

## **Research and Innovation In Instructional Delivery Systems**

SUBJECT: Assignment #4: Research And Innovation  
In 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)

Professor: Dr. Ronald D. McFarland, Ph.D.

Student: Leanne C. Boyd

Usercode: boydl

Due date: February 25, 1998

**Actual submission date: March 6, 1998**  
**(pre-requested extension; approval granted)**

### **Abstract**

This summary paper addresses instructional delivery systems and the role of design and approach, which encompasses the rapid growth of innovation, creative thinking, and implementation of a wide range of new offerings in telecommunications. There is a mind-boggling cornucopia of new technology afoot! Some are re-designs on old lines and some are just getting their foot in the door. Some are toys for us big kids and some are toys for our little kids. Some run independently, and some require a link to a larger system to deliver their goods. But they are all exciting and each one has a tremendous potential for adding to the base gift of the New Technology: Speedy, efficient delivery of information. Everywhere you look and everywhere you go, the world around you is swiftly becoming immersed in "total technology." Much of the progress in this arena of delivery systems has to do with renewed glances at the role of human creativity and innovation.

## Research And Innovation In Instructional Delivery Systems

### **Warning! Warning! Aliens Approaching! Fantastic Dreams And Cyberspace Nightmares**

The Information Age has taken us all by storm. Perhaps hardest-hit are education systems, worldwide. The ramifications for all areas of education are enormous. Already, whole new systems are being instituted in educational arenas, all over the planet. They are being funded by public and private means, by groups and individuals, by cities, provinces, and nations. New methods for distributing massive knowledge have literally taken hold, overnight. It may seem a bit drastic to yell out a warning, but, indeed, there ARE aliens approaching . . . in the sense that the digital age marches on us, previously unknown and unknowable. It steps out of the ether and materializes in a form we have never before seen. It has traveled silently among us, growing and implementing itself into our societies. It certainly sounds like a setting for a drama whose anti-heroes are alien beings!

It's wise to step back from this constant flood of information, and take a close look at the innovative spirit of the "worker bees" who have put all of this into action. It's prudent to carefully scrutinize the steps, the dreams, and the realities of our daily lives taking such unprecedented leaps. These, then, are the HEROES, and still, yet alien! For, who can understand the flow of such a collaborative project as the connected, *wired* world?

The fields of research, it would seem, have been allowed to run amok in a *Science-Fantastic Dream*. A few of the new systems also resemble a *Cyberspace Nightmare*. Each one carries its own history of development, of vision, and of a new dawning in the thinking process of humankind. Each new system brings its day of not just implementing change for individuals and groups, for education, business, and personal growth, but also the promise of indelibly engraving its name on the future of our race. Each system, each component, each building block has been the helpmeet of the collective architect. We all have a stake in this.

### **Of Visions And Dreams: Neglected Facts Are The Champions Of Innovation**

David Gelernter, professor of computer science at Yale, developer of the programming language called "Linda," and widely noted author, isn't ashamed to admit that his work acknowledges all of the "neglected facts" — everything, it would seem, that is blatantly ignored by most cognitive scientists. Those items that are non-analytic, non-problem-solving, and non-goal-directed (Denning & Metcalfe, 293). — the things that are products of "low-focus thought," of "free association," of relaxation, of meditation — of innovation. (117-119). Every day of our modern society heralds advances in technology that literally boggle the mind. Blessings or curses, just *where* do these things come from?

Of late, it is an incredibly difficult job to keep up with all of these marvelous new creations. Too much of a good thing, perhaps, *IS too much of a good thing*, and yet, this is the mode of the Age of Information. We can, and will, become accustomed to every push forward. Those on the inside of all this refreshing research and development know that the wellspring for the cutting-edge miracles lies in the realm of the mind and soul of . . . the creators. Companies far and wide are adding to the daily structure of their most innovative workers, a time to just reflect, study, ponder, think . . . and create. The information that arrives and the incredible systems that deliver it, are simply what dreams are made of.

