contemporary American society-and this relevance also affects rapidly changing expectations of students.

"Just as technology is a way of life in the community," she begins, "it must be a way of life in the schools. If we are serious about making instruction relevant to student's experiences-and if we want to prepare students to live and work in the world-we have to be serious and strategic about what we do with technology in education."

Just as technology is a way of life in the community... it must be a way of life in the schools.

She mentions a recent incident in which she observed a small child in a large discount store using a computer screen to find locations throughout the store. "There is an example of relevance," she points out.

"Technology . . . also requires incredible relational thinking skills-and these skills will become the skills that we value and need as a society."

Irwin also emphasizes how expectations of students are changing dramatically as the nation races toward the millennium and technology increases in contemporary society at almost an exponential rate. "We used to think of a good student," she notes, "as one who could do very good recitation, who could demonstrate orally what they knew.

"Now we expect a good student to have the ability to think and to solve problems. Technology is critical because it changes the access to information. Suddenly this access to information occurs in real time–not in school time."

She illustrates her argument by pointing to a mainstay of American popular culture: Television quiz shows. Just as contestants on quiz shows of the 1950s and 1960s were distinguished by the number of facts they knew, Irwin predicts the quiz shows of tomorrow will shift to a focus on rapid-fire problem-solving. "Technology not only becomes the tool that provides quick access to information," she observes, "but it also requires incredible relational thinking skills; and these skills will become the skills that we value and need as a society." ■

Barbara Means *is a researcher of technology and project-oriented teaching and learning.*

Laura Schehmann *is Principal of Northbrook Middle School.*

Judy Conger *is Dean of Community High School.*

Pi A. Irwin *is Superintendent of Glan Ellyn School district.*

Self-Assessment Tool for School Leaders: Technology and Transformation

The following questions are intended to guide you through a self-assessment of your district's and school's plan for technology and to assist you in determining some directions for integrating technology into your vision of learning. They are based in part on the Guiding Questions for Technology Planning, Version 1.0, created by the North Central Regional Technology in Education Consortium (Knuth, 1996) -and on the information provided in this issue.

	Fully	For the most part	Somewhat	Not at all
Technology and Our Vision of Learning				
1. To what extent have we clearly articulated a vision of learning for our school and district that incorporates key precepts of education reform?	_____	_____	_____	_____
2. To what extent does our vision of learning emphasize projects and the solution of real-world problems?	_____	_____	_____	_____
3. To what extent does our vision of learning incorporate technology as a key component that can promote a challenging curriculum and instructional practices that engage students (e.g., collaborative learning, problem-based learning, project-based learning)?	_____	_____	_____	_____
4. To what extent do our teachers, building principals, and other key staff understand their unique roles in this vision of learning and agree that technology needs to continue to be developed as a key tool to change instruction and learning?	_____	_____	_____	_____
5. To what extent does our vision of learning attend to the needs of students considered "disadvantaged" because of their socioeconomic status or other variables that may place them at risk of school failure?	_____	_____	_____	_____
6. To what extent does our vision of learning promote equity as we consider new uses of technology (e.g., programs to take laptops home, contracts with parents to use school equipment in return for classes)?	_____	_____	_____	_____

	Fully	For the most part	Somewhat	Not at all
Technology and Professional Development				
1. To what extent have we developed a professional development plan that addresses the skills teachers will need to integrate technology into the curriculum?	____	____	____	____
2. To what extent have we budgeted sufficient monies for professional development and support for teachers and instructional staff that will increase both their knowledge base about technology and their understanding of engaged, authentic learning?	____	____	____	____
3. To what extent have we projected monies for professional development and technological support for school staff over a sufficient time period (e.g., five years)?	____	____	____	____
4. To what extent do our board of education and community members understand and support our professional development plan and its budget?	____	____	____	____
5. To what extent have our teachers, building principals, and other staff had input into determining the type, content, and length of professional development necessary to integrate technology throughout their instruction?	____	____	____	____
6. To what extent does our professional development plan address how technology can accelerate and enhance learning for special needs students (e.g., economically disadvantaged)?	____	____	____	____
Technology and Equity				
1. To what extent do our plans for technology ensure that computers will be placed in a combination of classrooms and computer labs to ensure equitable access for all students in all content areas?	____	____	____	____
2. To what extent have we changed our methods of instruction to ensure that students who typically experience less challenging content and remediation can use technology to engage with challenging ideas and the solution of real-world, relevant problems?	____	____	____	____

	Fully	For the most part	Somewhat	Not at all
3. To what extent have our staff, board of education, and community members discussed and planned for school-initiated ways in which they can help their children at home and also learn important skills?				
4. To what extent have we involved parents and family members in discussions of computer technology and ways in which they can help their children at home and also learn important skills?				
5. To what extent do we monitor our instruction to ensure that one group or gender does not dominate access to computers?				

Technology and Resources

1. To what extent have we researched not only the amount of resources necessary to implement technology into our vision of learning, but also made plans to ensure we can acquire those resources?				
2. To what extent does our plan for technology ensure equitable distribution of resources to all schools in our district?				
3. To what extent does our budget for technology include adequate personnel to support teachers as they acquire the necessary knowledge to integrate technology throughout their instruction?				
4. To what extent have we ensured that teachers will not be forced to compete for scarce resources both for hardware and software, but also for ongoing repairs, maintenance, and computer upgrades?				
5. To what extent do our budget plans include incentives for teachers who seek out and acquire additional resources in the forms of grants or other monies to support the infusion of technology in their instruction?				

Educating the Net Generation

Don Tapscott

As technology becomes an integral part of our classrooms and schools, educators can look to the students—the Net Generation — to help make the shift to more student-centered learning.

Every time I enter a discussion about efforts to get computers into schools, someone insists that computers aren't the answer. "It won't help to just throw computers at the wall, hoping something will stick. I've seen lots of computers sitting unused in classrooms."

Agreed. Computers alone won't do the trick. They are a necessary but insufficient condition for moving our schools to new heights of effectiveness. We've still got to learn how best to use this technology. And I have become convinced that the most potent force for change is the students themselves.

Why look to the kids? Because they are different from any generation before them. They are the first to grow up surrounded by digital media. Computers are everywhere — in the home, school, factory, and office — as are digital technologies — cameras, video games, and CD-ROMs. Today's kids are so bathed in bits that they think technology is part of the natural landscape. To them, digital technology is no more intimidating than a VCR or a toaster. And these new media are increasingly connected by the Internet, that expanding web of networks that is attracting one million new users a month.

The Net Generation

The Net affects us all — the way we create wealth, the nature of commerce and marketing, the delivery system for entertainment, the role and dynamics of learning, and the nature of government. It should not surprise us that those first to grow up with this new medium are defined by their relationship to it. I call them the Net Generation — the N-Geners.

According to Teenage Research Unlimited (1997), teens feel that being online is as "in" as dating and partying! And this exploding popularity is occurring while the Net is still in its infancy and, as such, is painfully slow; primitive; limited in capabilities; lacking complete security, reliability, and ubiquity; and subject to both hyperbole and ridicule. Nevertheless, children love it and keep coming back after each frustrating experience. They know its potential.

What do students do on the Net? They manage their personal finances; organize protest movements; check facts; discuss zits; check the scores of their favorite team and chat online with its superstars; organize groups to save the rain forest; cast votes; learn more about the illness of their little sister; go to a virtual birthday party; or get video clips from a soon-to-be-released movie.

Chat groups and computer conferences are populated by young people hungry for expression and self-discovery. Younger kids love to meet people and talk about anything. As they mature, their communications center on topics and themes. For all ages, "E-mail me" has become the parting expression of a generation.

