Information and Communication Technology-Based Paradigm Shifts in Higher Education 6/13/05

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This material was presented to a group of 30 UO faculty members on 6/13/05. It has subsequently been somewhat expanded to reflect some ideas covered during the presentation that were not in the original document. I have also added some material that should have been in the original document, but wasn't. The material given here is sufficient for a workshop for up to three hours in length. Web access to this document is available at http://darkwing.uoregon.edu/~moursund/dave/Workshop6-13-05/Present%206-13-05.html

Throughout this document, you will see additional boxes such as this one. These are comments about what transpired during my session at the UO .workshop. A few of my comments draw upon what happened last year when I presented a somewhat similar session to a somewhat similar weeklong UO workshop for faculty.

Abstract

This presentation is a small part of a weeklong workshop for University of Oregon faculty who want to learn more about educational uses Information and Communication Technology (ICT). It provides an overview on ways to use ICT to:

- Significantly improve the education of our students.
- Help faculty deal with some of their (changing) professional responsibilities.

To do this, we examine some of the fundamental goals and methodologies of education, and we will look for possible major paradigm shifts that are facilitated by ICT and research in education.

While most of the workshop is "hands-on," this is not a hands-on-computers session. Rather, it is a "brain and minds-on cognitive session designed to help you build foundations for your future learning and use of ICT.

If the ideas covered during this session interest you, then you may want to read some of the free books and other materials on ICT in education that I have written and that I make available at http://darkwing.uoregon.edu/~moursund/dave/Free.html.

Introduction

My background includes: a doctorate in mathematics; being on the Math Department faculty at Michigan State University and the UO; helping to start the Department of Computer & Information Science at the UO and serving six years as its first Head of Department; many years of work in math education, computers in education, and brain science; and somewhat over 20 years in the College of Education. In addition, I started

this countries largest professional society for computers in precollege education and ran it for 19 years.

This is a highly interactive, "minds and brains-on" session designed to explore roles of Information and Communication Technology (ICT) in:

- Significantly improving the education of our students.
- Significantly improving the quality of our professional lives.

During this presentation we will explore roles of ICT in having a useful and increasing level of expertise in the various disciplines taught at this university. Each discipline has its owe ideas on what constitutes a high level of expertise. Words such as critical thinking, higher-order thinking, creativity, and problem solving are often used when talking about a high level of expertise.

While there are major differences among the various disciplines one can study in a college or university setting, they share much in common. For example, they draw upon communication skills such as reading, writing, speaking, and listening. They draw on math as a language and as an aid to representing and solving problems. They build upon the total accumulated knowledge, skills, and experiences we assume students have acquired in their precollege education.

Increasingly, students entering higher education have had years of experience in various aspects of ICT. Indeed, I sometimes have the feeling that come of our students are unable to walk across campus unless they are talking on a cell telephone. Many others seem unable to get through the day without spending quite a few hours playing electronic games. Perhaps more important from a university faculty member point of view, essentially all students know a little bit about using a computer for word processing, email, and searching the Web.

I used the term "a little bit" because the ICT knowledge and skills of most of our students is very weak. At the same time, there are many students whose ICT knowledge and skills far surpass that of the typical faculty member. This adds a burden to faculty who want to integrate routine use of ICT into their courses, much in the same manner as they routinely integrate the three Rs into their courses.

In addition to tools such as a word processor and a Web browser, a number of different ICT-based aids to teaching and learning are another aspect of ICT in education. For example, computer-assisted learning is slowly but steadily becoming a significant aspect of instructional delivery at all levels of education. The "Help" features in computer software provide simple example of "just in time" computer-assisted instruction. Distance learning, delivered over the Internet or via local area networks, represents a major paradigm shift in education. Distance learning is bringing a type of competition to higher education that it has never seen before.

Unifying Themes in Today's Presentation

The primary focus in this presentation is on how to make appropriate use of ICT in helping to improve the quality of education that students obtain at the UO. In brief summary, we can improve education by appropriate use of ICT to:

1. Improve teaching—for example, improve the effectiveness of faculty and other components of the teaching endeavor.
2. Improve the curriculum—for example, by deleting less valuable content and adding more valuable content.
3. Improve assessment—for example, improve feedback from assessment that is made available to students and faculty.
4. Improve students—for example, help students to become better learners who take more responsibility for their learning.

Many other items can be added to this list. For example, we can improve: buildings (better temperature control); instructional infrastructure (more library materials, more computer labs); diversity; etc. However, for this presentation, let's just focus on the list of four ideas.

