Past and Possible Futures of Information and Communication Technology in Education

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Introduction

This Colloquium/Seminar presentation is designed to be very informal and conversational. My message is simple. Information and Communication Technology (ICT) is a change agent that is far outstripping the ability of our educational systems to accommodate change. We can do much better than we are doing, but this will require a considerable amount of change in our precollege and higher education systems.

Change in the field of ICT is being driven by continued rapid progress in developing faster, more cost-effective ICT systems. These systems can solve or help solve a wide variety of problems. In many cases, solutions are developed that the end users find easy to learn to use. The cell telephone provides a good example.

In other cases, ICT systems are "merely" powerful aids to addressing complex problems. The complex problems are sufficiently challenging and open-ended so that they will likely never be "solved." For example, what might we mean by "solving" the problems of our educational system? Our world faces major environmental and social problems. ICT systems are helpful in addressing some components of such problems, but ICT systems will not solve such problems.

Opening Up the Discussion

Starting right here, the Colloquium/Seminar will function in an interactive, open discussion mode. I will guide the discussion through use of a sequence of some short stories that I will tell and questions I will raise. Our goal is to gain insight into some ideas that we can use to improve the quality of education that students are getting at the UO. The questions I raise are designed to make you think.

In the list given below, S stands for Story, while Q stands for a question topic to be explored. There are far more Stories and Questions than we will have time to explore during this hour. Keep in mind that our goal is to explore roles of ICT in improving our educational system. Feel free to raise other questions and topics. We should consider it a "plus" if we are led to other topics that are not on my list.

S1. My father and mother both taught at the precollege level, and they both went on to become faculty members in the Department of Mathematics at the UO. I began to learn about computers while I was in graduate school, studying mathematics. I soon became convinced that computers would soon revolutionize the teaching and learning of math. Talk about being naïve. Now, more than 40 years later, I am still waiting… What has

changed is that I am now looking for ICT to significantly change all of education, not just math education.

Q1. What are some examples of some of the most challenging problems of education? Let's look for some problems where ICT might be helpful and other problems where ICT is not apt to be helpful. Why haven't calculators and computers significantly changed the world of education?

S2. During World War II, the military hired hundreds of people (mainly women) to use desk calculators to carry out calculations needed to support the war effort. These people were called computers. They did data processing and ballistic calculations. I have a vivid picture in my mind of a photograph and description of 200 women seated in a very large room, each hunched over a desktop calculator.

Q2. How does the compute power of a cell telephone compare with the compute power provided by 200 people working with desk calculators during WW II? How does a cell telephone compare to current electronic game machines?

S3. Thirty years ago, Steve Jobs and Steve Wozniak pooled their financial resources to start a company called Apple. Wozniak contributed his Hewlett-Packard calculator. This calculator came in two versions—an engineering calculator and a business calculator. The first version sold very well and the second sold very poorly.

Q3 Why was there such a difference in the sales of these two types of calculators? How does the development of spreadsheet software, in the early history of Apple, fit into this discussion? We all know that the spreadsheet is a computer application that contributed significantly to changes in the world of business. Are there any lessons we might learn from this that are applicable to us as faculty in higher education?

S4. At one time it seemed like the growth of telephone service in the US would soon require more people working as telephone switchboard operators than the entire available workforce. ICT changed this, and makes possible very inexpensive direct dialing to the nearly two billion telephones located throughout the world.

Q4. What can we (educators) learn from the telephone switchboard operator story that might be applicable to education? Give some additional examples where ICT works behind the scenes in a manner that requires little learning on the part of the end users.

S5. I have frequently started the first day of a new course by talking briefly about the fact that the UO College of Education is a major national and global center for educational research. I then ask my students to name some educational research results they have learned in their previous education courses, and that have made a significant difference in education. I am always surprised about how few examples my students can come up with.

Q5. Think about the problem of translating educational theory into practice. Give some examples where this translation of theory into practice can be carried out by ICT systems in a manner that require very little learning about ICT on the part of the students and the teacher.

S6. When I first started teaching at Michigan State University, a math Department colleague of mine indicated that he had done a careful study and concluded that the totality of mathematical knowledge was doubling every ten years. I thought about what he was saying, and concluded that with my recent 20 years of schooling and doctorate in math, I had probably learned well under one-percent of the totality of human math knowledge. Moreover, even though I was spending all of my professional time studying in the field, I was falling still further down on this percentage measure.

Q6. In recent years I have read that the totality of human knowledge is doubling every five years or so. This certainly creates a problem for people who are trying to become broadly educated. Indeed, as illustrated in my math story, it creates a problem even for people who focus their education in a single discipline. Now, we have both ICT as a discipline of study and ICT as an aid to dealing with the rapidly increasing totality of human knowledge. How has this should this been affecting education here at the UO or in the College of Education, and how should it affect it in the future?

S7. My first hands on experience with a computer occurred in 1959 when I played Tic-Tac-Toe with a computer located at Oregon State University. The intelligence of the program was not very high, and I found I could beat the computer. Since then, I have been interested in Artificial Intelligence, and have even written a book on roles of AI in education. This book, and a number of my other recent books, are available free on my Website.