Digital Anxiety

For many adults, all this digital activity is a source of high anxiety. Are kids really benefitting from the digital media? Can technology truly improve the process of learning, or is it dumbing down and misguiding educational efforts? What about Net addiction? Is it useful for children to spend time in online chat rooms, and what are they doing there? Are some becoming glued to the screen? What about cyber-dating and cybersex? Aren't video games leading to a violent generation? Is technology stressing kids out — as it seems to be doing to adults? Has the Net become a virtual world — drawing children away from parental authority and responsible adult influence — where untold new problems and dangers lie? What is the real risk of online predators, and can children be effectively protected? How can we shield kids from sleaze and porn? As these children come of age, will they lack the social skills for effective participation in the work force?

These questions are just a sampling of the widespread concern *raised not just by cynics, moralists, and technophobes, but also* by reasonable and well-meaning educators, parents, and members of the community.

Everybody, relax. The kids are all right. They are learning, developing, and thriving in the digital world. They need better tools, better access, better services — *more* freedom to explore, not less. Rather than convey hostility and mistrust, we need to change *our* way of thinking and behaving. This means all of us — parents, educators, lawmakers, and business leaders alike.

Digital kids are learning precisely the social skills required for effective interaction in the digital economy. They are learning about

Digital kids are learning precisely the social skills required for effective interaction in the digital economy.

The new technologies have helped create a culture for learning (Papert, 1996) in which the learner enjoys enhanced interactivity and connections with others.

peer relationships, teamwork, critical thinking, fun, friendships across geographies, self-expression, and self-confidence.

Conventional wisdom says that because children are multi-tasking — jumping from one computer-based activity to another — their attention span is reduced. Research does not support this view. Ironically, the same people who charge that today's kids are becoming "glued to the screen" also say that kids' attention spans are declining.

At root is the fear that children will not be able to focus and therefore will not learn. This concern is consistent with the view that the primary challenge of learning is to absorb specific information. However, many argue — and I agree — that the content of a particular lesson is less important than learning how to learn. As John Dewey wrote,

> Perhaps the greatest of all pedagogical fallacies is the notion that a person learns only the particular thing he is studying at the time. Collateral learning . . . may be and often is more important than the spelling lesson or lesson in geography or history that is learned. (1963, p. 48)

The Challenge of Schooling

The new technologies have helped create a culture for learning (Papert, 1996) in which the learner enjoys enhanced interactivity and connections with others. Rather than listen to a professor regurgitate facts and theories, students discuss ideas and learn from one another, with the teacher acting as a participant in the learning. Students construct narratives that make sense out of their own experiences.

Initial reserach strongly supports the benefits of this kind of learning. For example, in 1996, 33 students in a social studies course at California State University in Northridge were randomly divided into two groups, one taught in a traditional classroom and the other taught virtually on the Web. The teaching model wasn't fundamentally changed — both groups received the same texts, lectures, and exams. Despite this, the Web-based class scored, on average, 20 percent higher than the traditional class. The Web class had more contact with one another and were more interested in the class work. The students also felt that they understood the material better and had greater flexibility to determine how they learned (Schutte, n.d.).

The ultimate interactive learning environment is the Internet itself. Increasingly, this technology includes the vast repository of human knowledge, the tools to manage this knowledge, access to people, and a growing galaxy of services ranging from sandbox environments for preschoolers to virtual laboratories for medical students studying neural psychiatry. Today's baby will tomorrow learn about Michelangelo by walking through the Sistine Chapel, watching Michelangelo paint, and perhaps stopping for a conversation. Students will stroll on the moon. Petroleum engineers will penetrate the earth with the drill bit. Doctors will navigate the cardiovascular system. Researchers will browse through a library. Auto designers will sit in the back seat of the car they are designing to see how it feels and to examine the external view.

Eight Shifts of Interactive Learning

The digital media is causing educators and students alike to shift to new ways of thinking about teaching and learning.

1. *From linear to hypermedia learning.* Traditional approaches to learning are linear and date back to using books as a learning tool. Stories, novels, and other narratives are generally linear. Most textbooks are written to be tackled from the beginning to the end. TV shows and instructional videos are also designed to be watched from beginning to end.

   But N-Gen access to information is more interactive and nonsequential. Notice how a child channel surfs when watching television. I've found that my kids go back and forth among various TV shows and video games when they're in the family room. No doubt that as TV becomes a Net appliance, children will increasingly depend on this nonlinear way of processing information.

2. *From instruction to construction and discovery.* Seymour Papert says,

   > The scandal of education is that every time you teach something, you deprive a child of the pleasure and benefit of discovery. (de Pommereau, 1996, p.68)

   With new technologies, we will experience a shift away from traditional types of pedagogy to the creation of learning partnerships and learning cultures. This is not to say that teachers should not plan activities or design curriculums. They might, however, design the curriculum in partnership with

The ultimate interactive learning environment is the Internet itself.

A teacher is equally crucial and valuable in the learner-centered context, for he or she creates and structures what happens in the classroom.

learners or even help learners design the curriculum themselves.

This constructivist approach to teaching and learning means that rather than assimilate knowledge that is broad-cast by an instructor, the learner constructs knowledge anew. Constructivists argue that people learn best by *doing* rather than simply by *listening*. The evidence supporting constructivism is persuasive, but that shouldn't be too surprising. When youngsters are enthusiastic about a fact or a concept that they themselves discovered, they will better retain the information and use it in creative, meaningful ways.

3. *From teacher-centered to learner-centered education.* The new media focus the learning experience on the individual rather than on the transmitter. Clearly, learner-centered education improves the child's motivation to learn.

   The shift from teacher-centered to learner-centered education does not suggest that the teacher is suddenly playing a less important role. A teacher is equally crucial and valuable in the learner-centered context, for he or she creates and structures what happens in the classroom.

   Learner-centered education begins with an evaluation of abilities, learning styles, social contexts, and other important factors that effect the student. Evaluation software programs can tailor the learning experience for each individual child. Learner-centered education is also more active, with students discussing, debating, researching, and collaborating on projects with one another and with the teacher.

4. *From absorbing material to learning how to navigate and how to learn.* This means learning how to synthesize, not just analyze. N-Geners can assess and analyze facts — a formidable challenge in a data galaxy of easily accessible information sources. But more important, they can synthesize. They are engaged in information sources and people on the Net, and then they construct higher-level structures and mental images.

5. *From school to lifelong learning.* For young baby boomers looking forward to the world to work, life often felt divided—between the period when you learned and the period when you *did*. You went to school and maybe to university and learned a trade or profession. For the rest of your life, your

challenge was simply to keep up with developments in your field. But things have changed. Today, many boomers reinvent their knowledge base constantly. Learning has become a continuous, lifelong process. The N-Gen is entering a world of lifelong learning from day one, and unlike the schools of the boomers, today's educational system can anticipate how to prepare students for lifelong learning.

6. *From one-size-fits-all to customized learning.* The digital media enables students to be treated as individuals — to have highly customized learning experiences based on their backgrounds, individual talents, age levels, cognitive styles, and interpersonal preferences.

