ICT in Preservice Teacher Education: Information Overload and Paradigm Shifts (Draft 6/24/05)

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This Workshop: http://darkwing.uoregon.edu/~moursund/dave/SIGTE2005.html.

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> This document covers the first part of the workshop. People who arrive late to the workshop can read this document and quickly catch up with what is going on.
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> Some of the facilitators in this workshop will use the term ICT (Information and Communication Technology) rather than the term IT (Information Technology). ICT is the generally preferred term outside of the United States.

Getting Started

This workshop is sponsored by ISTE's Special Interest Group for Teacher Educators (SIGTE, n.d.). The workshop is about preservice teacher education in the field of Information and Communications Technology (ICT). This workshop has three main goals:

1. To provide an environment in which presenters and participants can share their knowledge and experience.
2. To improve the ICT education of preservice teachers.
3. To improve the education of PreK-12 students.

The latter two goals are lofty and far-reaching. However, keep in mind the ancient proverb: "The longest journey begins with a single step."

This workshop is designed to promote and facilitate discussion and sharing among all of the participants. The topics, facilitator/presenters, and tentative order of presentation are:

1. ICT assessment of entering preservice teachers. Rachel Vannatta, rvanna@bgnet.bgsu.edu, Bowling Green, Ohio.
2. “Traditional" ICT in education courses. Tweed W. Ross, twross@ksu.edu, Kansas State University.
3. ICT integrated into non-ICT courses. Louanne Smolin, louannes@uic.edu, University of Illinois at Chicago.
4. Online, hybrid, and computer-assisted learning. Donna Russell, russelldl@umkc.edu, University of Missouri-Kansas City.
5. ICT in teacher education outside the US. Sandra Turner, turners@ohio.edu, University of Ohio.
6. The future of ICT in preservice education. David Moursund, moursund@uoregon.edu, University of Oregon.

To get us started, I would like each person in the room to tell a little about them self and indicate their involvement with the field of Information and Communication Technology (ICT) in teacher education. After that, I will present an introductory overview of the field of ICT in education, and then we will follow the topic agenda given above. We will have lunch available at noon.

Some Foundational and Overview Ideas (Dave Moursund)

This section provides one possible starting point for thinking about local, national, and global aspects of ICT in education.

Paradigm Shifts

Throughout today's workshop, we will be talking about possible ICT-facilitated paradigm shifts in local, national, and global education systems.

par·a·digm n

1. a typical example of something
2. an example that serves as a pattern or model for something, especially one that forms the basis of a methodology or theory

The development of agriculture beginning about 11,000 years ago was a major paradigm shift from the hunter-gatherer paradigm. Our educational system came about because of a paradigm shift from an *oral tradition* to a *written tradition* that began more than 5,000 years ago. Our current concept of science and scientific method are a paradigm shift from our knowledge and belief system of a few thousands ago. The Industrial Age is a major paradigm shift from the Agricultural Age. The Information Age we are now in is a major paradigm shift from the Industrial Age.

Over the past 5,000 years, our educational system has adjusted to (accommodated to, implemented) a large number of paradigm shifts. Here are a few examples in the US:

1. Free public education is available to all students, and many years of schooling are required. This is a huge change from 200 years ago.
2. Students now routinely use ballpoint pens (invented in the 1930s) to write on paper, and many use a word processor for writing.
3. Scientific method is now a routine component of science education (Khun, n.d.).
4. The 1975 Education for All Handicapped Children Act (Public Law 94-142) led to a major paradigm shift in the education of students with the handicapping conditions specified in the law.
5. Schools make routine use of chalkboards and/or white boards, projection display systems such as overhead projector and/or video projector, broadcast radio and television, and video and audio recordings.
6. Four-function calculators and much more powerful equation solving and graphing calculators have come into routine use in the math and science curriculum.