Q7. The "intelligence" of computers is gradually being increased through a combination of research in the field and building faster computers. In many narrowly defined problem-solving domains, computers are now better than people. How has this situation affected education at the University of Oregon and in the College of Education, and how should it affect it in the future?

S8. When I was a child, I enjoyed making model airplanes and playing with a variety of other models—such as model railroads and the game called Monopoly. As an adult, I learned that modeling and simulation are serious academic topics. As a computer person, I learned that computer modeling and computer simulation have become significant components of mathematics, all of the sciences, business, architecture, and many other disciplines.

Q8. What are our students learning about modeling and simulation as a method to represent and help solve the types of problems that they are studying at the UO? For a very specific question, what are our preservice teachers learning about modeling and simulation in their content courses and methods classes?

S9. Many years ago, I read David Perkin's 1992 book: *Smart schools: Better thinking and learning for every child*. In this book, he talks about the idea of "person plus," meaning a person working together with physical and mental aids to solve a problem or accomplish a task. Since reading Perkin's book, I have made frequent use of his idea in my own teaching and writing. To continue this story, in 1997 a computer defeated Gary Kasparov in a chess match—Kasparov was world chess champion at the time. Since then, Kasparov has pioneered a game called super chess, in which a person and a computer play together as a team against other similar teams.

Q9. What are some good examples of where our students are being deeply immersed in the idea of person plus, where the "plus" is an ICT system? What challenging problems and tasks are our students learning how to deal with in this environment—problems and tasks where the ICT makes a major or perhaps dominant contribution?

S10. Before joining the Teacher Education faculty, I taught 4 years at Michigan State University and a number of years in the Mathematics Department and the Computer Science Department here at the University of Oregon. Imagine my surprise when I first began to hear some of the commonly used educationalize. The ones that really seemed funny to me were the terms authentic content, authentic instruction, and authentic assessment. Eventually it sunk in that these were good ideas, and that I had not paid much attention to them in my previous teaching. This past spring I was discussing these ideas with students in my class, and I suggested that if they were teaching students to solve problems and accomplish tasks in an ICT environment, then they should make use of "open ICT" assessment. We discussed the parallel with open notes and open book tests. Imagine my pleasure when, a few weeks later, one of the students reported on his experiment in open ICT assessment with a fourth grade class. It was a great success from his point of view, the students' points of view, and in the eyes of other teachers in the building.

Q10. What are your experiences in making use of open ICT during inclass tests?

S11. Through many years of teaching teachers about educational uses of ICT, I gradually learned about some of the roles of ICT in the area of adaptive and assistive aids in special education. More recently, as my brain has grown older and has shown signs of not working as well as it used to, I have thought quite a bit about ICT as an aid to my brain. More generally, I have begun to think about and occasionally write about ICT as a type of auxiliary brain.

Q11. What are your thoughts about ICT as an auxiliary brain, and providing all students with an education in which they learn to make effective use of this adaptive, assistive technology?

S12. I have read quite a bit about lower-order and higher-order knowledge and skills. Sometimes I can even remember Benjamin Bloom's taxonomy: knowledge, comprehension, application, analysis, synthesis, and

evaluation. One day it occurred to me to ask the question: How does ICT affect the ideas of lower and higher order? For example, if we were considering the education of a robot, would lower-order and higher-order be the same as for a human student? My students and I have had fun exploring this question. Clearly, some things that are quite difficult for people to learn are very easy for computers, and vice versa.

Q12. From a human education point of view, how should the growing availability and capability of ICT affect our current balance between emphasis on lower-order and emphasis on higher-order in curriculum, instruction, and assessment?

S13. Over the years, I have irritated many teachers by suggesting that there are some parts of the school curriculum that computers can teach better than human teachers. In the courses I teach, this turns out to be a topic that interests my students. We spend time trying to figure out what human teachers can do a lot better than computers, and vice versa.

Q13. Within the curriculum you teach, or within the curriculum that we are preparing our graduates to teach, can you think of examples where computers can teach better than humans? If you can, what are you doing about this in your teaching?

Final Remarks

ICT systems can do lots of things that people cannot do, and people can do lots of things that ICT systems cannot do. The capabilities and cost effectiveness of ICT systems will continue to grow quite rapidly during the next few decades. ICT systems will have a steadily increasing level of artificial intelligence.

The growing capability and availability of artificially intelligent ICT systems presents a huge challenge to our educational system and those who prepare people to work in this educational system.

My six most recently written books, as well as 14 older books, are available free in PDF and Microsoft Word formats at my Website http://darkwing.uoregon.edu/~moursund/dave/Free.html#Books. This past fall I created a Website to support people who are interested in instructional use of ICT at the University of Oregon. See http://otec.uoregon.edu/ICT-UO.htm. In addition, I have created a Discussion List for faculty and others who want to share ideas about instructional use of ICT at the UO. This is a closed list, so I am the only one who can add people to the list. It currently has about 50 members. If you want me to add you to the list, please sent me email making such a request.