   As Papert puts it,

   > What I see as the real contribution of digital media to education is a flexibility that could allow every individual to find personal paths to learning. This will make it possible for the dream of every progressive educator to come true: In the learning environment of the future, every learner will be "special." (1996, P.16)

   In fact, Papert believes in a "community of learning" shared by students and teachers:

   > Socialization is not best done by segregating children into classrooms with kids of the same age. The computer is a medium in which what you make lends itself to be modified and shared. When kids get together on a project, there is abundant discussion; they show it to other kids, other kids want to see it, kids learn to share knowledge with other people — much more than in the classroom. (1997, p. 11)

7. *From learning as torture to learning as fun.* Maybe torture is an exaggeration, but for many kids, class is not exactly the highlight of their day. Some educators have decried the fact that a generation schooled on *Sesame Street* expects to be entertained at school — and to enjoy the learning experience. They argue that learning and entertainment should be clearly separated.

   Why shouldn't learning be entertaining? In Merriam-Webster's Collegiate Dictionary, the third definition of the verb to entertain is "to keep, hold, or maintain in the mind" and "to receive and take into consideration." In other words, entertainment has always been a profound part of the learning process, and teachers throughout history have been asked to convince their

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Learning is becoming a social activity, facilitated by a new generation of educators.

students to entertain ideas. From this perspective, the best teachers were the entertainers. Using the new media, the learner also becomes the entertainer and, in doing so, enjoys, is motivated toward, and feels responsible for learning.

8. *From the teacher as transmitter to the teacher as facilitator.* Learning is becoming a social activity, facilitated by a new generation of educators.

The topic is saltwater fish. The 6th grade teacher divides the class into teams, asking each team to prepare a presentation on a fish of its choice. Students have access to the Web and are allowed to use any resources. They must cover the topics of history, breathing, propulsion, reproduction, diet, predators, and "cool facts." They must also address questions to others in their team or to others in the class, not to the teacher.

Two weeks later, Melissa's group is first. The students have created a shark project home page with hot links for each topic. As the students talk, they project their presentation onto a screen at the front of the class. They have video clips of different types of sharks and also a clip from Jacques Cousteau discussing the shark as an endangered species. They then use the Web to go live to Aquarius, an underwater site located off the Florida Keys. The class can ask questions of the Aquarius staff, although most inquiries are directed to the project team. One such discussion focuses on which is greater: the dangers posed by sharks to humans or the dangers posed by humans to sharks.

The class decides to hold an online forum on this topic and invites kids from classes in other countries to participate. The team asks students to browse through its project at any time, from any location, because the forum will be up for the rest of the school year. In fact, the team decides to maintain the site by adding new links and fresh information throughout the year. The assignment becomes a living project. Learners from around the world find the shark home page helpful and build links to it.

In this example, the teacher acts as consultant to the teams, facilitates the learning process, and participates as a technical consultant on the new media. The teacher doesn't have to compete with Jacques Cousteau's expertise on underwater life; her teaching is supported by his expertise.

Turning to the Net Generation

Needless to say, a whole generation of teachers need to learn new tools, new approaches, and new skills. This will be a challenge, not just because of resistance to change by some teachers, but also because of the current atmosphere of financial cutbacks, low teacher morale, increased workloads, and reduced retraining budgets.

But as we make this inevitable transition, we may best turn to the generation raised on and immersed in new technologies. Give students the tools, and they will be the single most important source of guidance on how to make their schools relevant and effective places to learn. ■

References

de Pommereau, I. (1997, April 21). Computers give children the key to learning. *Christian Science Monitor*, P. 68.

Dewey, J. (1963). *Experience and education.* London: Collier Books.

Papert, S. (1996). *The connected family: Bridging the digital generation gap.* Marietta, GA: Longstreet Press.

Schutte, J. G. (n.d.). *Virtual teaching in bigber education* [On-line]. Available http:// www. csun.edu/sociology/virtexp.htm

Teenage Research Unlimited, Inc. (1996, January). Press release. Northbrook, IL: Author.

Teenage Research Unlimited, Inc. (1997, Spring). Teenage marketing and lifestyle update. Northbrook, IL: Author.

***Don Tapscott** is President of New Paradigm Learning Corporation and Chairman of Alliance for Converging Technologies, 133 King St. E., Ste. 300, Toronto, ON M5C 1G6, Canada (Website: http://nplc.com; e-mail: nplc@nplc.com)*

Give students the tools, and they will be the single most important source of guidance on how to make their schools relevant and effective places to learn.

Singapore Pre-service Teachers' Software Review Criteria

Cheung Wing Sum, Cheah Yin Mee

. . . software evaluation skill is one of the core skills.

INTRODUCTION

The launch of a S$2 billion "Master Plan for IT in Education" is evidence of the Singapore Government's commitment to educate its population in the use of computer and information technology (IT). The Master Plan outlines four key dimensions where IT in education will be introduced: curriculum and assessment, learning resources, teacher development, and physical and technological infrastructure.

Where teacher development is concerned, the Singapore Government plans to train every teacher "to handle IT based instruction" (Ministry of Education, 1997, p.5) and to "equip trainee teachers with core skills in teaching with IT resources" (Ministry of Education, 1997, p.7). There are many core skills that can be identified and taught to pre-service teachers, and many educators (Jolicoeur and Berger, 1986; Vachon, 1992; Gill, Dick, Reiser, and Zahner 1992; Cheung, 1994) believe that software evaluation skill is one of the core skills. This is because teachers will be involved in the selection and use of software programs in their lessons just as they used to select and use print materials for their lessons.

Given the importance of this task, we were interested in investigating how graduating pre-service teachers at National Institute of Education, Nanyang Technological University, Singapore go about this process of software evaluation. Since this process is often assisted by the use of established lists of software criteria, we were specifically interested in finding out what criteria these student teachers value and use for selecting software.

CONTEXT AND RATIONALE OF THE STUDY

The National Institute of Education, Nanyang Technological University provides education and training for all the pre-service teachers in Singapore. Since the institution is the only place which provides teacher training in the country, it plays a significant role in equipping teachers with core skills for integrating information technology into the classroom. All the pre-service teachers have to learn how to evaluate software in their course work.

We were interested in investigating what student teachers had learned about software evaluation from the criteria they used in choosing software packages. The criteria used will determine the adoption and use of particular software packages in schools. When the student teachers become full time teachers, they are also in a position to influence other teachers (especially since they are often more computer literate than the older teachers) in their schools to use their criteria for evaluating software packages. The evaluation criteria thus constitute a key issue in the selection and use of software programs in schools.

REVIEW OF LITERATURE

Educators and instructional designers have developed a number of lists of software evaluation criteria. For instance, in 1985, the New South Wales Department of Education in Australia prepared a set of criteria for teachers (Rowe, 1993). It has seventeen evaluation areas which in turn generated one hundred and twelve different criteria.

Bitter and Wighton (1987) conducted a Delphi study which surveyed 28 members of the Educational Software Evaluation Consortium representing different organizations from the U.S. and Canada. From these members' contributions, Bitter and Wighton identified 22 common criteria to evaluate educational software. Other software evaluation criteria have been developed separately by Gros and Spector (1994) and Heinich, Molenda, Russell, & Smaldino, (1996). Roblyer, Edwards, and Havriluk (1997, p. 120) proposed the following four categories of minimum criteria:

1. Required Instructional Design and Pedagogy: Does it teach?
2. Required for Content: Is it correct?
3. Required for User Flexibility: Is it "user-friendly"?
4. Required Technical Soundness: Does it work correctly?

The criteria used will determine the adoption and use of particular software packages in schools.

. . . lengthy lists of criteria tend to be less user-friendly to teachers who may not have the time to go through each of the criterion.

We believe the above criteria were generated from the authors' personal knowledge, theories, and experience in the field. The only criteria listing generated by research study are from Bitter and Wighton's work (1987). These lists provide some useful insight to the process of evaluating software, although lengthy lists of criteria tend to be less user-friendly to teachers who may not have the time to go through each of the criterion.