7. Card catalogs have largely disappeared from libraries, and access to the Web has become a common addition to or replacement of physical libraries.
8. Highly interactive, asynchronous distance learning and assessment are making good progress toward being a major paradigm shift in teaching and assessment.

Models of Educational Improvement

Figure 1 illustrates an incremental, “continual improvement” model for improving education. This diagram also illustrates the idea of Upper Limit Theory (Branson, n.d.). Beginning in the mid 1980s, Robert Branson has argued that the teaching centered model of education that prevails in the United States and many other countries is bumping into its upper limits. Now, nearly 20 years later, we can look back over nearly 40 years of national data on K-12 education and see that little progress is occurring in the overall quality of student performance in areas such as reading, writing, and math. Branson argues that on average, our educational system was performing at approximately the 95% level of possible performance by the mid 1960s.

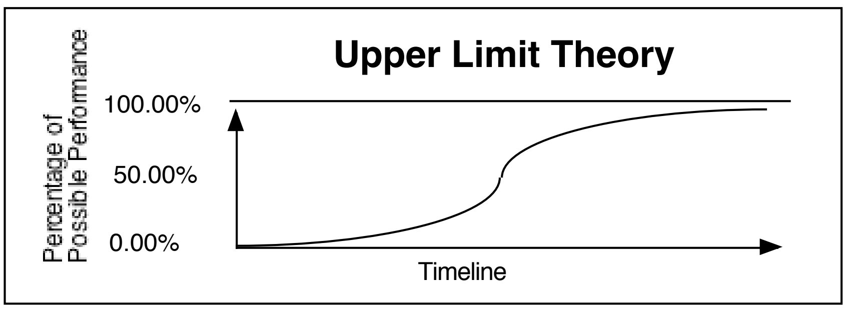

Figure 1. Continual improvement model and upper limit theory.

As the continual improvement model begins to bump into upper limits, paradigm shifts often occur that open up new, higher level upper limits. Here are two ICT-related examples. Making smaller vacuum tubes that have a longer life and produce less heat gave way to transistors. Making smaller and more quickly responding magnetic cores for use in primary computer memory gave way to transistorized memory. Figures 2 and 3 help to illustrate the idea of a successful paradigm shift.

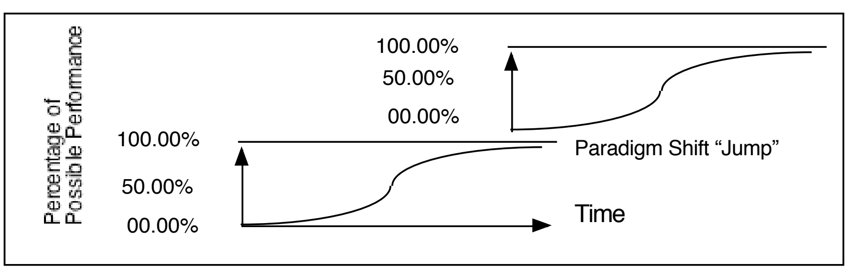

Figure 2. Paradigm shift jump to a “higher “ level, opening room for more incremental change.

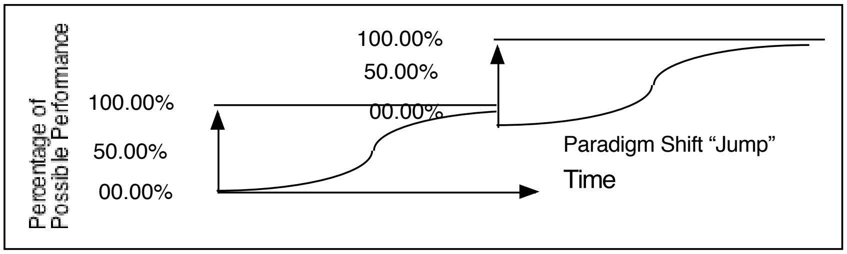

Figure 3. Paradigm shift jump to a "lower " level, opening room for more incremental change.