Activity 1: (Whole group) Select the two items on this list that you feel are most apt to make a significant contribution to improving the quality of education that students get at the UO. We will vote by a show of hands. Each person gets two votes. Just for the fun of it, think about what you know of good research that supports your votes. Think of this as a "warm up" activity designed to get us started thinking about improving education.

> This proved to be an effective activity when I used it on 6/13/03. Item #4 (improve students) got the most votes, while #1 (improve teaching) was a reasonably close second. Item # 3 (improve assessment) got quite a few votes, while item # 2 (improve content) got very few votes.
>
> My personal first place vote goes to improving content, and my second place vote goes to improving teaching. ICT can make a huge contribution to these two aspects of education. For example, ICT can solve or help solve many of the types of problems that students are learning to solve by hand. ICT makes information retrieval much easier and faster, cutting down the need for so much rote memorization. And, computer-assisted instruction, delivered through the routine compute tools one uses and via asynchronous, interactive distance learning, is beginning to make a significant contribution to instruction.

Problem Solving is Fundamental to Every Discipline

ICT provides aids to problem solving in every academic discipline. By problem solving, I include:

- Question situations: recognizing, posing, clarifying, and answering questions.
- Problem situations: recognizing, posing, clarifying, and solving problems.
- Task situations: recognizing, posing, clarifying, and accomplishing tasks.
- Decision situation: recognizing, posing, clarifying, and making decisions.
- Using higher-order, critical, creative, and wise thinking to do all of the above. Often the "result" is shared or demonstrated as a product, performance, or presentation.

A somewhat different way to describe what I mean by problem solving is to refer to Bloom's Taxonomy (Bloom's Taxonomy, n.d.). The upper end of Benjamin Bloom's six-part taxonomy consists of analysis, synthesis, and evaluation. Thus, for example, you may want to include these three words in each of the first four bulleted items listed above.

In addition, you may want to change the vocabulary to better fit your own discipline. What words do artists, musicians, and poets use in talking about the challenge of capturing the essence of a sunset in their chosen media?

Activity 2: This is a whole group activity. Each participant is to think about their academic discipline(s) from the point of view of problem solving. Ask yourself:

1. To what extent do I teach problem solving?
2. Am I satisfied with the progress my students make in problem solving?"

We will spend about five minutes sharing insights from people from different disciplines about the nature and extent to which they teach problem solving in their courses. In this discussion, we will also likely encounter the idea of discipline or domain-specificity versus discipline or domain-independence aspects of problem solving. That is, what aspects of problem solving cut across many different disciplines, and what aspects are quite specific to a particular discipline?

> This is a key activity in the presentation. It lays the groundwork for a focus on problem solving throughout the presentation. At the 6/13/05 presentation, several participants were bothered by the term "problem solving." Some disciplines use other vocabulary in place of the term problem solving. Thus, I have reworded the definition a little, and I have inserted a little more text to help make it clearer that I am talking about all disciplines.

What is an Academic Discipline?

From my point of view, each academic discipline can be defined by a combination of general things such as:

- The types of problems, tasks, and activities it addresses.
- Its accumulated accomplishments such as results, achievements, products, performances, scope, power, uses, impact on the societies of the world, and so on.
- Its history, culture, language (including notation and special vocabulary), and methods of teaching, learning, and assessment.
- Its tools, methodologies, and types of evidence and arguments used in solving problems, accomplishing tasks, and recording and sharing accumulated results.
- The knowledge and skills that separate and distinguish among: a) a novice; a person who has a useful level of competence; c) a reasonably competent person; d) an expert; and e) a world-class expert. Each discipline has its own ideas as to what constitutes a high level of expertise within the discipline and its sub disciplines. See Figure 1 for a slightly different way of looking at expertise.

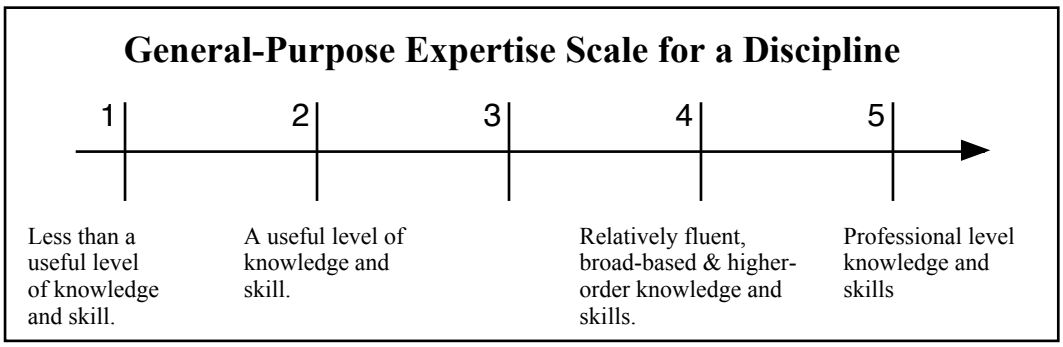

Figure 1. General-purpose expertise scale.