There has been much written, often by scientists, about that "creative moment" in which true insight hits. These stories "tend to confirm what we know, that creative insights are associated not with concentration but with *unconcentration*." (119). It is akin to that moment of falling asleep — it cannot be willed or controlled, but is subject to *unconcentration* rather than concentrating on falling asleep. (119). It appears that true inspiration — genius, even — is born in that tiny continuum between analytical scrutiny and a more peaceful oblivion . . . the product of the neglected facts.

### **Creative Contenders: Systems Born In Our Image**

In his book, *Beyond Calculation: The Next Fifty Years of Computing*, Peter J. Denning stated, "For education at the end of the twentieth century, it is the best of times and it is the worst of times. More than ever, people see education as their great hope to help them overcome poverty, find good jobs,

change careers, and live meaningful and fulfilling lives. At the same time, they are becoming more demanding with consumerist expectations . . ." (268). The demand is high on the educational fields to produce more expert offerings, more counseling, more classes, and more assurance that graduates will be quickly employed. And, for less cost, no less! This writer believes that this has to be the height of the double-edged sword of benefits versus casualties of our new Information Age . . . with all of its antecedents for "instant gratification." Denning states it to perfection with, "This paradox has been brought about by the explosive spread of information technology, which is changing people's practices of work and relationships and their expectations and hopes for education." (268). With credentials stemming from institutions such as George Mason University, the NASA Ames Research Center, CSNET, and Purdue, it is easy to believe the insights of this distinguished writer. (290-291).

What we have seen over the course of the last 30 years is that information technology and computers have become intensely more important to the ongoing flow of business operations. New technologies have been born and have been applied to a myriad of business concerns. Our comprehension of what the digital components are and what role they have in supporting business has grown-up, as well. There has been a tremendously important shift during these decades toward a transfiguration of our discernment of computers from just a calculator or a storage device, to a whole new medium for unprecedented means of communication. It was in the early 1980s, when the personal computer poked its nose on the scene that we started to see computers as major role-players in a larger scene — they were so efficient with document preparation, illustration, and desktop publishing. For the growing numbers of people who were using computers for these tasks, the machines began to lose their "calculator image" and take their place as a powerful supplement to a person's creative works. (177).

David Gelernter proposed just one such radical idea, while he has been engaged in the pursuit of the goal of a machine made in the *mind's image*. He hasn't been contented with the established distinctions that have been made between the physical capabilities of computers versus humans. He has pondered one of the most singular of all human characteristics, which is the ability to extract new ideas out of non-guided, presumably random correlations — in other words, creativity! He has suggested how such an ability could be patterned into a computer program." (89). Recent evidence and the daily arrival

of news tends to back up this proposed concept, as word pours in concerning the systems at our very door that perform actions that defy belief! The *ubiquitous computing era*, where computers are literally everywhere, will be one where many computers will share the space of just one human. Some of these will be the dozens or hundreds that we use and rely on while surfing the Internet for just a short time. Others will be embedded — "in walls, chairs, clothing, light switches, cars — in everything. [Ubiquitous computing] is fundamentally characterized by the connection of things in the world with computation." (77).

It seems almost incomprehensible that computing has invaded, or infused, every corner of our lives. As persons concerned with learning environments, we definitely must take a closer look at how these systems have changed the face of education and especially the private pursuit of knowledge by individuals. Denning and Metcalfe, in *Beyond Calculation*, show us that the problem is enormous, and end with a *not*-optimistic prediction for our existing school systems:

"Through the CD-ROM, the cable TV channel, the modem, and the Internet, the microchip challenges the book, the library, and the classroom, offering new access to knowledge just in time to overcome the turmoil of the obsolescence it creates. Private businesses and educational brokerages are beginning to offer for-profit educational services. Traditional schools, colleges, and universities are having enormous problems coping with the changes." (268).