RESEARCH QUESTION

Given the importance of the issue of software evaluation, we were interested in the following research question: What are the criteria that graduating pre-service teachers used in evaluating software packages? Since students were exposed to a number of software criteria lists, we were also interested in how they would use each list. In particular, we were interested in their use of Bitter and Wighton's criteria since this is the only list that we know that was generated from surveying a group of professionals. It is thus more relevant to use their findings with our student teachers than those generated from an individual's or a group's experiences and knowledge.

METHODOLOGY

Twenty-four pre-service teachers taking a course in evaluating and using language software were chosen for the study. These students were in their fourth and final year of study, and would graduate to become full-time teachers in about 4 months after the study. Two of the students majored in Physical Education while the rest majored in the Humanities. There were 2 males; the rest were females as is often the case at the Institute. All were expected to teach English, among other subjects, upon graduation and all had some computer experience from their computer literacy courses during their first two years at the Institute. All students also had some teaching experience from their periods of school attachment during their four years in their undergraduate programme.

The graduating pre-service teachers were asked to choose five criteria from Bitter and Wighton's list (1987). The original list was in question form, but this was transformed into a list of 22 statements (Center for Educational Research and Innovation, 1989, pp. 82-83). We made minor modifications to the statements to make them more concise because the list was appended to a longer questionnaire on students' computer experience. We asked the pre-service teachers to choose five criteria of their choice

from the list and number them 1 to 5 in order of importance. In addition, we allowed them to write down any criteria that they prefer to use in software evaluation if their criteria were not listed.

We had good reasons to adopt the criteria provided by Bitter and Wighton (1987). According to our review of the lists of software evaluation criteria, we found that each was generated by one or several educators according to their knowledge, experience, and / or background. However, the list provided by Bitter and Wighton (1987) was generated by a group of educators representing various organizations. According to Center for Educational Research and Innovation (1989), Bitter and Wighton's study included members from different areas and from organizations with varying purposes. In all, the study included twenty-eight members of the Educational Software Evaluation Consortium.

FINDINGS

The ranking of the twenty two criteria by the graduating pre-service teachers is in Table 1. According to their ranking, it seems that what they valued most is the content quality of the software and the ease in using the software for classroom instruction. The criterion least valued by them was "the program is appropriate for computer technology; the material cannot be presented better in another medium". Two criteria received the ninth rank; another two received the twentieth rank.

In the survey, we also invited the subjects to write down the criteria that they valued but were not on the list. Only one subject put down one criterion which was "cost".

DISCUSSION

The top seven criteria chosen by the pre-service teachers can be classified into two major categories: content quality, and easiness in using the software in the classroom. Content quality is a student-oriented concern while "ease in using the software in the classroom" is a teacher-oriented concern. Without "good" content quality, the pupils in the classroom will not benefit from using the software. On the other hand, teachers will not wish to spend too much time and energy going through each and every piece of software they want to use. If the software is easy to use, this will save them time. We believe that a balanced view, incorporating both teacher and pupil's concern, is necessary when choosing software packages for classroom use.

. . . what they valued most is the content quality of the software and the ease in using the software for classroom instruction.

. . . give a more balanced view about using technology for educational purposes.

The first seven criteria ranked by the graduating pre-service teachers do appear within the first top eight criteria in Bitter and Wighton's study. This implies that this group of pre-service teachers valued similar software evaluation criteria as those members of the Educational Software Evaluation Consortium in North America. At the same time, the first nine criteria also matched with Roblyer, Edwards, and Havriluk's four major software evaluation criteria (1997).

In addition, there is one other interesting finding. The criterion, "the program is appropriate for computer technology; the material cannot be presented better in another medium", was ranked as the third most important in the Bitter and Wighton's study. However, it was ranked as the least important criterion by the pre-service teachers in our study. In a sense, none of the pre-service teachers chose that criteria at all. We believe that there are several explanations for this. First, it could be that these teachers did not think about the fact that some material could be presented better in another medium as they had little experience using the computer for teaching and learning. Second, they might have misconceptions about using computer technology. Many of them were overwhelmed by the computer and believed wholly in its potential that they failed to consider its limitations. This might have arisen by the emphasis placed on technology in the curriculum as a result of the government's push towards more computer technology for education. As teachers educators, we should strive to give a more balanced view about using technology for educational purposes.

There was only one pre-service teacher who suggested "cost" as an additional criterion. However, he/she did not provide any details to elaborate on the criterion. It seems that others were satisfied with the given list of criteria. This implies that most pre-service teachers did not consider "cost" as a criterion in the software review process. We believe that the cost of software packages should be considered in the software review process when it comes to selecting software for purchase. However, if the software evaluation process is a way to determine the quality of the software, then the cost of software package should not be a criteria. On the other hand, one reason why this criterion of cost was not considered by teachers could be because most Singapore schools are given adequate funds to purchase software; money is thus not a major concern.

CONCLUSION

Our study showed that the top seven criteria used by pre-service teachers in Singapore matched the top criteria used by the North American educators in Bitter and Wighton's study (1987). This implies that their concerns in choosing software packages are similar to educators elsewhere although we are not certain if this similarity truly reflects like concerns. There is also a possibility that students could have been influenced by their readings around the topic of software evaluation.

a "practical, student-oriented" view in choosing software packages.

On the other hand, these graduating pre-service teachers also revealed a "practical, student-oriented" view in choosing software packages. They are practical in a sense that they demand that the software be user-friendly and can be easily integrated into classroom use. They are student-oriented in a sense that they also insist on good quality content for their pupils. However, we are not sure if their view will have any influence on other teachers in the future, nor are we certain how experience in the classroom will in turn influence their choice of criteria for evaluating software programmes. Both these issues, we are certain, will provide interesting questions for future research. ■

REFERENCE

Bitter, G. & Wighton, D. (1987). The Most Important Criteria Used by the Educational Software Evaluation Consortium, *The Computing Teacher, 14*(6), 7-9.

Centre for Educational Research and Innovation, (1989). *Information Technologies in Education*, Organisation for Economic Co-operation and Development (OECD), Paris.

Cheung W, (1994). *A New Role for Teachers: Software Evaluator.* In J. Wright and D. Benzie (Eds.), *Exploring A New Parnership: Children, Teachers and Technology* (191-199). Amsterdam: Elsevier.

Gill, B., Dick, W., Reiser, R. & Zahner, J. (1992). A New Model for Evaluating Instructional Software, *Educational Technology, 32*(3), 39-44.

Gros, B. and Spector, J. (1994). Evaluating Automated Instructional Design Systems: A Complex Problem. *Educational Technology, 34*(5), 37-46.

Heinich, R., Molenda, M., Russell, J. & Smaldino, S. (1996). *Instructional Media and Technologies for Learning.* Prentice-Hall: Englewood Cliffs, NJ.

Jolicoeur, K. & Berger, D. (1986). Do we really know what makes educational software effective? A call for Empirical Research on Effectiveness. *Educational Technology, 26*(12), 7-11.

Ministry of Education (1997). *Master Plan for IT in Education: A Summary.* Singapore: Ministry of Education.

Roblyer, M., Edwards, J. & Havriluk, M. (1997). *Integrating Educational Technology into Teaching.* Upper Saddle River, NJ: Prentice Hall, Inc.

Rowe, H. (1993). *Learning with Personal Computers: Issues, Observations, and Perspectives.* Australian Council for Educational Research: Hawthorn, Victoria Australia.