In his writings, Robert Branson argues that distance learning and computer-assisted learning are the keys to a new paradigm that will move our educational system well above its current performance levels.

My personal opinion is that he is partly correct. However, the very heart of ICT is its aids to solving problems and accomplishing tasks in all academic areas. Thus, the paradigm shift I am looking for involves the through integration of ICT throughout curriculum, instruction, and assessment. It involves helping students to learn to work with ICT as an aid to solving problems and accomplishing tasks. It involves having students become independent, life-long learners who can adjust to the rapid pace of technological change that will occur during their lifetimes. This learning will occur in an environment of highly interactive computer-assisted learning delivered over computer networks and embedded in the computer applications one uses. I believe there is a global need for this paradigm shift.

Global Communication—The Internet and the Web

Marshall McLuhan (1911-1980) used the term *Global Village* in talking about how the developing global telecommunications network was changing and would change the world.

> Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. (Marshall McLuhan, Understanding Media, 1964)

Notice the 1964 date of this quotation, and compare it with the 1969 establishment of the first four nodes of what we now call the Internet. The initial network consisted of 50 Kbps circuits linking University of California at Los Angeles, SRI (in Stanford), University of California at Santa Barbara, and University of Utah.

In less than 50 years, ICT has brought us the Internet and Web, microcomputers and easily transportable wireless computers, cell telephones, handheld computer games, portable music storage and playback devices, and so on. Satellites and fiber optics have helped to create a relatively inexpensive global telecommunications system. ICT has contributed substantially to brain science and to the human genome project.

There are many ways to talk about how ICT is changing the world. As an education-related example, think about the Web and Grid Computing as an interactive Global Library. Grid Computing is the worldwide sharing of the compute power of millions of computers connected to the Internet (Grid, n.d.). This Global Library is designed for the storage, **processing**, and retrieval of information. One aspect of this Global Library is that it can solve a wide range of problems and accomplish a wide range of tasks. That is, the Global Library is a lot different than a hard copy book. The Global Library is steadily growing in its ability to carry out "intelligent-like" tasks that previously required the work of humans.

Like any technology, the Global Library has its plusses and minuses. The Global Library is both a powerful aid to our current educational system and a powerful challenge to our current educational system. More and more problems can solved by merely looking up a solution process in the library and having the computer carry out the steps needed to solve the problem. If a computer system can solve a type or problem (or, accomplish a type of task) that students have previously learned to do by hand, how should this affect the curriculum?

A Shrinking World: Thoughts from Robert Friedman

Robert Friedman (2005) has recently written a book that provides a modern perspective of how global communication is affecting the global market place and employment. Quoting Friedman (Chanda, 2005):

> I would argue that there have been three great eras of globalization. One I would call, for shorthand, Globalization 1.0. That was from about 1492 till 1800 when we saw the beginning of global arbitrage... Columbus discovers America, so basically that era shrunk the world from a size large to a size medium. The dynamic element in globalization in that era, was countries globalizing, for imperial reasons, for resources.
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> The second great era was 1800 till the year 2000 - it just ended. And that era shrunk the world from a size medium to a size small. And that era was really spearheaded by companies globalizing, for markets and for labor. …
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> And Lexus [one of my earlier books] was wonderful for what it was, but it was out of date! It couldn't tell the whole story anymore, it couldn't explain the world, because what I really found in going to India was that we'd entered Globalization 3.0. And it's shrinking the world from size small to size tiny, and flattening the global economic playing field at the same time.

We are living at a time of rapid technological change that is affecting the nations, companies, and individual people of the world. Moreover, the pace of this change is increasing. In June of 2000 Ray Kurzweil said: “We’ll see 1,000 times more technological progress in the 21st century than we saw in the 20^{th}.” (Dixon, 2000). Kurzweil is a prominent computer scientist, writer, entrepreneur, and futurist. His prediction corresponds roughly to a doubling in the rate of technological progress every 11 years during the 21^{st} century.