### **Computational Gifts Of The *gods*: Systems Are Omnipresent In Our World**

If we are admitting that all of this new technology is overwhelming, then it appears obvious that it might feel that way to the students who learn from us. It seems almost painfully obvious that in training students in the networking advances being made, they (like we!) need to learn to integrate the information on using these new systems with much hands-on practice! In this way, it's a bit like learning to swim. To overcome the trepidation of the water, you have to first get your face in it, and then you have to learn to "float." Finally, when the initial fears have abated by your newfound skills, you can dive in! (Harasim et al., 164).

One truly unique adventure to be found in the online *learning center* is that it has many places to experience social communication. This is such an essential component of any learning activity, and most surely one of the essential bits and pieces of a *collaborative* learning place. This is a spot for informal discourse, a place for the students to call their own, independent of the ties to any curriculum, a place to share ideas, goals, and frustrations. The effective "cafes" and "coffeehouses" that are arising are the ones that are learner-directed, moderated and cared for by the students themselves. (137). This is becoming a highly important part of the lives — social *and* academic — of many modern students as they work within these uncharted waters of new appliances in our lives. For the youngest participants, "text-based virtual realities foster literacy skills (reading, writing, and composition) and technical skills (keyboarding and spelling). For adolescent students, social interaction skills, interpersonal skills, and personality development emerge as primary activities. College students who are not computer science majors enjoy the opportunity to gain some computer literacy and try their hand at creating their own contributions to the cyberspace worlds." (52-53).

It is the intention of this writing to point out that recent years of intense research and innovation have forever altered the experience of the learner, no matter his or her age. The term, *ubiquitous*, like many "catch phrases," has almost become tiresome. However, as sojourners in this adventure, we **MUST** develop an understanding of how far-reaching the new systems are. They literally have left this planet with **NO** un-searched — or at least, un-searchable — corner! *Everywhere* simply means **EVERYWHERE**. That is where the new delivery systems have gone, or will shortly go. It's not like we haven't experienced this in earlier, yet very recent, epochs of history! Denning and Metcalfe point out that we have, indeed, been here before:

"The social impact of embedded computers may be analogous to two other technologies that have become ubiquitous. The first is writing, which is found everywhere from clothes labels to billboards. The second is electricity, which surges invisibly through the walls of every home, office, and car. Writing and electricity become so commonplace, so unremarkable, that we forget their huge impact on everyday life. So it will be with UC [*ubiquitous computing*]. Two harbingers of the coming UC era are found in the imbedded microprocessor and the Internet. It is

easy to find forty microprocessors in a middle-class home in the USA today. They can be found in the alarm clocks, the microwave oven, the TV remote controls, the stereo and TV system, and the kids' toys. These do not yet qualify as UC for two reasons: they are mostly used one at a time, and they are still masquerading as old-style devices like toasters and clocks. *But network them together, and they are an enabling technology for UC. Tie them to the Internet, and now you have connected together millions of information sources with hundreds of information delivery systems in your house. (77-78). (italics by this writer).*

This has got to be one of the most profound, and even scariest, predictions of all our readings.

### **The Calm In The Eye Of The Storm: Creating Worlds With Our Words**

For today's learner, what impact will new delivery systems have? Furthermore, as innovation proceeds at such a rapid rate, what will these systems become, and how may we keep pace? One answer almost has biblical implications, in that today's computer user literally creates his or her world with their own words! We speak it, and somehow, it comes into being.