Cheung Wing Sum *is Assistant Professor, National Institute of Education, Nanyang Technological University,*
e-mail : w scheun@nie.edu.sg

Cheah Yin Mee *is consultant of Learning Ventures, Singapore.*
e-mail : yinmee@cyberway.com.sg

TABLE 1. Ranking of the Software Evaluation criteria.

Rank	Criteria of Software Evaluation
1	The content presented is clear, concise, and of sufficient depth to facilitate learning.
2	The program can be easily integrated into classroom use, and teachers can use it easily.
3	The program is user-friendly.
4	The program is free from grammatical, informational, computational and syntactical errors.
5	The content of the software is directly relevant to the curriculum.
6	There is a good amount of interaction promoted by the software.
7	There are multiple levels of difficulty, and children can move easily from one level to the next.
8	Colour, sound graphics and animation features are used effectively to enhance the program.
9	The program can assess student input and can provide appropriate feedback.
10	The program is motivating.
11	The user can control the rate, amount, and sequence of presentation.
12	The program has branches which allow for individualized instruction according to individual students' needs.
13	The content is free from bias (race, sex, cultural, ethnic, stereotyping, violence).
14	Corrective feedback message or help screens are provided as needed.
15	The program is reliable and free from technical errors.
16	Teacher's notes are comprehensive, easy to understand and well organized.
17	There are user support materials which are appropriate and effective.
18	The objectives of the software are clearly stated and met.
19	Screen displays are effectively and appropriately formatted.
20	The content can be modified by the teacher.
21	There is a management system which provides an effective means of recording keeping and/or assignment control.
22	The program is appropriate for computer technology; the material cannot be presented better in another medium.

Teacher-Generated Web Pages : Moving Beyond Introductory Internet Strategies

Michael J. Rudnac

Recent decades have witnessed profound changes in the basic structure of the American economy. Gone are the smokestack industries, traditional symbols of American dominance and vitality, replaced by advanced technology manufacturing that requires an entirely different and increasingly sophisticated level of workplace skills. A report by the Labor Secretary's Commission on Achieving Necessary Skills indicates that the future workplace will require that workers have the ability to acquire, evaluate, organize and maintain information and use computers to process it (SCANS, 1991). With continued foreign competition, coupled with the globalization of the market, the need to manipulate and manage information will likely increase exponentially in the years ahead.

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President Clinton recognized this basic shift toward an information-based economy and established the goal of wiring every classroom in the nation to the Internet by January 1, 2000. There is strong evidence that this special effort to wire American schools and increase the technological savvy of students is indeed justified. According to the Department of Labor, almost 50% of all workers use computers on the job (double the percentage of 10 years ago); and those who do, earn 43% more than other workers (Taglang, 1997). However, as school districts continue the process of connecting to the Internet in anticipation of reaching Clinton's established goal, there is a growing sense that the "Information Super Highway" will not only train the workers of tomorrow, but will provide the stimulus to revitalize our system of education. In fact, we have come to believe that merely installing vast amounts of technology and showing off the Internet at Parents' Night are justifications in themselves for "better, more effective learning." A curious myth is being perpetuated throughout America: "Connect to it and they will learn."

Internet connections in every American classroom obviously will not guarantee that the learning experience will improve in any

real, qualitative way, although some optimistic technology vendors would have you believe just that! What is guaranteed, however, is that a large number of vexing "Internet Challenges" will soon be directed toward well-meaning professionals who may have difficulty constructing coherent arguments and explaining how technology will improve learning. Members of the local community will justifiably ask questions that concern the type and quality of teacher-student interaction, the changing roles of teachers in the classroom, the type and quality of teaching, the search for information versus the conducting of actual research, the clicking on icons versus the reading textbooks, the "copypaste" syndrome, and a host of others. It will not be long before circumspect parents are no longer impressed when their children tell them that "It's fun, and we always look up stuff on the computer."

The most significant questions are as simplistic as they are profound: "What will we do with the Internet, and how will it improve instruction?" "How will using the Internet improve my child's ability to survive in a knowledge society?" "Should the emphasis on learning be geared toward content and declarative knowledge or on procedural knowledge wherein students learn how to apply knowledge to new circumstances?" "Don't kids today *suffer from 'information overload' and already possess too much* data to be meaningful?" "What exactly does it mean to be an educated person in the 21st century?" The inability to answer these fundamental questions is a portent of failure and a precursor to a vast array of future problems.

"Should the emphasis on learning be geared toward content and declarative knowledge or on procedural knowledge wherein students learn how to apply knowledge to new circumstances?"

On the national level, there currently is no shortage of challenges to the "connect philosophy." Diane Ravitch, (Ravich, 1998) historian and Fellow at the Manhattan Institute in New York City, argues that money spent on technology for schools is a questionable investment: "This [technology] smells suspiciously like the latest miracle cure. The nations that regularly leave us in the dust on academic tests - like Korea - have focused on good teaching, not on technology. There is no evidence that use of computers or the Internet improves student achievement. Yet the *billions spent on technology represent money not spent on music, art, libraries, maintenance and other essential functions."* Computers in the 1990s have been likened to the filmstrips of the 1960s (Oppenheimer, 1997) because students didn't have to think for an hour, teachers didn't have to teach, and parents believed their schools were high-tech. But, did learning occur? Even if schools are connected to the Internet, there is skepticism concerning the ability to pay for continued maintenance of equipment. Continued and efficient access to educational

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technology will require substantial amounts of additional resources that schools are simply unable to provide. Our nation's schools have yet to determine how they will maintain these expensive investments and continue to provide adequate education to prepare our future workforce (Gutierrez & Osorio-O'Dea, 1998).

There are, of course, many exciting images of how the Internet can enhance learning. The World Wide Web (WWW), in particular, has a number of obvious strengths. It can provide immediate access to information that is difficult if not impossible to locate in any other medium. This information is immediate; it can be viewed in real time. For example, one can literally view a Doppler Radar screen and observe the movement of storms, their direction, speed, and intensity. The information on the Web is not only original, but it is continuously updated and expanded from Web sites around the world. The World Wide Web as an information retrieval system is unprecedented in human history and can locate data in a way that printed material simply cannot begin to approximate.

Despite these obvious advantages, the WWW is hardly the cure-all for all the instructional deficiencies that are found in schools. Many schools have experienced little change in the teaching-learning environment after Internet connections were completed. The problem is that administrators and teachers alike often lack the vision to incorporate the "Internet piece" into the larger "school restructuring puzzle." They see the Web as nothing more than access to new sources of information. Students merely "look stuff up," albeit in a new medium, and then proceed to copy, memorize, and reproduce said information in a way that is acceptable to the teacher. Hence, at the very time that we have access to millions of new information sites, all we seem to be able to accomplish with these new sites is the enduring "Industrial Model" type of learning.

The Industrial Model mirrors the very behaviors that its name suggest. Students are seen as workers whose tasks--read, absorb, memorize, reproduce are typically lower-level cognitive behaviors. While most teachers have moved significantly beyond the Industrial Model, there are Industrial Model practitioners who subscribe to the theory that the only legitimate learning outcome is the ability to commit to short-term memory a dazzling display of facts. Japanese schools, with their emphasis on conformity and intense rote learning, are usually seen as the quintessential example of the Industrial Model. Even there, in a culture in which

tradition is sacred, critics are beginning to advocate change. Ichiro Ozawa, the leader of the main opposition party, argues in Time that the educational system is at the heart of Japan's difficulties because it forces children to memorize and solve math problems. While those tactics may have been sufficient when Japan needed nothing but obedient, selfless workers, it does not nurture the right skills for Japan's future!

