

## **Evaluation Of Instructional Delivery Systems**

SUBJECT: Assignment #5: Evaluation Of Instructional Delivery Systems

COURSE: MCTE 661 — Advanced Instructional Delivery Systems

Textbooks: • Beyond Calculation: The Next Fifty Years of Computing  
Denning & Metcalfe (1997)

- Learning Networks: A Field Guide to  
Teaching and Learning Online  
Harisim, Hiltz, Teles & Turoff (HHiTT) (1995)

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### **Abstract**

This paper addresses the subject of the evaluation processes for instructional delivery systems. As with all the topics in our course of study, instructional systems have been impossible to separate from the larger picture of national and global issues. Learning, by leaps and bounds, is becoming ensconced within parameters of economy and global culture. This writing will look at definitive examples of how we can begin to evaluate the systems. Mostly, it will show that there is one supreme word that encompasses every aspect of that evaluation: INNOVATION. All levels of success in the New Media and our Age of Information now fall under the criteria of major innovative effort, how well that effort is implemented, and how willing an individual, company, or institution is to keep pace with such rapidly evolving technology.

## Evaluation Of Instructional Delivery Systems

### **Delivery Systems, Present And Future: Criteria For Assessment**

It seems almost impossible to begin thinking about how to assess delivery systems. The rapid advancement of technology has made it virtually impossible to keep up with all of the facts. When this is applied to just one segment of the users of the technology, it becomes almost more difficult, rather than simpler (by definition of containing the information by being more specific in the target area). This is rather a conundrum of this vast technology, where many times, zeroing in on information often makes a task more difficult than remaining at a more global view. The "overseer" seems to have an easier task than those embroiled at grassroots levels. In the instance of educators, attempting to understand, let alone evaluate, the new systems with which they MUST contend, it must also be observed that the task is monumental. Whereas the "overseer" perhaps does not need to know all the grassroots level details, those at the end of the user-chain must definitely have a huge understanding of the total issues. This means that education must take on the task of understanding all aspects of information delivery, in order to not only utilize it, but plan for future implementation in a constantly changing scene. They must do this, in order to survive.

Essential to being able to assess delivery systems is the notion that all of this has come upon all of humanity in a very quick, impossible to assimilate, fashion. Those individuals or institutions that are so inflexible and staid in their ways as to NOT be able to institute radical thinking or innovative measures are probably and certainly doomed to fail. New ideas and technologies have enabled consumers to be much more productive and efficient at work, as well as at school and home. Software companies and user providers of all types have been committed to making personal computing easier and more valuable, in education as well as business arenas. As astonishing as recent technical rates have been, people of the near future will be able to do things with computers that are difficult to imagine today. Part of the evaluation process for these components of delivery are tied in with public and private

opinion of the developers that strive to deliver high-quality products at reasonable prices. They also look to these companies to be responsible leaders in innovation for the benefit of the consuming public. (Gates, 1998). This, of course, includes the learning community, perhaps more than the general public, for it is the responsibility of "Education" to provide the means to learn new modes and methods. At least, that is the traditional view.

### **Delivery Systems *MEANS* The Internet**

The stance of this writing includes that we cannot get away from the fact that any discussion of learning systems will already include the presence of the Internet. A central function of any system is to allow users to approach information storage devices wherever they are located, in local drives or remote servers and networks. The Internet *itself* is a huge information "storage device" that occupies a public network that happens to be global. This explains why literally all modern operating systems include a variety of Internet-related technologies, including Web browsing capabilities. Therefore, within this writing, all commentary will be geared toward the attitude that when we discuss delivery systems, we are innately discussing attachment to the Internet.