The roles of ICT vary from discipline to discipline. However, within any academic discipline, we can find significant examples of appropriate and useful roles of ICT within each of the five bulleted areas listed above. In this presentation, the focus is on roles of ICT in problem solving and expertise.

Activity 3: In groups of two or three, each person share by "thinking out loud" about an academic discipline they know well, and how ICT fits into this discipline in the five bulleted areas.

> As noted at the beginning of this presentation, there is far more material than can be covered in the 75 minutes we had available on 6/13/05. I usually design my classes and workshops in that manner. As the class or workshop proceeds, I then feel free to deviate from my outline, leaving out some of the material and adding in other material. In such settings, I try to achieve an appropriate balance between content and process. Often, the interaction and following where the interaction seems more important to me than "covering" a predetermined content.

Computer-Assisted Learning and Distance Learning

This particular presentation includes only a modest focus on computer-assisted learning (CAL) and distance learning (DL). These to aspects of ICT have begun to merge, as CAL is delivered in the form of asynchronous distance learning.

Since the development of reading and writing, it has been possible to store much of the accumulated knowledge of a discipline in a somewhat transportable, somewhat permanent mode. However, knowledge that a person understands and stores in his or her head is in some sense a lot different than data and information stored in a static form in a book.

Once books were developed, however, education was changed. The oral tradition was supplemented by the written tradition. A person could learn from a human teacher, but a person could also learn from books. Clearly, a book lacks many of the characteristics of a good human teacher. Now, however, we can computerize the book, put it into a multimedia format, and make it highly interactive. We can add some "artificial intelligence" to the interface between the learner and the CAL materials. The result is that information can be stored in a manner that aids greatly in its learning and use. That is a major paradigm shift, and it is occurring in every discipline.

The history of use of computers to teach is now close to 50 years old. To date, CAL has had more success in "training" than it has had in "education." Of course, it is very hard to draw a lime between training and education. Nowadays, CAL plays a significant

role in the education systems used in quite a few precollege schools and in some institutions of higher education.

By 1994, there was a meta-meta study CAL (Kulik, 1994). This produced strong evidence of the effectiveness of CAL, with students (on average) learning via CAL 30% faster and somewhat better than students in control groups. Current research and development work in CAL tends to include a focus on Highly Interactive Intelligent Computer-Assisted Learning (HIICAL). There is a slow but significant trend toward producing HIICAL materials that can teach better than human teachers. The comparison is between what a teacher can achieve in a regular-sized class situation versus what HIICAL can achieve in a one-on-one situation.

Activity 4: In groups of two or three, share your knowledge about CAL and DL as it is currently used for teaching and learning in your discipline.

> This whole section and its activity was added after the 6/13/05 presentation. During the presentation the topic of CAL and DL came up form time to time. In my original planning, I had decided to downplay these topics. I realize now that this was a mistake.
>
> Many faculty members find CAL and DL to be somewhat frightening. It is easy to see reasons for this. Currently, higher education is mainly a craft industry. This craft industry paradigm does not make good provisions for substantial increases in teacher productivity. Contrast increases in teacher productivity with the factor of 50 increases in agricultural productivity and in industrial productivity that have occurred in the United States during the past 200 years.

Models of Educational Change

Here are three common models of change:

1. **Continual improvement model.** Focus is on always being involved in small, incremental improvements that are accumulative. See Figure 2. Notice the idea of an upper limit. This is discussed more later in this section.
2. **Paradigm shift model.** Focus is on larger, "discontinuous," changes. See Figures 3 and 4. Often these are disruptive; often attempts to implement such changes are not successful. There is a lot of research literature on attempts to implement major educational changes.
3. **Fighting alligators.** (This is an attempt at humor, designed to suggest there are many other models of change.)
    a. "When you are up to your neck in alligators—that **is not** the time to start thinking about draining the swamp."
    b. "When you are up to your neck in alligators—that **is** the time to start thinking about draining the swamp."
    c. The swamp is a protected wetland, and alligators are a protected species. Rethink and reframe the problem; select a different metaphor.