There are, of course, many inherent problems with the Industrial Model. There is not always a clear indication that the information is ever learned for the long-term, just that it can be replicated within a relatively short period of time. In addition, the learner has not necessarily attached or constructed any meaning to the "learned" material and, consequently, there is the suspicion that the learned information can neither be applied to new circumstances nor used in any meaningful way other than the way it was passively absorbed. Finally, with the doubling time of the information base measured in mere months rather than decades, it is doubtful that a substantial amount of the memorized information will be relevant in the future. In short, combining the Industrial Model with the Web ensures only that students will continue the futile exercise of memorizing even more irrelevant, inert knowledge. The only consolation is that at least the information that students are "learning" is relatively new and not subject to the usual textbook constraints.

We may continue to insist that our students are "Internet literate" and that we have harnessed the vast capabilities of Internet technology to prepare students for the "challenges and jobs of tomorrow." Some unsophisticated and well-meaning parents may even laud our efforts and continue to be impressed with our rhetoric, if not our results. This "smoke-and-mirrors" approach may continue for some time until some worldly parent questions the value of employing the newest technologies in a way that bears no relationship to either current learning and retention *theory or to the next century.*

To maximize the benefits that the Web has to offer, we must consider less obvious and more creative uses for technology. The very uniqueness of the World Wide Web is vastly different from other educational technologies, including video disks, filmstrips, videotapes, and the like. The information in these technologies tends to be static in nature and hot suitable to change. By contrast, not only is it possible to view the ever-changing information on the Web, it is entirely possible to create information on individual Web sites. With proper training, teachers

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. . . many emerging practical possibilities that employ teacher-generated Web sites as a way to personalize instruction and move beyond simple "search and report" strategies.

can generate their own Web pages to meet the needs of individual students. This subtle yet dynamic property highlights the most meaningful advantage of the Web. If properly used, it has the ability to accomplish what no other educational technology has been able to achieve: encourage educators to change the paradigm of instruction from the erstwhile Industrial Model to a more dynamic "Millennia Model."

The Millennia Model is synonymous with viewing education as an active, authentic, and dynamic process. If teachers recognize the need to move toward more energetic modes of instruction, the uniqueness of the Web makes it possible for the classroom teacher to create Web pages as a way to generate new and innovative modes of instruction that not only incorporate the latest in learning and retention theory, but fundamentally change the way we look at the processes which take place in our classrooms. We can, therefore, broaden the horizons of students whose learning experiences were limited to the "read-absorb-memorize-reproduce" mode. We can make it possible to change the type of knowledge presented in a classroom; the type of thinking can also be altered. We can teach students to be more reflective. We can help them to "learn how to learn" and build bridges from new topics to older, learned material. We can encourage students to be imaginative, to build models, to solve problems, to collaborate, to create new information, and to review the work of others and "post" comments to it. We have the ability to transform the paradigm of American education away from exclusive use of direct instruction and memorization to a new, more kinetic model. This Millennia Model is captivating because it creates totally new ways of teaching and learning.

Emerging Practices

The following examples represent three of the many emerging practical possibilities that employ teacher-generated Web sites as a way to personalize instruction and move beyond simple "search and report" strategies. In general, they were created to encourage imagination, creativity, teamwork, communication skills, information-finding skills, problem-solving abilities, technological literacy, and above all, a continual readiness to learn. These qualities were identified as necessary in order to produce people who can thrive in and contribute to a society built on knowledge and the ability to produce information (Bereiter, 1997).

The Geogl Web site (Rudnac, 1998) is designed for a Geography class and is intended to replicate a number of "real world" skills commonly used in the workplace. In essence, students assume the dual role of professional geographer and site acquisition manager from the business world. Groups of students begin by using the Web to search for viable business opportunities and then query government census sites for the most appropriate and useful population data. In the second phase, students select, organize, prioritize, and plan how they will use the most useful data. In the final phase, emphasis is placed on moving beyond the obvious data to much more sophisticated and complimentary concepts such as income, infrastructure, topography, climate, drainage patterns, transportation, communication, and the like. Geogl is a problem solving exercise; a puzzle of sorts that requires students to consider a wide variety of data and logically create new knowledge from that data.

Mindtools are generalizable computer tools that are intended to engage and facilitate cognitive processing - hence cognitive tools. (Kommers, Jonassen, & Mayes, 1992). Cognitive tools are both mental and computational devices that support, guide, and extend the thinking processes of their users (Derry, 1990). They are knowledge construction and facilitation tools that can be applied to a variety of subject-matter domains (Jonassen, 1996).

The Mindtools page (Rudnac, 1996) is designed to study a subject in a quantitative manner while helping students to construct meaning to what is a higher-order learning experience. Mindtools simulates the type of comparative studies, e.g. automobiles, hospitals, schools, often conducted by consumer groups. These groups typically choose various factors, weight each of these factors, test each of the factors, and then draw conclusions from the data.

Mindtools are generalizable computer tools that are intended to engage and facilitate cognitive processing

In short, this Web site from a World Cultures class requires *students to quantitatively compare the "quality of life" between* two nations, one of which is the United States. Students begin by locating similar cells, i.e., health care, education, transportation, communication, etc. and decide which of these factors to compare. The students then must locate, retrieve, rank, and factor each data cell based on its perceived importance. Following the study, the students are required to explain and justify their findings while answering questions from the class. The rubrics emphasize greater use of technology; students are further encouraged to position the required spread sheet into a student Web page thereby creating a gateway to universal access during and after the oral report.

. . . applying that knowledge and creating a vision for its use are of paramount importance because these are two characteristics often possessed by successful people in an information culture.

The Ford R&D (Rudnac, 1997) assignment was completed by teams of students in a leadership class, and the lesson attempted to simulate Ford Motor company's redesign of the Taurus. Essentially, the task was to "create" a new car by either finding "flaws" with current models or by locating a niche in the current marketplace that had been ignored by current automakers.

The students initially searched for and retrieved appropriate information such as the "usual" data that included income, family size, average work commute, sales of current models, and the like. Emphasis was then placed on "unusual" or creative solutions, and students soon focused their efforts on planning and synthesizing interdisciplinary information from a variety of sources ranging from alternative fuels and drag coefficients to marketing considerations and safety precautions. A number of related computer applications were also used. Students completed data bases and spread-sheets, and employed various drawing and painting programs.

As in previous applications, the ability to locate and retrieve information is important; applying that knowledge and creating a vision for its use are of paramount importance because these are two characteristics often possessed by successful people in an information culture.

Why Bother?

The obvious question is why teachers would prefer to create their own personalized Web sites rather than simply purchase "professionally-made" Internet applications. This school of thought implies that teachers have neither the time nor the inclination to "create" and assume ownership in a "technology product." As a consequence of this perceived lack of initiative, the "smoking gun" points to the emphasis on the many CD ROM materials and prepackaged computer programs rather than underscoring the need for technical inservice training for classroom professionals. However, in order to understand the concept of "ownership," it is important to study how teachers usually interact with technology.

Studies of technology integration provide an insightful model of how teachers adopt new technology, adapt to it, and ultimately use it for instructional purposes. Rieber and Welliver (Rieber & Welliver, 1989) proposed that a hierarchy exists for the successful application of computer technology to education. This hierarchy involves five steps: 1) familiarization; 2) utilization; 3) integration;

4) reorientation; and 5) evolution. The utilization level, in particular, is of critical importance because it is at this point that teachers feel some sense of satisfaction with the technology. However, there is no real commitment given to it and, consequently, any "problems" which arise result in the abandonment of the technology in favor of more "tried-and-true" methods. Rieber and Welliver point out that the majority of educational media fail to advance beyond the utilization stage.