In the computer industry, especially in software, product life cycles are incredibly short, with an average of just twelve to eighteen months. (Gates, 1998). Software publishers, as well as developers of all computing components, are racing to introduce new products at an increasing pace. There are rapid and unpredictable changes. This not only threatens the position of existing companies, but also creates the base for the average consumer to experience massive confusion. The status of a product is never secure because it is impossible to know when the next new idea will come along that might render that entire product line obsolete. This makes the position of educator or business entity very precarious, as decisions for purchases become quite shaky. Very few industries face the kind of intense competitive pressure as those in the high technology sector. Unfortunately, those pressures are passed on to the eventual users, including our education systems. The computer industry is cluttered with the remnants of many companies that had great success for a short while, but were transcended by newcomers that better

served the needs or desires of the user. It should always be kept in mind that the underlying instigator of innovation is almost always a human need or desire.

If we are indeed looking at even larger leaps of innovation, where is the best resource for ferreting out information as, or before, it happens? It has been the experience of this writer over five years of Internet exploration that THE ONLY method of research is also the delivery system. Little information, or at least enough information to make a difference, can be gleaned from traditional methods. We MUST utilize the Internet in order to understand the Internet. We *must* use this method as it is the only means available for acquiring CURRENT, state-of-the-art information. There is no other way. We are the recipients of the latest facts available, because the Internet has been made the mode of storage as well as delivery. It is only in this way that we can stay current on the latest trends — whether they will be long-standing or not remains to be seen — and innovative measures all over the world.

### **Setting Criteria For Assessment: The Factors Of Speed And Human Interface**

Two of the measures for evaluating new products are 1) the ease of human interface to the computer, and; 2) SPEED. Very recent searches brought up some highly important information for future impact on instructional delivery systems. It is hard to imagine, for instance, "surfing the Internet" without a mouse, keyboard, joystick or a microphone. It's even harder to imagine not even touching the computer at all. Recent developments by a company called Reality Fusion, have brought unusual new approaches to computers. They call it "free-action" technology, where users look into the computer screen and see their own image, something akin to looking into a mirror. Users "touch" the air in front of objects depicted on the monitor, but don't actually touch the computer. This prompts the computer to perform its operations. (Walton, M. & CNN, 1998). In this writer's opinion, this infant advancement provides endless material for consideration for instructional purposes for students with special needs such as deafness, paralysis, autism and other mental disorders. It also opens tremendous opportunistic doors for the handicapped, within highly technical professions.

One of the most relevant issues today concerning delivery, is of course, *speed*. Engineers at International Business Machines (IBM) have developed an experimental microprocessor that runs at

1000 megahertz (MHz), which is about triple the speed of today's fastest commercial chips. Researchers said that the design and circuits used in the evaluation will eventually be applied to chips using IBM's recently-introduced "copper chip" technology (Excite, Inc., 1998), which is the first of its kind. It is also a shift in technology that many believe will keep the industry on track to achieve ever-greater leaps in performance. The Digital Equipment company is producing a 1,000-MHz Alpha chip. Intel has outlined details of the architecture used in their fastest Pentium II chips, which are expected to reach 450 MHz by year's end. (CNET staff, 1998). The short-range impact of this massive increase in speed capabilities will, of course, result in necessary re-planning for purchases and implementation in homes, school computer labs and businesses, worldwide. The long-range benefits will be increased capabilities, which will be certainly widely felt in the educational community.

Every day, our technologies take us to deeper levels of *ubiquitous computing*, with the Internet carrying us through an era of widespread *distributed computing*. This could only be achieved by deeply embedding computation in all aspects of the world. We quickly approach the day that no area or human life will be *unaffected* by embedded computing. (Denning & Metcalfe, 75). Every process we do or endure has computing attached to it. As prices continue to spiral downward and performance improves at an accelerating rate, it won't be long before every business, school and home will be able to take advantage of the huge enrichments from something that was once thought of as a luxury or an expensive toy. Personal computers will become as prosaic in American households as the television or the telephone. (Gates, 1998). In fact, it is interesting to note that this particular horizon has probably already been achieved. After wavering around 40% in 1996, home-based computer ownership surged ahead about five percentage points in 1997. This leads evaluators such as *Computer Intelligence* and its 1998 Consumer Technology Index (CTI) to predict that home computer ownership grew *beyond* 45% by the end of 1997, and will achieve over 50% by shortly after the year 2000. (Lanctot, 1998).