Figure 2 illustrates an upper limit theory that often limits the success of the continual improvement model.

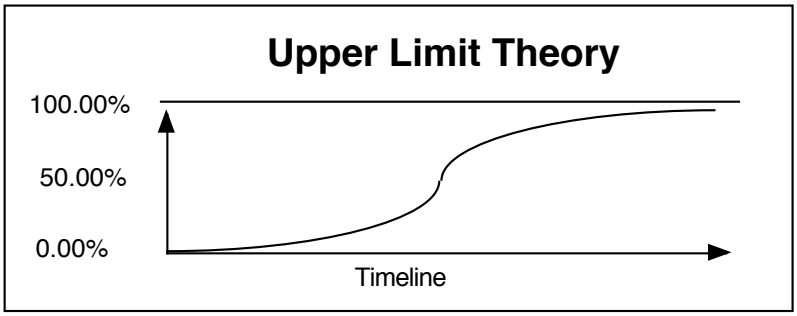

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Figure 2. Upper Limit Theory

Figures 3 and 4 help to illustrate the results of a successful paradigm shift.

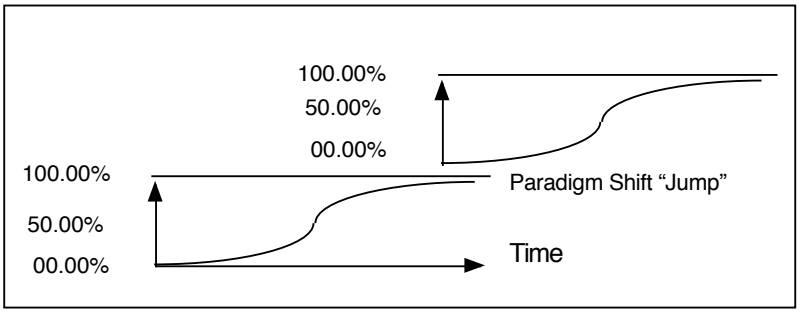

Figure 3. Paradigm shift jump to a "higher " level, opening room for more incremental change.

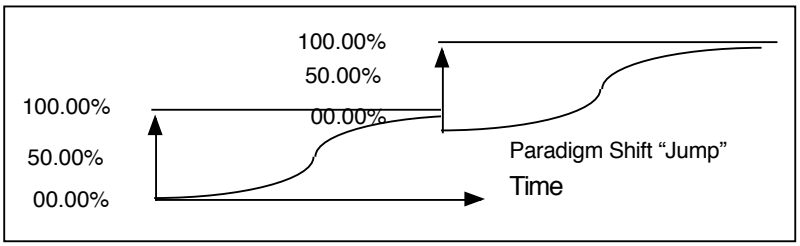

Figure 4. Paradigm shift jump to a "lower " level, opening room for more incremental change.

Figures 2, 3, and 4 all include the model of continual small, incremental improvements. In the late 1980s, Robert Bransford published a number of articles about upper limit theory as it applies to precollege education (Bransford, 1987). He argued that the current teaching centered and teacher-centered form of our precollege education system had progressed above the 95% level in its continuing efforts to improve education. In essence, he argued that without a paradigm shift, our precollege educational system could not expect significant improvement. The paradigm shift he has proposed consists of a combination of CAL and DL that incorporates CAL.

Activity 5: Discuss in small groups some paradigm shifts that have occurred or might well occur in education at the UO.

During the 6/13/05 session, one of the best examples came from a faculty member in Chemistry. The paradigm shift includes using computers to solve the types of problems that computers can solve, and using computerized information retrieval to replace a substantial; amount of rote memorization. Another common example is a shift to having students do much more comprehensive library-based (Web-based) research and making more use of primary resources. Still another example is provided by making use of ICT-based group discussions, in both asynchronous and synchronous modes.

Lower-Order and Higher-Order Knowledge and Skills

Benjamin Bloom, University of Chicago, is remembered for "Bloom's Taxonomy", the "two sigma" effect of individual tutoring, and other efforts to improve education. [As noted earlier, this presentation only briefly mentions Computer-Assisted learning. CAL has characteristics of one-on-one tutoring, and research strongly supports the effectiveness of one-on-one tutoring.] In this section, we want to think about education using ideas from Figures: 5 and 6.