For example, "MUSEcode . . . conveys the ability to build automata, computer simulations that can model real phenomena." (Kort, 1993; as cited in Harasim et al., 51). Some of this technology isn't a product of brand-new innovation — it has been around for quite a while, and has been explored by such agencies as MIT and long-founded online communities such as The Well. For instance, *MUDs* and *MUSEs* are real-time, text-based illusory worlds that reside in computer databases on the Internet. Rheingold, [1993] 45; as cited in Harasim et al., 51). He defines *MUDs* as "Multi-User Dungeons" — digital spaces where people can use words and programming languages to create melodramas, build fantastic worlds and all the objects to use in that world. They can learn to solve puzzles, invent diversions and the devices or gadgets necessary to traverse those lands. *MUSEs* were later modifications of the *MUDs*. A *MUSE* is a "Multi-User Simulation Environment," and shows the popularity of this particular form of creation. ALL players, not just wizards, are allowed the powers to shape the imaginary landscape and script. (Kort, 1993; as cited in Harasim et al., 51). It doesn't take a huge leap

of vision to see that this type of delivery system will only become more popular, or a newly enlarged and enriched version of the same!

For students, this arena provides the ultimate in devising one's own panorama for exploration. It also holds much promise for David Gelernter's proposed *radical idea* — while *MUDs* and *MUSEs* are not *machines made in the mind's image* . . . they certainly are products of those machines, and they are images conceived in the mind! The ultimate machine as envisioned by Gelernter perhaps will be a device chartered and placed into being within an imaginary landscape, a *MUD*, a *MUSE*, a land created by one's own words.

Some new learning devices are products created for the online environment and simply will not work in any other manner. They are indeed the "new kids on the block," and are forebears of learning tools yet to come, by systems yet not available. There is, for instance, a whole new twist available online, for the good old, steadfast thesaurus. The Java-powered *Visual Thesaurus*, created by Plumb Design, puts a premium on action, dynamic typography, and design. Marc Tinkler, Plumb Design's director of technology, says it was devised with "*Thinkmap*" technology and is an effort to allow navigation — not just content — to be a part of discovering conceptual meanings and relationships of words. This kind of navigation helps to understand a *connection* between things, in a visual way. This leaves behind the typically dense paragraphs of synonyms found in the average thesaurus.

The *Visual Thesaurus* floats words in space, and connects them with lines to represent various relationships. As the user clicks on words, ever-channeling closer to the meaning he seeks, more synonyms float into the scene, as he explores. The site is written in Java, so it works across different databases and platforms. *Thinkmap* is able to show linguistic word dependencies and associations that just cannot be manifested in a conventional thesaurus. Related words appear more brightly and swing closer into the user's vision, and less related ones waver and retreat. The learner is given an uncanny ability to reweigh, reprioritize, and reorganize this information, as well as his original quest, in a real-time manner.

Why is this such a defining factor for a tool of the Information Age? In this writer's opinion, this has to do with multimedia and its current and upcoming place in the new learning environment.

*Thinkmap* was the end product of Tinkler's effort to create a tool that lets people create a display of the underlying connections between diverse items. It allows users to understand data relationships, which is so intimidating to many. This innovative technology knits together the qualitative (the essence and character of things) and the quantitative analysis. (Oakes, *Synonyms*, 1998). It is not only a unique, innovative tool, but this writer sees this as a prototype of tools yet to come. New ideas will be delivered to the learner in a manner akin to the best of the creative capacities of both the human mind and the growing capabilities of the computer to perform in creative ways.

### **A Postmechanical Aesthetic Of Complexity: Gyration Of Technological Prowess**

At this point, it should be noted that there are *definitely* certain segments of our wired communities that are much more in tune to the arrival of these gyrations of technological prowess. The children — more than their technically-savvy parents, and even more than the innovators who are bringing on this delectable menu of options — seem to be the ones most in tune with, and the least fearful of what is going on! Today's children are almost snug with the idea that inanimate objects — the computers and systems that occupy their academic and pastime worlds — *just might be able to both think and have a personality!* In this writer's opinion, this also happens to be in the category of "imaginary playmates," so it isn't much out of character when compared to any age and era of children. This might be called a *humanistic* description of this particular example.