The “Information Overload” and “Information Underload” Problems

People often talk about the “information overload” problem. They point to the steady blitz of ads, sound bytes from the news services, technological progress, the Web, and email as examples of information overload.

I think that actually we have an **information underload** problem that consists of two parts:

1. We do not have enough information. In our everyday lives, we face a very large number of complex problems and decision-making situations that we do not have enough information to adequately address.
2. Both the human components and the non-human components of our information retrieval systems are inadequate to the task of retrieving, processing, and appropriately using the rapidly growing amount of information that is available. Our current educational system is not doing a good job in preparing students of make good use of the Global Library and other aids to information retrieval and use.

Humans have a very long history of addressing this information underload problem. More than 5,000 years ago reading, writing, and arithmetic were developed as aids to the storage, processing, retrieval, and use of information. Schools were developed to help people gain the knowledge and skills needed to take advantage of the 3Rs. The information underload problem was addressed by the better accumulation and sharing of information.

Since then there has been a "race" between the growth in the cumulative collected knowledge and the growth in aids to storing, processing, and making effective use of this knowledge. Many people argue that the collected knowledge is growing exponentially, now doubling in perhaps as short a time as 5-10 years.

In summary, the real problem that we educators and teachers face is helping students to learn to retrieve, process, and appropriately use accumulated information. In this endeavor we must deal with:

1. A continuing exponential growth in the totality of accumulated information.
2. Very rapid progress in the improvement of ICT systems and other (non-human) aids to the input, storage, processing, retrieval, and use of information. This rapid progress facilitates automation of many tasks that previously have been done by humans making use of less powerful aids. It also makes possible "off shoring" of many information processing jobs.

Education and the Information Underload Problem

Since the first commercial mass production of the UNIVAC computer beginning in 1951, the cost effectiveness of computers has improved by a factor of more than two billion. Computerization of many different manufacturing and information processing tasks has moved us from the Industrial Age into the Information Age. The Global Library is steadily growing in size and processing power.

While the totality of accumulated information has been doubling every 5 to 10 years over the past few decades, the capabilities of ICT systems have been doubling every 1 ½ to 2 years (Moore's Law, n.d.). Thus, we seem to be engaged in a race. The rapid progress in ICT is being pitted against the rapid growth in the totality of accumulated knowledge. This situation is somewhat confused by the fact that ICT is contributing substantially to the research that is leading to the rapid increase in knowledge.

Unfortunately, the education component of addressing this racing situation is not doing well. Our informal and formal education system has not yet shown that it can adequately prepare students for this rapidly changing information underload problem. Some of the reasons for this poor performance lie in our preservice and inservice teacher education systems.

Certainly, we have made some progress. Almost all preservice teachers now enter teacher education programs with some ICT knowledge and skills, and most own or have ready access to a computer. Essentially all preservice teachers in the US make regular use of ICT for communication, information retrieval, and writing papers. IST is a component of every teacher education program in the US and in many other countries.

However, the gap between the education-related ICT knowledge and skills of newly certified teachers and the capabilities of the field of ICT in Education is growing. We are making ICT in education progress, but we are falling further and further behind! PreK-12 students are not getting an education that adequately prepares them to deal with the information underload problems they face now and the steadily growing information underload problem they will face in the future.

If we keep doing what we have been doing, we will continue to fall further behind. This reminds me of the old adage: "The hurrier I go, the further behind I get." We need a paradigm shift. This shift will not occur if it further burdens teachers who are already overloaded.

Final Opening Remarks

As you listen to and participate in today's presentations, you will be exposed to a variety of ICT in preservice teacher education problems and possible solutions. Think about these from the points of view of a continual improvement model and a paradigm shift model. Pay special attention to issues of preparing preservice teachers so that they can take a leadership role in ICT-related paradigm shifts that in the process of occurring in our schools or seem likely to begin in the near future.

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