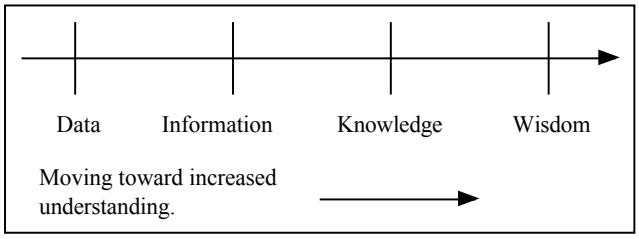

Figure 5: Data … Wisdom.

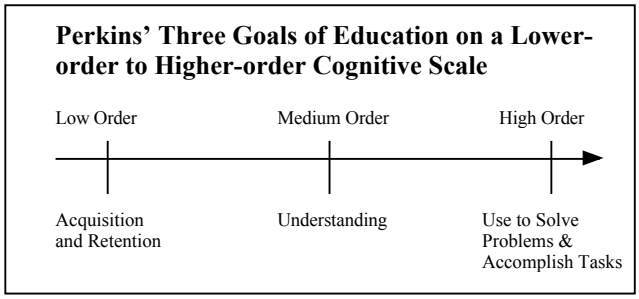

Figure 6: Lower-order and higher-order cognition and education goals.

The main point I want to make is that computers are very good at the lower end of the two scales pictured. A computer can easily "memorize" the contents of a thousand books. Humans are not very good at such data storage and retrieval tasks, as compared with computers.

Humans are much better than computers at the higher end of these scales—provided they have appropriate education and training. Thus, we want to have an educational system that prepares students to work well in ICT environments, where the ICT systems and the humans each contribute what they can to solving complex and novel problems.

Many people define the term "knowledge" in a manner that precludes a computer from having knowledge. However, the field of computer and information science began as data processing, and relatively quickly moved to include information processing. At

the UO, for example, the department was first named the Computer Science Department and later became the Department of Computer and Information Science.

Artificial intelligence, which includes the topic of machine learning, has long interested computer scientists. If this topic interests you, you might want to read Chapter 7 (Machine Learning) from my free book *Brief Introduction to Educational Implications of Artificial Intelligence* (Moursund, 2005). Quoting from that chapter:

> Data mining is the process of finding new and potentially useful knowledge from data. In recent years, this has become an active area of research and implementation. For example, in 1998 the Association for Computing Machinery established the Special Interest Group on Knowledge Discovery in Data and Data Mining (SIG KDD).
>
> > The primary focus of the SIGKDD is to provide the premier forum for advancement and adoption of the "science" of knowledge discovery and data mining. To do this, SIGKDD will encourage:
> >
> > basic research in KDD (through annual research conferences, newsletter and other related activities),
> >
> > - adoption of "standards" in the market in terms of terminology, evaluation, methodology, and
> > - interdisciplinary education among KDD researchers, practitioners, and users. (ACM SIGKDD, n.d.)

In essence, KDD focuses on moving the field of Computer and Information Science in the direction of being the field of Computer and Information/Knowledge Science.

Activity 6: Within your discipline(s), think about the teaching emphasis on lower-order versus the teaching emphasis on higher-order. Is what you teach (what you expect your students to learn) being affected by the steadily increasing capabilities of ICT systems? Spend a couple of minutes sharing your thoughts with someone sitting near you.

During the 6/13/05 session, the data-information-knowledge-wisdom idea provoked quite a bit of discussion. Thus, I have added some material in this section of the document.

I suspect that a group of university faculty members could spend many hours discussing possible meanings of knowledge and wisdom, and whether an ICT system might possible (some day, in the far future) be able to have and/or display knowledge and wisdom. In last year[‘s version of my presentation, one of the Business School faculty members in attendance was able to provide us with a lot of information about the progress that has been made in business use of computers for knowledge processing.

Activity 7: Now think about the ICT that you want and expect your students to learn. Is it mainly at a lower-order level, or is the focus on higher-order learning and use, focusing on using ICT to address hard problems within your discipline? As you think about and discuss this topic, keep in mind that it is not easy for students to take lower-order ICT knowledge and skills and integrate it into higher-order thinking and problem solving.

During the 6/13/05 presentation, I asked about participant’s awareness of Benjamin Bloom’s Taxonomy. Several participants shared their knowledge with us. I find it interesting that the lower-order versus higher-order knowledge and skills issue in higher education was well studied nearly 50 years ago by Bloom and his colleagues. As faculty members, we all want to stress the higher end of Bloom’s Taxonomy, the analysis, synthesis, and evaluation. But, we find it a real challenge to get our students to function at this level. Indeed, (as a faculty) we suspect that precollege education is doing a poorer job at this, which makes our job more difficult.