It is no longer the case that too many current Internet projects are simply efforts to deliver yesterday's services with tomorrow's technology. (Aranda & Vigilante, 1995). We are firmly into an era where the technology of TODAY is delivering things that are astoundingly different from yesterday's

technology. If the pace keeps up, there literally is no way to predict what tomorrow's technology will bring — it is difficult enough to keep up with today's offerings!

Recent months have ushered in exciting versions of online scholastic projects. From *Scholastic* to Simon and Schuster, *Classroom Connect* to the *Jason Project*, the US Olympics' and PBS' *Cyber School*, to countless other educational undertakings — many new proposals have sprung up to begin taking advantage of the Internet's potential for learning. The projects have harvested both criticism — for appealing essentially to only financially sound schools with technology access and know-how — and praise, for bolstering student learning and for opening previously closed worldwide windows. (*Brown, PBS Snowboards. . .*, 1998).

As we continue our evaluation process of delivery systems, it quickly becomes apparent that one of the greatest advantages provided by the Internet is its use as an educational tool. Students are utilizing it to send Email messages around the world. They are learning about different cultures and making new friendships that never would have been possible in earlier years. We quickly are approaching a time — with prices of computers dropping so drastically — that students attending school in poor areas or remote locations will be able to use the Internet to access the same library resources as students attending schools in our wealthiest areas. (Gates, 1998). This fact alone opens many possibilities for improving educational opportunities for *all* children, all over the world. This makes our scrutiny of delivery systems instantly exciting, with an almost endless, bottomless reservoir of choices.

The ease of human interface has already been proposed as being one of the most important evaluation criteria for systems. The criteria are evaluated on the *results*, which is always the case. As far as the success of Web-related learning, students seem to be more motivated when they know their work has the possibility of being published. The Internet is a huge publication tool! Students' engagement with projects becomes intense, because this medium "belongs" to this generation — they've grown with it, and it "speaks" to them. Even considering the technology as it exists today — *without* looking toward the future — we see that current studies sometimes aren't much different than with a textbook. However, the very act of by studying it via the Web has allowed us to reach a new generation of students who might otherwise be turned off. It's the sheer interactivity. It is the medium they've grown up with.

(Brown, *PBS Snowboards*. . . , 1998). One of the major goals of the computer industry, overall, has been to create tools that improve the quality of people's lives. The results have been that hard work and innovation have provided people with new and useful technologies that they want and need. This direction has left no segment of society(ies) untouched, including education.

There really is no other industry where consumers have benefited from greater cost and performance gains, over the past twenty years or so, than in the personal computer industry. It has had extreme effects on the academic community. In fact, the increasing popularity of personal computers is in great part attributable to their use as *information machines*. As we have already seen, one materialization of this phenomenon is the extraordinary growth of the Internet, which permits boundless access to truly amazing quantities of information on any subject, from any source throughout the world. The Internet, with its connectivity, holds more covenant than anything else that has happened in not only the computer industry, but literally in ANY industry, in recent memory. Increased access to the Internet through low cost computers and other devices will empower students to become lifelong learners. It will give untold numbers of workers the tools to keep pace and increase performance. Consumers at every level will have new forms of communication, information, entertainment, and commerce. This writer contends that perhaps this era is the most exciting in all of history in which to be alive! The exciting changes in technology and the systems that connect us, promise to advocate a veracity and healthy competitive environment . . . more than any other innovation of the last hundred years.

### **Silicon To The Speed Of Light — Saving The World From Atomic Catastrophe**

In evaluating delivery systems, it seems natural to question the varying levels that are affected, and for which we need some sort of appraisal. This writer is one of those caught squarely between the "Baby Boomers" and the "Generation X-ers." We were known as the Hippies and some of us, Yuppies, but certainly most of us remember our innocent days being haunted by the Bay of Pigs. For us, one high-level topic for assessment might be the decades-old issue of atomic warfare. While this may not be the usual topic of conversation when it comes to computing and education, the realities are that it may come closer to home than one would think. The reason for this is that much of our technology has historically

been derived from either conditions of warfare, or, in more recent decades, from the international space and defense race. Therefore, education, like all other arenas, is heavily impacted by governmental and military discoveries and usage. A highly pertinent example of this was recently and serendipitously discovered in an Internet search by this writer. It appears that the Department of Energy wants a computer simulation that will replace real-world nuclear weapons testing. The issue, as for all of us, concerns the "computing speed" it will take to get to that goal.