As teachers move up the hierarchy to the reorientation stage, there is a better understanding of the function that technology can play in education. The role of the teacher in the classroom is modified to accommodate new and increasingly sophisticated instructional responsibilities. The final stage, evolution, provides the impetus to not only identify instructional problems, but to design, develop, implement, and evaluate how technology can provide viable solutions.

Rieber and Welliver's work has serious implications for schools in the midst of an Internet boom. Not only is there unmistakable evidence that most technology never develops beyond the utilization stage, but it is entirely plausible that unless teachers experience some sense of ownership with the intended technology, it is doomed to be misunderstood, underutilized, and relegated to a position of secondary importance.

Canned, prepackaged, mass-marketed Internet applications are likely the very instruments that will never develop beyond the utilization stage. Corporate America provides simple Internet applications, but teachers experience no real ownership in these programs. The level of interest begins to wane. The Information Highway degenerates to the Information Hypeway. Finally, the return on our investment, in terms of higher-level thinking and authentic-type learning activities, is negligible.

There is, therefore, an inextricable connection between teachers' willingness to move up the hierarchy to the evolution stage and their ability to design their own ways of using the technology for instructional purposes. On the introductory level, educators must be provided with the training to negotiate the Internet. However, consideration must be given to creating a systematic approach to move beyond the basics with the objective of encouraging classroom practitioners to create their own solutions to instructional problems in the classroom. These personal solutions revolve around the idea that teachers will identify areas of perceived need and will create their own Web pages as a way to

The role of the teacher in the classroom is modified to accommodate new and increasingly sophisticated instructional responsibilities.

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solve these problems. The ability and freedom to create personal solutions not only provides ownership in the product, it creates an atmosphere wherein the teacher is much more likely to experiment and refine such solutions.

Looking Ahead

As the new century approaches, educators have a unique opportunity to change the traditional teaching-learning paradigm. The "typical" school often relied on direct instruction and rote memory, not only because these tactics were relatively simple and efficient, but because the technology to change them was virtually nonexistent. However, the availability of technology now makes a change not only possible, but desirable. When we recognize that the exclusivity of traditional means of instruction will not adequately prepare students for a 21st century workplace where the knowledge base doubles every few years, then we will have reached a fundamental understanding of why technology – used in a thoughtful and purposeful manner – is so important for America's schools.

The apparent strengths of the Internet go well beyond the availability of millions of Web sites. This technology allows teachers to design Web sites that can change the very essence of the types of thinking and knowledge which are experienced in any classroom while providing access for students to complete assignments from Cyberspace connections throughout the world. The Internet can exponentially increase the repertoire of teacher behaviors; it can invigorate the indifferent veteran. We simply have to view education in terms other than the "Industrial Model" of teaching wherein what "used to be" so encodes our context that it defines our future.

Without question, the Internet holds the promise of helping teachers dramatically increase the quality of instruction. With a commitment to technological training, teachers cannot only harness the energy of the Information Age, they can synergize that energy with the latest research on learning and retention. While the Internet is not a "cure all," it does provide advantages that other media cannot duplicate. We must consider living in the Information Age and what that concept means to our students. The change to a new model of teaching–the Millennia Model–will neither be easily accepted nor simple to implement. Change is difficult. History shows that the change from the "one-room schoolhouse" to comprehensive, urban schools was discomforting at the least. Just as the dawn of the Industrial Revolution, we are

at the crossroads of change, technology, and education. We have the opportunity to positively shape the future or be judged irrelevant by it. ■

References

Bereiter, C. (1997). "Education in a Knowledge Society." Paper presented at the Conference on Liberal Education in a Knowledge Society, La Salle, Illinois, May 30 - June 1.

Kerry, S.J. (1990). "Flexible cognitive tools for problem solving instruction." Paper presented at the annual meeting of the American Educational Research Association, Boston, April 16-20.

Gutierrez, M.D., and P. Osorio-O'Dea. (1998). (Connecting Schools and Libraries to the Internet: Empty Promises or Worthwhile Goals?" LBJ Journal of Public Affairs, 10 (SPRING 1998): 21-30.

Jonassen, D.H. (1996). Computers in the Classroom: Mindtools for Critical Thinking. Englewood Cliffs, New Jersey: Prentice Hall.

Kommers, P.A.M., D.H, Jonassen, and T.M. Mauyes. (1992) Cognitive tools for learning. Heidelberg, Germany: Springer-verlag.

Kunii, I.M., S. Oba, and H. Tashiro. (April 22, 1996). "The Failed Miracle." Time, 63-64.

Oppenheimer, T. (July 1997). "The Computer Delusion." Atlantic, 47-48.

Ravitch, D. (March 23, 1998). "The great technology mania," Forbes Magazine, 134.

Rieber, L. P., and P.W. Welliver. (1989). "Infusing Educational Technology into Mainstream Educational Computing." Int'l J. Instructional Media, Vol. 16(1). 21-32.

Rudnac, M.J. (1996). [cited August 1998]; available from http://westy.jtwn.k12.pa.us/users/mjr/mindtools.html;INTERNET.

Rudnac, M.J. (1997). [cited August 1998]; available from http://westy.jtwn.k12.pa.us/users/mjr/mindtools.html;INTERNET.

Rudnac, M.J. (1998). [cited August 1998]; available from http://westy.jtwn.k12.pa.us/users/mjr/mindtools.html;INTERNET.

Secretary's Commission on Achieving Necessary Skills (SCANS): [cited August 1998]; available from http://www.academicinnovations.com/report.html; INTERNET.

Taglang, Kevin (1997) "The Next Generation of Universal Service: Discounts for Schools and Libraries." Benton Foundation website (Washington, D.C., 1997 [cited August 3, 1998]); available from http://www.benton.org/Library/Nextgen/intro.html;INTERNET.

Michael J. Rudnac *is a classroom teacher and department chair at Westmont Hilltop High School in Johnstown, PA. He has been recognized by several organizations for his work in technology and is one of five featured teachers in Pennsylvania's Link2Learn Page.*

You can contact him at:

Westmont Hilltop High School
1405 Murphy Drive
Johnstown, PA 15905
(814) 255-2918
mgr@westy.jtown.k12.pa.us

The Internet's an exhilarating ride — here's how to make it a safe one

Colleen Thompson

Chances are that you have access to a computer that's hooked to the Internet. Although you know that this tool can deliver a sea of resources, you've probably read or heard a few horror stories about children using the Internet's World Wide Web. When you realize that your students could have access to sites on everything from bomb building to pornography, you probably see your teaching certificate flash before your eyes. What's the good news?

Although the Information Highway can be treacherous, taking these six simple precautions can give your students instant access to greater educational resources than you ever thought possible.

1 Plan carefully

Once you've logged on to the Net, find a good search engine, which is a program that checks Web sites for keywords you type into a box. One good engine is Metacrawler (http://www.metacrawler.com). To narrow your search, use the word and between words in your topic. For instance, if you wish to learn about endandered species in Australia, you might type in 'endangered' and 'species' and 'Australia'.

You will probably notice that, no matter how harmless the subject matter, strange matches come up when you do your search. Ignore them, but realize that they do come up. Be prepared to handle their arrival when your students begin doing their own searches.

Your Internet browser, such as Netscape's Navigator or Microsoft's Internet Explorer, will allow you to bookmark Web sites you'd like to visit again. When you make a bookmark from the browser menu, the Web address is stored in a special file. The next time you want to visit the area you've marked, you can just open your bookmarks and select the site — a big time saver. If you find sites you want to share with your students, you can copy the bookmarks onto a disk or email them (if you have that capability) to the other computers in the classroom. This ensures that the children will be visiting previewed, appropriate sites.