In the 6/13/05 presentation—just to stir things up a little—I suggested that if a computer system can do something, we should automatically define that to be lower order. A good education contains an appropriate balance between lower-order and higher-order. As ICT systems move up the data, information, knowledge, wisdom scale, this puts pressure on our educational system to spend less time teaching students to compete with computers, and to spend more time on the things that humans do much better than computers.

Basics of Education

Here are a few questions for thought:

1. Why are the three Rs considered to be **the** basics?
2. Why are Language Arts, Math, Science, and Social Studies the "core' of the elementary school curriculum, and of much of the curriculum in middle and secondary school?
3. What would it take for ICT to become one of the basics and to be thoroughly integrated into the core curriculum?
4. What would it take for ICT to become thoroughly integrated into the content of each discipline taught at a university level?

Activity 8: I find the third and fourth questions to be particularly interesting. Suppose that you (personally) believe that ICT is a basic, that it should be integrated into the core curriculum, and that it should be part of the content of each course in the various academic disciplines at our university. Think about would you do about this. Share a few ideas at a whole group level.

As you think about and discuss this topic, think about your current ability to integrate ICT into the content of what you teach, and to provide appropriate assessment of and feedback to students. You might enjoy reading *Requiem for the Term Paper* (Mankin 2004). It discusses the idea of students doing hypermedia projects instead of "traditional" term papers. You might want to ask yourself how well qualified you are to appropriately read, provide feedback on, and grade such a "paper."

At the 6/13/05 session, we did not spend much time on this activity. However, the issue came up about student writing, plagiarism, and multimedia papers. The Mankin (2004) paper vividly illustrates the difficulties that faculty members face as students gain in their ability to effectively communicate in a hypermedia environment.

Some faculty members at the UO are comfortable in integrating routine use of ICT as an aid to problem solving (using the very broad definition given earlier in this document). However, this is the exception, rather than the rule. This is a great topic for discussion, and it ties in well with the next section of this document.

National Precollege ICT Standards in Education

I founded the International Society for Technology in Education (ISTE) in 1979 and ran it for 19 years. In 1998, just as my position in running ISTE was ending, the organization published the National Educational Technology Standards for students (NETS, 1998). These have been widely adopted in the US. Here is an example of fifth grade standards:

Prior to completion of Grade 5, students will:

1. Use keyboards and other common input and output devices (including adaptive devices when necessary) efficiently and effectively.
2. Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.
3. Discuss basic issues related to responsible use of technology and information and describe personal consequences of inappropriate use.
4. Use general-purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum.
5. Use technology tools (e.g., multimedia authoring, presentation, Web tools, digital cameras, scanners) for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.
6. Use telecommunications efficiently to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests.
7. Use telecommunications and online resources (e.g., e-mail, online discussions, Web environments) to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.
8. Use technology resources (e.g., calculators, data collection probes, videos, educational software) for problem solving, self-directed learning, and extended learning activities.
9. Determine which technology is useful and select the appropriate tool(s) and technology resources to address a variety of tasks and problems.
10. Evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources.

Activity 9: Think about whether the typical undergraduate student you currently teach meets these fifth grade standards. What happens as an increasing number of your students meet the ISTE 12th grade standards? Share your thoughts with a person seated near you. This raises the issue of who is responsible for helping students to gain general, domain-independent knowledge and skills in ICT. You might feel that this should not be the responsibility of your particular UO department. The analogy with reading and writing may be helpful. You want to assume that students can read and write at a "college level" before they begin taking your courses. However, your students assume you can read and write at a level that will help them to gain increased reading and writing knowledge and skills in the courses they are taking from you.

> I often use variations on this activity in the classes I teach. In the 6/13/05 presentation, we focused just on items #5 and #7 in the list. Current faculty may find some relief in the fact that most students entering the UO as freshmen do not meet the ISTE fifth grade standards. Moreover, Oregon is in no sense a leader among states that have adopted some version of the ISTE Standards. However, perhaps UO faculty members can see the light at the end of the tunnel, and hear the roar as it moves in their direction!

Artificial Intelligence and Futures of ICT in Education

Short books I have written on Artificial Intelligence and on Futures of ICT are available free at Moursund (2005). Some of the key ideas are summarized by the diagram in Figure 5.