In order to provide such a simulation software, more calculations per second are needed than in even computing systems available to high-tech or military auspices. DOE requested that IBM build a supercomputer capable of trillions of calculations per second. This is something that even those of us in computing have some trouble envisioning! However, IBM has signed an \$85 million contract with DOE, who expects that the agreement will result in an eight-fold increase in the level of simulation detail. The proposed computer will be capable of 10 trillion calculations per second. Only two years ago, NO ONE believed that computers of this speed would be possible — not even the innovators who were producing other incredible instruments. (Oakes, *DOE tags*, 1998). DOE is not the only governmental faction interested in technology that previously seemed doomed to stay in the pages of science fiction.

It definitely is apparent that when it comes to chip designs for the next century, conventional methods won't be able to keep pace. Experiments underwritten by the Office of Naval Research (ONR) and the Army Research Office (ARO) are researching the ability of silicon wafers to conduct photons (commonly called light waves), in the hope that someday this will lead to the creation of an ultra-fast computer chip that operates at the speed of light — or about 100,000 times faster than current semiconductors! This incredible research has found that if electrical voltage is sent through the substrate, visible light is created that "shines" from the silicon. The researchers believe that this indicates that silicon technology will eventually include photons. They see this as an indication that integration of electronic and photonic capability on a single silicon chip is a very real possibility. Our current computers and other electronic instruments process information only via an electrical current, with the bits of data being transmitted with electrons. These are the subatomic particles with a negative electrical charge. They are the primary carriers of electricity in solids. At this time, electronic and photonic

semiconductors *cannot* be built on the same chip. But with light-emitting silicon, this hybrid device could be built, *conceivably*, on the same chip. Research such as this may eventually help computer science circumvent the limitations of today's integrated circuits. (Koprowski, 1998). This will provide the giant leap needed into the 21<sup>st</sup> century!

What are the benefits of such research and development, especially if we hark back to the example of nuclear warfare and the generation that was raised in a fear of instant annihilation by world powers? What could such disparate subjects as mega-speed and atomic issues possibly have in common? The answer is that IBM projects that "such 'tera-scale' computing speed will enable complex modeling and simulation — enough to ensure the reliability of the nuclear stockpile without actual testing, according to the DOE. If computers replace nuclear testing, the nation can enter into a Comprehensive Test Ban Treaty, the agreement to end nuclear testing worldwide." (Oakes, *DOE tags*, 1998). This writer says, "I can live with that."

### **A New War And Peace: We NEED A Strong Sense Of Community!**

The very thing that makes the Internet so appealing is the ability of individuals to decide for themselves what information they will access and assimilate. The openness of the Internet is elemental in its architecture. The information on the Internet is distributed across uncountable numbers of computers around the world. There are literally an infinite number of access points to that information — in our classrooms, and in your and my living rooms. As a result, the Internet is the *antithesis* of the giant computers that have been portrayed in science fiction . . . that not only contain all of the world's information but also are subject to either the control of governments or else a predisposition toward attaining self-induced powers for destroying humanity.