What becomes a bit unsettling is to rephrase this example into extreme technical proportions: "Today's computational models of the mind often embrace what might be characterized as a postmechanical aesthetic of complexity. Mainstream computer researchers no longer aspire to program intelligence into computers but expect intelligence to emerge from the interactions of communicating subprograms." (Denning & Metcalfe, 95).

"Whoa," the reader yells.

This needs to be broken out of its techno-jargon into words we can understand! *Postmechanical* would mean that it is happening in a time after the mechanical era — which would be our present, information-based time period. *Aesthetic*, here used as a noun, would indicate an inventive or

discriminating point of view — in this case, a view of *complexity*, or a complex state of being.

Therefore, this statement appears to suggest that we are in a time when we are somewhat awestruck by the complex systems around us, but that this is a hold-over from when we were trained to view things in a mechanical world (industrial-based) as opposed to a digital world (information-based).

If the mainstream computer researchers are truly no longer aspiring to program intelligence into computers but are expecting that intelligence will emerge from the interplay of the *subprograms*, then it appears that again, we are looking at emerging systems as being artifacts in keeping with Gelernter's vision! These computers may be relied upon to not only communicate intelligence — but to CREATE it.

### **Gleaning New Ideas: "I Learned It From My Doll!"**

The focus of this writing, then, has turned to things that, heretofore, have been commonplace subjects, but with a twist that could only have come about with the emerging systems of delivery. We have explored some of the new systems, and we have seen that they are very complex. It is commonly known that these systems have become a part of the efficiency of our world, and yet many are still in awe — or even fear — of these very systems. Perhaps it is because, as adults, we too heavily contemplate the biggest issues of life. Perhaps an understanding of and a comfort zone with these systems may only be approached when one looks at them through the eyes of a child! Even with the early examples of ubiquitousness cited above — writing and electricity — children have an ability to grasp the concepts and discard the points that are currently meaningless to them. For right now in her small life, a child may not understand what makes the television run. She only understands that it is *on*, and it is delivering information to her. Electricity's complex details are not the central issue. It certainly may be that children zone in on things that are NOT the "big problems," and therein lies their ability to concentrate on the finer details of observation, communication and learning. Following this train of thought, it may be that our most innovative researchers are the ones that adhere to a more childlike quality in their inquiries and development.

Speaking of big problems . . . have we now arrived at a time where the ubiquitous computer and delivery systems will bring information technology to a point *beyond* the big problems, right down to

the little things in life? Some would consider children's toys not as little *accouterments* in the war for becoming better informed, but as little *annoyances*. However, the fact remains that toys are a ground-level tool of childhood, from broom-straw dolls to intelligent Barbies who *DO* understand Mathematics. "Many researchers are working towards this emerging era. There are many companies integrating computation into everyday, well-known toys, including Mattel and Disney." (Denning & Metcalfe, 78).

Mattel now has an agreement with Intel to develop "PC-enhanced toys." For decades, the genre of horror fiction has depicted dolls or toys that walk, talk and kill. It might be with some trepidation that today's parent would view this new generation of high-tech playthings for kids! The reality is that there probably isn't a better introduction to the personalized power of computing than to acquaint a child with higher concepts through the mode of their "best buddy."

These toys will be packed with semiconductors, and will use both current technologies, and also future technologies — with components built in that will some day utilize abilities that are still on the drawing board. Mattel designers and Intel engineers plan to collaborate in creating new systems and "play experiences." Mattel will kick in its experience in design, production, marketing, and distribution of children's toys. Intel will bestow its *savviness* in PC processing. Their line of thinking is fairly sound. The smarter and more interactive the toys become, the better they will foster children's thinking skills during play. Intel's vision is to work with toy companies to enable this extraordinary new category of playthings that are more fun and more intelligent because they harness the power of high-end computers in the home. (SBN Staff, Semiconductor Business News, 1998).