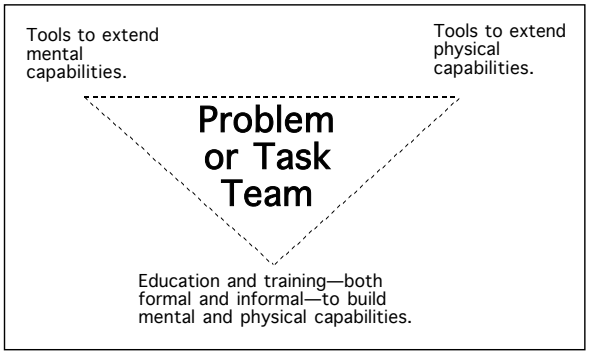

Figure 7: Problem or Task Team

The idea of a Problem or Tack Team emphasizes humans and machines working together to solve problems and accomplish tasks. What can humans do much better than ICT systems? What can ICT systems do much better than humans? What does an educational system look like if it has been designed to prepare humans to work well with machines in a manner that takes advantages of the strengths of each?

Right now, computers are not very smart. Here is an amusing or thought-provoking pair of Statements:

1. The typical car has an engine rated at approximately 1,000 "person-power. When it comes to brute strength, machines are much "stronger" than people. Humans, unaid3ed by machines or drugs, are approaching upper limits on how fast they can run, how high they can jump, and so on.
2. The typical modern microcomputer might be rated as approximately .01 "human-brain-power." When it comes to brain power, people are much smarter than computers. However, computers have by no means reached their upper intellectual limits Some of the futurists I have read suggest that microcomputers will exceed 1.0 "human-brain-power" sometime in the next 50 years (Kurzweil, 2001).

Measuring computer capacities in terms of "human-brain-power" is suggestive, but misleading. In some areas, such as brute force computation, computers are a billion times as capable as human brains. However, it is still a "far out, wild" prediction to suggest we may have artificially intelligent computers and robots equivalent to a five year old human within 15 years or so.

Activity 10: What do you know about the capabilities and limitations of AI within the discipline that you teach? How do you share your knowledge (or, lack there of) with your students?

We did not have time to discuss AI during the 6/13/05 presentation. It is a topic that I enjoy discussing with my students.

There is a good chance that most people reading this document make use of Microsoft Word when they are using a word processor. Thus, they are familiar with the wavy red underline that the software uses to indicate possibly misspelled words, and the wavy green underline that is used to indicate possible errors in grammar. The software usually can make suggestions on how to deal

with the (possible) errors. This is done using AI. Sometimes I am impressed by how "smart" the system seems to be, and at other times I am impressed by how dumb it is.

Search engines, such as Google, provide another easily accessible and commonly used piece of software that makes use of some AI. Information retrieval on the Web would certainly be a lot easier if the computer system could just learn to read people's minds!

Personal Professional Website

My personal opinion is that each faculty member should have a professional Website designed to communicate with professional colleagues, students, and others interested in the areas of the faculty member's teaching, research and other professional activity, and service. You can access my professional website at http://darkwing.uoregon.edu/~moursund/dave/index.htm. If you do, you will notice that the Website contains my picture, my Vita, free access to about 20 books and a hundred articles I have written, information about the types of workshops and other presentations I do, and detailed syllabi of courses I have recently taught.

I also use my Websites as places to store information that I might want to use at a later date. For example, I like to make use of short quotations at the beginning of chapters in books I write. I collect quotations I might use sometime in the future and store them in the Quotations section of my personal professional Website. When I read an article that might be relevant to revising one of my books, I often include a reference to it on the bottom part of the Web page that provides access to the book.

An important aspect of my service work is sharing my ideas and knowledge with a worldwide audience. I do some of this through the Oregon Technology in Education Council, which is another of the menu items on my personal professional Website. I volunteer my services as the Webmaster of this organization that I helped to establish a few years ago.

Finally, you will note that my personal professional Website contains the statement "**This work is licensed under a Creative Commons Attribution-NonCommercial 2.5 License.**" Creative Commons provides (at no cost) a number of different licenses that one might want to use in lieu of the a restrictive copyright. The license I use allows people to copy, distribute, display, and make derivative works. However, they may not use this work for commercial purposes and they must provide an appropriate attribution.

Activity 11: This is a whole group discussion activity. What are some of the advantages and some of the disadvantages of having a personal professional Website?