For a good long while, the educational community has experienced one example of the use of such connectivity. MUSEs (Multi-User Simulation Environment) have been integrated into curricula as educational media. They have been both created and used by educators. While a student often joins a MUSE out of curiosity, this environment has increasingly been viewed by teachers as a "virtual space" and an opportunity for establishing a networked classroom. In this manner, students from different

schools can work together in a collaborative simulation and role-play. MIT developed and has operated the MicroMuse for years, and it is a superior example of how students can create new activities and even new "worlds." It is interactive, it is online, it is state-of-the-art — and yet it upholds great standards for assessing education along traditional lines. This environment supports real-time interaction among many participators who are collaborating in building their own worlds. In this way, they are really supporting a *constructivist* model of learning, very much in the spirit of Montessori or Dewey. "MUSEs foster a strong sense of community among participants." (Kort, 1993; as cited in Harasim et al., 51). This writer would like to point out that this very aspect is perhaps the most essential of all, when it comes to the individual and his/her place in the global community. These self-constructed, ethereal communities provide a base for more stable relationships in the offline world as well.

The swiftness with which people around the world have embraced the Internet is truly amazing. It is powerful evidence that no one in the computer industry can afford complacency. The Internet is going to continue to grow. It is conceivable that almost everyone in the developed AND developing worlds will be using the Internet within the ascertainable future. Access to these technologies promises to have far-reaching effects on the way we live and learn and work. Many of these technologies are still "around the corner." We cannot even imagine today what that all will mean. We indeed have entered an era where information is literally "at our fingertips." The everyday way in which these marvelous abilities sort of blend into the background is also merit for assessment. If the tool has brought comfort, or information, or usefulness of any sort, but without a glitch in our everyday lives, then it is successful not just as a tool, but as an integral part of our being.

### **New Technologies: Ages-Old Implications**

We have benefited from the precursors of today's exciting new machines for quite a while. Visionaries have seen the possibilities for a couple of decades. In the fact that these systems are still in effect, lies the knowledge that any form of evaluation would have to carry positive results! There has been a form of a community-based Learning Network, "The Buddy System Project," in Indiana, since the mid-1980s. This system uses networks to integrate the school with the home. In 1987, an attempt

was made to better prepare young people for life in the Information Age, and also to help adults improve their skills and knowledge. Indiana introduced a project to test the proposed idea of giving each student a computer in the classroom and also a "buddy computer" at home (Hansen, 1992; as cited in Harasim et al., 55). It was hoped that both students and parents would profit. Parents were included because they were considered integral to the success of the project. Fully 30 percent of adults in Indiana at the time, had not graduated from high school. The State of Indiana believed that adult literacy and training was as important as the education of the students.

They equipped the computers with modems. This permitted the linking of not only homes and schools, but also public and private information services. This provided a means of communication and also a doorway to massive information in databases. This concept became the Buddy System Project. *Networking* was the key word. Test results indicated that students who participated in the project produced much better work, longer attention spans for more homework, and they acquired computer skills. Significantly, higher levels of parental involvement were also noted. (Harasim et al., 54-55). This is a truly excellent example of new technology (although the story is more than a decade old) and the benefits of computer technology for strengthening the local community.

When it comes to the learning environment and students' learning needs, we are going to NEED parental involvement. Things are accelerating, and the job corps is seeing the brunt of much of the current lack in education. The computer industry is one of the healthiest, most competitive and most innovative sectors of the US economy. No segment of the U.S. economy is growing faster, nor creating more jobs — high paying, high technology jobs. These are some vital signs of a healthy and thriving industry, as well as the health and well being of the community. We MUST encourage parents, businesses, and educators to adopt practices that will support our students at every level. Any form of assessment of our systems will thus retain a very human element, as we proceed in utilizing and evaluating, making changes, and then returning to once more utilize and evaluate. It has become a great circle of the recycling of human and electronic abilities.

**The Greatest Advances Are Yet To Come: "Innovate Or Die!"**

Bill Gates of Microsoft recently stated to the Senate Judiciary Committee, "I believe that the continued unfettered growth of this industry is critical to both our economy at home and our competitiveness abroad." (Gates, 1998). It is becoming obvious that researchers and developers who fail to keep pace with technological change will be outstripped by their competitors. The prevailing properties that are required to create excellent computer industry components are human intelligence, inventiveness, and an enthusiasm to undertake entrepreneurial risk. All of these are in plentiful supply in our country. Those in the industry are acutely aware that the success story of today might readily become tomorrow's "old news." Much of the criteria for evaluating the success of systems and components rest on this fluctuating factor, as unstable and finicky as that might seem. The "giants" in the industry realize this perhaps better than anyone. It is Microsoft itself that has adopted an unyielding rallying cry: "Innovate or Die!" (Gates, 1998). In the opinion of this writer, this is the essence of evaluation for current and future systems: in order to keep pace, to provide strong solutions worldwide, to offer the upcoming generation a hope to stand firm in the changing tide of technology, all who are involved must embrace and seek such a spirit.