Aside from the fact that recent technology itself, has brought us the special effects that gave us dolls who murder, and hockey gear for criminally-insane teenagers in bloody, Friday-the-13<sup>th</sup> death scenes — we *do* have much to be thankful for. With the opening of such a new epoch of high creativity in the arts, it was inevitable that it would spill over into the toy world! To keep a brand fresh — whether it's movies or toys — it has to reflect the attitude and trends of the culture. We're moving toward technology in every realm. The "Chuckie Dolls" and the "Jasons" of the cinematic world reflect that. Certainly Barbie has to reflect it also, in order to maintain her visibility!

The creativity and imagination of children surely could only be enhanced by high-tech advances. Mattel's plans for focusing on magnifying their current, stand-alone toys will be by testing new ways to download information to them from a PC. The fact that a toy could tap into a computer system means that they would have more capacities for voice recognition, for connecting to the Internet to get more information, and for allowing more games to be downloaded into their internal components. Built into this marketing trek is the fact that computerized toys will convince more parents to purchase computers. It is obvious that technology is appealing to children, but the interesting side-thought to this is that children have an innate ability to see the "play value" of the computer, as well as the tool value. About one-half of the people who buy computers for their home are currently families with children. Probably one main reason they buy them, is for children. (Brown, 1998). As this technology takes a larger hold in communities, this will provide a strong base for bringing yet more computing prowess into the home. Indeed, *they* are everywhere. We *will* learn to adopt all these delivery systems into our lives, even if we end up learning how and *why* we are doing it, from our children.

### **Constantly Questioning: But With Which Half Of Our Brain?**

With all of the technological demands brought about in the short (yet eons-long!) history of the Internet and its related delivery systems, the world has gone into hyper-learning mode. It is evident that, rather than leaving segments of society out of the flow, including children, this massive suite of offerings tends to extend itself to all groups. In many ways, it almost appears to over-extend or even engulf people in the wake of its arrival. What is an answer to this complicated situation? In our readings, we were introduced to a concept called *calm technology*. Authors Mark Weiser and John Seely Brown gave us a piece of the solution, which is that when "our world is filled with interconnected, imbedded computers, calm technology will play a central role in a more humanly empowered twenty-first century." (Denning & Metcalfe, 85).

Many people face the daily task of dealing with information overload. If we are totally surrounded by computerized components, how could it then be, that MORE information could bring calmness? Again, Weiser and Brown give us a hint. In a world where we seriously contemplate the

possibility that the height of innovation may be to come up with a computer that is capable of human-like, generative abilities to CREATE, independently of a human programmer — we indeed sit on the brink of an age of contradiction. (85). That seems to be an element of the Information Age: It is filled with conundrum and mystery. That which appears to be a paradox could actually become the basis for a new piece of technology. Therefore, it isn't that much of a contradiction to say that the way to become synchronized to *more* information is to *pay less attention* to it. (84-85). The end result will be that computers will do what they have been created to do, with perhaps some innovative twists of their own. This will leave more time and mental sharpness for humans to contemplate the next steps of innovation!

Research is not the goal of an activity, but rather, the means for achieving that goal. The investigation *cannot* be the goal. Finding what you seek *is* the goal. Because the product of computer science research is innovation, it — and the research itself — are measured by their results. (259-260). In our own search concerning innovation and research as they apply to delivery systems, we are caught in a "round-robin" of sorts. Our research leads to the research of others. Their innovation becomes our own innovation — in the sense that their results (a highly technical system) provide the avenue (a highly technical system) to achieve our results. We are all involved in a continually changing scenario of bright devices delivering massive information. The methods for research, then, are often also the final product!

Since the paradox is impossible to resolve, we are left with accepting that these devices are, in the end, *enabling* us. It is time to *accept that for what it is*. Then, and only then, will this technology transform into what we have refused to let it be . . . calming because it is empowering. In the world of work, this is often called an ability to delegate tasks. No one ever said that the task had to be given to another human!