At the end of my presentation on 6/13/05, I asked about how many participants had personal professional Websites. The quick show of hands suggest that perhaps 10 to 15% of the participants had Websites, and several more intended to develop a Website during the week-long workshop.

I enjoy bring up this topic when I meet with various faculty groups on campus—for example at faculty meetings in my own department. I also enjoy putting forth the suggestion that such a Website should be taken into consideration in promotion, tenure, and reappointment cases. It is interesting to see the level of resistance to this idea.

A Few Tidbits from Teacher Education

Way back in the dark ages, when I was a faculty member in Math and then in Computer Science, I had not heard of:

- Authentic assessment (Authentic Assessment, n.d.).

- Constructivism, situated learning theory, transfer of learning, and other learning theories (OTEC, n.d.).
- Contributions that Cognitive Neuroscience (Brain and Mind Science) are making to education (Brain Lab, n.d.).
- ICT-Assisted Project Based Learning (Moursund, n.d.).
- Transfer of learning theories, such as near and far transfer, or high-road/low road theory of transfer (Perkins and Salomon, 1992).

If you are serious becoming a better teacher and better understanding roles of ICT in teaching and learning, I recommend you learn more about these five topics.

Final Questions and Closure

Change. How is ICT affecting the discipline you teach? How might it affect this discipline in the future? What are you doing to help prepare your students for changes that are occurring in your discipline?

Activity 12: Have each person share one idea from the workshop that seemed personally relevant and important. (Note that I often use this same activity at the end of a small to medium sized class that I am teaching. If the class is large, I ask for volunteers or just call on a modest number of people to do this sharing. The sharing process provides useful feedback to me and helps refresh the students' minds on important ideas that have been covered.)

> Whenever I run out of time in doing a workshop presentation, I am apt to omit this very useful closing activity. When I am doing a full day workshop, I often use the activity at the end of the morning session and again at the end of the afternoon session. Sometimes I use it still more often. It is a good way to do a Formative Evaluation "on the fly."

Appendix 1: Educational Change

This appendix contains material from an article written by two of my doctoral students. The following quoted material suggests the challenge of producing a in education.

Strudler, Neal and Keith Wetzel (Summer 2005). The diffusion of electronic portfolios in teacher education: Issues of initiation and implementation. *Journal of Research on Technology in Education.*

Change Is a Complex, Socio-Cultural Process that Takes Time

Hall and Hord (2001) view change in education as a complex process that takes a minimum of three to five years, with large-scale innovations taking longer. Fullan concurs that the "total time frame from initiation to institutionalization is lengthy; even moderately complex change takes 3 to 5 years, while larger scale efforts can take 5 to 10 years with sustaining improvements still being problematic" (p. 52). One explanation for this difficulty is that an organization 414 Summer 2005: *Volume 37 Number 4* will not change until individuals within it change (Hall & Hord, 2001). Furthermore, the culture of the organization can present a major obstacle to implementing new ideas and practices. Fullan (2001) quantifies this challenge in what he calls the *25/75 Rule for Educational Change* in which "twenty-five percent of the solution is having good directional ideas; 75% is figuring out how to get there in one local context after another" (p. 269). Fullan (2001) supports this view in citing the work of Senge, a prominent theorist on organizational change. Senge wrote, "The fundamental flaw in most innovators' strategies is that they focus on their innovations, on what they are trying to do—rather on understanding how the larger culture, structures, and norms will react to their efforts" (p.

99). Hall and Hord (2001) agree that most change efforts overly emphasize development at the expense of implementation.

Appendix 2: Global Change

ICT is changing the world. If this is a topic that interests you, I recommend that you read:

Friedman, Thomas L.(2005). *The world is flat: A brief history of the twenty-first century*. New York: Farrar, Straus and Giroux. ISBN: 0374292884.

An alternative is to view a video of a recent talk by Friedman and/or read a recent interview. Both are available at http://www.yaleglobal.yale.edu/video.jsp. Quoting from the interview:

> 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.
>
> 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. …
>
> Now, what I discovered by visiting India in 2004 was that we'd actually entered a whole new era of globalization. And Lexus [one of his 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. And so this book builds on the shoulders of Lexus, in that sense, but it's really about the next stage.

References

Notice that almost all of the references are to Websites, and the remainder are books I have read. This is deliberate. I am trying to encourage my readers to do follow-up reading on the various topics I write about. Of course, this has the disadvantage of some of the Websites disappearing sometime in the future. It also means that I seldom reference primary resources that are only available in hardcopy journals.

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