Today's technical offerings have only begun to scratch the surface. The greatest advances in the computer industry are yet to come. We are already seeing plans for operating systems that will allow personal computers to distinguish users when they come into a room, to react accurately to voice and handwritten requests, and to serve as extremely competent interchange, productivity and pleasure devices. (Gates, 1998). The research community is pushing to develop these innovative technologies, and much work has gone into broadening and expanding many instructional enterprises. One measurement for evaluation of a system should be, for the survival of our technical future, a commitment to help ensure that every child has access to the intelligence and disciplines they need to learn. Within our country, this commitment needs to be local. Then, in ever-widening circles, we need to expand to every area on the globe. Giving children the appropriate tools has always enhanced their capability to learn. It also sparks their interest in the learning sequence and their enthusiasm. In our current state and surely in times that are upon us, this is ever so much more essential.

### **Innovation, Evaluation, And A Prophecy For The Future**

In the book, Beyond Calculation: The Next Fifty Years of Computing, Fernando Flores expresses that, "Not only do many people have access to computers, but given the Internet, we now have access to millions of people to whom we did not have access before. Fifty years ago, we could not have predicted this. I am therefore hesitant even to speculate about specific information-technology (IT) products and services that will be invented throughout the next fifty years." (Denning & Metcalfe, 175). It is yet more difficult, in this writer's opinion, to project how information technologies will change the face of education. Certainly we can evaluate the successes of current projects, or those in the near history of computing, and *dare* to project an analysis of what our students will participate in. Projects such as the MicroMuse project at MIT have sought to explore the educational potentiality of network-based virtual realities, for instance. Particularly in respect to building strong computer literacy, cognitive skills, and an awareness of science and scientific principles through such deliberately crafted content at least sets the stage for the next steps in innovation and the ability of today's students to participate in 21<sup>st</sup> century happenings. Certainly, many of these projects have been geared toward informal science education, creative writing, and multicultural activities. (Harasim et al., 52-53). These are essential components for the global "team setting" that has pervaded our economy and our educational environments.

For those of us who need (for personal and professional reasons) to evaluate current technical trends, adopting successful methods into existing curricula and setting new pathways where lack is evident, there is a severe need to view all of these in the light of the overall effectiveness of these modes in *teaching*. "Clearly there is also a need to train and upgrade the ability of teachers to understand and use tools of this type. This ultimately implies a world in which the teacher is a very highly skilled professional in the techniques of facilitating the learning process. This will not happen overnight and will be a gradual transition. Initially there will probably be special professionals who are concerned with conducting sophisticated student evaluations for feedback to teachers and also for brokering information through the networks (similar to a reference librarian in concept)." (Harasim, et al. 257-258). Education at any and all levels will be seen more as a cultured craft performed by a practitioner. This is in

opposition to current views — apprehensions, even — that the teacher will be plunged to a level of an "intern," delivering programs developed by technical professionals, and functioning as merely mechanics of the delivery process. (258). For those of us working within the IT industry, it is paramount that we keep in mind the global effects of what we do, for the heaviest impact will reach to the most vulnerable levels. In this case, that means the youngest users — the students — and those who oversee their training . . . the teachers.

On a final note, this writer wishes to emphasize that our methods of evaluation, as well as our reasons for evaluating the systems that deliver content, must be in keeping with the rate of innovation. This rate will continue to accelerate as microprocessors become more powerful and new software and delivery modes are developed to benefit from and take advantage of that elevated power. Think on it for a moment: merchants are presenting innovative products in genres that *didn't even exist* two or three years ago. Every commodity on the market today very likely stands the chance for being obsolete in that same short amount of time. (Gates, 1998).