In Beyond Calculation, Paul Abrahams said, "[T]here is the tantalizing prospect that smart machines might someday be able to advise us on how to improve our lives and our society — and also know how to get us to take their advice. It may be that humans just aren't smart enough to figure out how to deal effectively with their own problems. If computers can ever do that for us through advances in artificial intelligence, they will truly have become the most important artifacts humanity has ever

conceived." (147). This writer would like to point out that computers *probably* have already achieved that particular status!

The true nature of innovation is that we are constantly questioning existing knowledge so that we can provide something new. Humans innovate in terms of concepts, methods, materials, or whatever else is *needed*. (260). The truly mysterious aspect of this line of thought is whether or not we have the capacity to endow our flesh and blood, base resources to the computers that serve us.

Everywhere we turn, the concept of the CYBORG, the partnership of human and machine, haunts us . . . or, at least, it refuses to leave the perimeters of our camps. Gelernter said that "[w]e understand half the mind fairly well and the other half barely at all . . ." (117). It is almost embarrassing to admit that perhaps the best insights and products of humankind happen with the part of our brains that are the most unknown. It's almost like saying that we don't really "know" what we are doing! Even that concept holds great promise, however, for it is in those "ethereal" and "lost" moments, in times of great need, that innovation abounds and solutions are found. As we bond more closely with our computer counterparts, even the label "cyborg" will lose meaning. These extensions of our selves are part of the creation of this great interconnectivity that we all are experiencing.

It isn't important to place labels anymore. It is vital, however, that we restructure, broaden and enrich our lives, with always an eye to NOT throwing out the baby with the basket. In the case of education and general academic history, we should never entertain eliminating huge chunks of what has gone before. That history has brought us to HERE, and we are obliged to give it a huge amount of respect.

Current systems deliver the best *now* available. In a mode of restructuring and broadening these elements to enrich our lives, the systems also will experience growth. If, indeed, our finest creative moments are done in the unknown portions of our brain, we may also take comfort in the supposition that there has always been truth in the old adage, "*I could do it with half a brain!*"

## References

**Brown, Janelle.** (1998). *Mattel turns Barbie into PC-enhanced geek*. Wired News: HotWired. Issue: Feb. 11, 1998. [Online]. Available: <http://www.wired.com/news/news/culture/story/10213.html>

**Denning, Peter J., & Metcalfe, Robert M.** (1997). Beyond calculation: The next fifty years of computing. New York: Copernicus/Springer-Verlag New York, Inc.

1. **Abrahams, Paul W.** Chapter 11: *A world without work*.
2. **Denning, Peter J.** Chapter 20: *How we will learn*.
3. **Evans, Bob.** Chapter 13: *The stumbling titan*.
4. **Gelernter, David.** Chapter 9: *The logic of dreams*.
5. **Tsichritzis, Dennis.** Chapter 19: *The dynamics of innovation*.
6. **Turkle, Sherry.** Chapter 7: *Growing up in the culture of simulation*.
7. **Weiser, Mark, & Brown, John Seely.** Chapter 6: *The Coming Age of Calm Technology*.

**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, MA: MIT Press.

1. **Kort, B.** (1993). *The MUSE as an educational medium*. Available on musenet.bbn.com in the anonymous FTP Directory. (as cited in Harasim, Hiltz, Teles, & Murray, 1995).
2. **Rheingold, H.** (1993). *The virtual community: Homesteading on the electronic frontier*. Reading, MA: Addison-Wesley (as cited in Harasim, Hiltz, Teles, & Murray, 1995).

**Oakes, Chris.** (1998). *Synonyms in Space*. Wired News: HotWired. Issue: Feb. 6, 1998. [Online]. Available: <http://www.wired.com/news/news/technology/story/10113.html>

**SBN Staff, Semiconductor Business News.** (1998). *Intel and Mattel's PC-based toys are child's play*. CMPNet: Feb. 6, 1998. [Online]. Available: <http://www.techweb.com/investor/story/>

INV19980206S0003