2 *Prepare your students*

Train them to use the Internet appropriately. In my case, the district developed a student handbook that discussed appropriate uses of the Web. Our district decided on these guidelines:

- Researching topics related to a school project is the only appropriate use for the Web. In other words, students aren't permitted to check baseball scores, the sites of favorite bands, or the latest plot synopsis of a popular TV series.
- Chat rooms, where anybody can type almost anything, are strictly banned.
- Any email must be approved and must be for research purposes only.
- All students are required to take a test about Internet safety before using the Internet.
- Anyone who abuses the Internet will be banned from future use and, depending on the severity of the situation, could receive a stiffer penalty.

I also talk to my students honestly about the fact that strange people sometimes lurk around the Internet — and that some can even be dangerous. For this reason, no student can ever use identifying material, such as last name, address, or telephone number, while online.

Yes, these rules make kids a little nervous. But students take this tool seriously, and after a short time, they enjoy surfing for information.

3 *Know where they go*

When students begin their research, you'll find that you can't possibly keep up with the spreading web of information. And there's no way you can preview every site. Instead, you must monitor carefully. I walk around as my students work, and I insist on approving their links. (Links are the highlighted words, usually in blue, that take you to another Web site.) There's usually a description of the site so you can get a feel for the information that will be found there.

My students work in pairs on their research. This way, temptations to visit an inappropriate site are less appealing.

4 *Teach students to be critical researchers*

All Internet "authorities" aren't true experts, and quality varies greatly from site to site.

For example, students might find a site on the behavior of Ganges River dolphins written by a scientist from a marine laboratory. That site would carry more weight than a Web page entitled Francine's Flippered Friends, written by an ardent fourth-grade dolphin fan. Teach students to check credentials and to try to guess the author's purpose for having the site. This could be a great time for a lesson on persuasive devices and propaganda, depending on your students' level.

5 *Make sure they're really reading*

I don't let my students save articles from sites they visit. Instead, they have to carefully read through what they find on the sites and take notes. If students can save or print articles, it's easy for them to cut and paste sentences or paragraphs without genuine comprehension.

Here's trick to teach your students: If a Web page has a lot of text on it, conduct a "find" on the page to locate a certain topic. (The Find command is in the browser's menu.) This will cut the amount of time they spend at each site.

6 *Teach them to give credit*

The Internet is a notorious place for idea snatching. Make sure your students know how to credit their sources. This can be difficult because some Web pages lack even basic identifying information. Encourage younger students to write down the page title (located in the top of the browser window) and the Web address of any page they pull information from.

You've got it covered

These six tips should keep your palms from sweating as your students explore the Internet. One lesson I learned is to relax: Try to see the Internet for what it is—one resource among many. It doesn't replace books or encyclopedias, but if your students are informed on how to use it appropriately, it can give knowledge a thrilling immediacy and make learning a joy.

And isn't that what your job is all about?

Colleen Thompson *teaches fifth and sixth grade at Mitchell Intermediate School in The Woodlands, Texas.*

Ready, Set, Go!

Linda McElvenny

With millions of computers sharing rich material, there are many good Web sites worth visiting. How do you direct your students to the good stuff? Finding information is as easy as 1, 2, 3.

1. Type in an URL

A universal resource locator, or URL (pronounced "earl"), is a cyberspace address. Here are several good education URLs:

http://www2.classroom.net/databases/grades/edufind.html Classroom Connect's Global Resources Directory: You can conduct a search for information appropriate for grades K-12.

http://www.w3.org/pub/DataSources/bySubject/Overview.html The World Wide Web virtual library subject catalog: You can type in any subject you want information about and pull up sites to visit.

http://www.whitehouse.gov The White House Web site: You can take a tour, write a letter to the commander-in-chief, and more.

http://rs6000.bvis.uic.edu:80/museum/Dna_To_Dinosaurs.html The Field Museum: This is a great resource for dinosaur information and pictures.

http://www.seds.org/nineplanets/nineplanets An award-winning Web site from Nine Planets: It's about — you guessed it — planets.

http://www.discovery.com/area/nature/nature.html The Discovery Channel's Nature page: You'll also find links to other information-packed areas from the Discovery Channel.

http://www.wln.com/~deltapac/hocm.html The Hands-on Children's Museum: If you can't go to a museum in person, this is the next best thing.

2. Use the search engines

As Colleen mentions in her article, search engines help you locate information when you type in keywords. You'll get links to Web sites and newsgroups within seconds. Try these addresses:

- http://www.yahoo.com
- http://www.yahooligans.com (more "kid-appropriate" links)
- http://www.lycos.com
- http://www.excite.com
- http://www.altavista.com

Another engine is Electric Library, developed by Infonautics (800-304-3542, http://www.infonautics.com). This search engine is a software product that allows students to search using sentences. The program automatically references the source so kids can't plagiarize by cutting and pasting text.

3. Just surf

This means starting at a site of interest and moving, using links, to other places of interest. Unfortunately, surfing can lead anywhere, including places that may be inappropriate for students. You'll need to monitor them carefully.

Make it worry-free

Colleen gives you some great tips on making online experiences safe. There are also software programs that shield children from inappropriate areas. You may want to talk with your computer specialist or media specialist about these products. Prices range from $30 to $100.

SurfWatch. (800) 458-6600 or http://www.surfwatch.com. Works by blocking access to hundreds of areas that SurfWatch staffers have deemed unsuitable for children. You can customize the controls and parameters to meet particular standards.

CyberPatrol. (800) 828-2608 or http://www.cyberpatrol.com. Reports Internet access at certain times of day and records the amount of time spent online, allowing you to supervise access.

Net Nanny. (800) 340-7177 or http://www.netnanny.com. Screens material coming from the Internet and information sent back out to the Internet. It also posts a log of all activity for your review later.

EdView. (612) 338-0533 or http://www.edview.com. Uses a search engine that calls on a database of educator-approved sites that is frequently updated and reviewed by an educational advisory panel.

***Linda McElvenny** is the owner and director of FUTUREKIDS in Exton, Pennsylvania. FUTUREKIDS provides computer-literacy training for faculty and students in grades K-8. You can contact Linda via email at fkids@uscom.com. For information on FUTUREKIDS, call (800) 765-8000.*

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If this application is for renewal or upgrading, please provide previous Membership No : _____ . Thank You.

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Learn

like it's oxygen to the brain

Work

like you don't need the money

Love

like you've never been hurt before

Appreciate

as if everyday is a divine gift

Live

like here is no guarantee of tomorrow

Smile

like it's the best day of your life

Note: Food for thought as shared with participants at a recent ASCD workshop conducted by Eric Jensen.

A Call for Articles...

The ASCD (Singapore) REVIEW Committee seeks original articles on teaching and learning...

Manuscripts should be between 2000-2500 words, typewritten (preferably Microsoft Word document) and submitted in the form of a hard copy together with a 3 ½ inch diskette. Photographs would be appreciated. Contributions may be addressed to:

Mrs Soo Kim Bee
ASCD (Singapore) REVIEW Committee
c/o ASCD Secretariat Office
Tele-Temps Pte Ltd.
1002 Toa Payoh Industrial Park #06-1475
Singapore 319074 Tel: 250-7700
Email: kbee@gmt.com.sg

The themes for the forthcoming issues are:

Vol.9 No.1: **Working with Parents and the Community**
Deadline for articles: 30 Oct 99

Vol.9 No.2: **Into the New Millenium**
Deadline for articles: 30 Nov 99