Everybody involved in this industry must become adept at not only creating the modes (or at least creating new uses for the components), but also in evaluating current effectiveness. In this way, and this way *only*, we can come to truly understand the competitive base on which we now stand: if we continue to innovate and give birth to products that respond to ever expanding needs and demands, we will succeed. Conversely, a lack of this type of ingenuity will quickly bring about irrelevance. In such a dynamic era of technology, a sense of non-importance or triviality surely is worse than outright failure. The learners of today and tomorrow deserve our commitment to the highest standards of this exciting new Age of Information.

## References

- Aranda, R. Rembert, & Vigilante, Richard P.** (1995). *Re-engineering management training with networked multimedia*. Telecommunications. Issue: July, 1995. Lotus, Inc.: Distance Learning. [Online]. Available: <http://www.lotus.com/services/school.nsf/6f63fa601a0227b285256541006a45d4/564c8a632aafc6218525637e0065d47f?OpenDocument>
- Brown, Janelle.** (1998). *PBS snowboards into online ed*. Wired News: HotWired. Issue: Jan. 30, 1998. [Online]. Available: <http://www.wired.com/news/news/culture/story/9986.html>
- CNET staff.** (1998). *The fastest chips in the world*. CNET, Inc.: Roundup. Issue: Feb. 4, 1998. [Online]. Available: <http://www.news.com/News/Item/0,4,18779,00.html?latest>
- Denning, Peter J., & Metcalfe, Robert M.** (1997). Beyond calculation: The next fifty years of computing. New York: Copernicus/Springer-Verlag New York, Inc.
1. **Weiser, Mark, & Brown, John Seely.** Chapter 6: *The Coming Age of Calm Technology*.
  2. **Flores, Fernando.** Chapter 14: *The leaders of the future*.
- Excite, Inc..** (1998). *IBM demonstrates 1000 MHz processor*. Excite News: Technology News. Issue: Feb. 4, 1998. [Online]. Available: <http://my.excite.com/news/r/980204/15/tech-ibm>
- Gates, Bill.** (1998). *Bill Gates' statement to the Senate Judiciary Committee, March 3, 1998*. Wired News: HotWired: Business News. Issue: March 3, 1998. Redmond, WA: Microsoft, Inc. [Online]. Available: <http://www.wired.com/news/news/business/story/10658.html>
- Hansen, A. G.** (1992) *A buddy computer in the home: Five year progress report*. Technological Horizons in Education Journal 19 (9) (April): 61-65. (as cited in Harasim, Hiltz, Teles, & Murray, 1995).
- Harasim, Linda, Hiltz, Starr Roxanne, Teles, Lucio, & Turoff, Murray.** (1995). Learning networks: A field guide to teaching and learning online. (3<sup>rd</sup> printing, 1997). Cambridge, Massachusetts: MIT Press.
- Koprowski, Gene.** (1998). *Chip design reaches for light speed*. Wired News: HotWired. Issue: Jan. 27, 1998. [Online]. Available: <http://www.wired.com/news/news/technology/story/9888.html>

**Lanctot, Roger C.** (1998). *U.S. Home PC penetration tops 45 percent*. CMPnet: TechWeb News. Issue: March 11, 1998. Originally published: Computer Retail Week. [Online]. Available: <http://www.techweb.com/wire/story/TWB19980311S0025>

**Oakes, Chris.** (1998). *DOE tags IBM for superfast computer*. Wired News: HotWired. Issue: Feb. 12, 1998. [Online]. Available: <http://www.wired.com/news/news/technology/story/10267.html>

**Walton, Marsha, & Cable News Network, Inc..** (1998). *Hands-free computer among new high-tech concepts*. CNN Interactive: Feb. 9, 1998. Correspondent Marsha Walton contributed to this report. [Online]. Available: <http://www.cnn.com/TECH/computing/9802/09/hands.free.hi.tech/>