# A College Student's Guide to Computers in Education

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## Abstract

This short book is for undergraduate and graduate college and university students, and for others thinking about enrolling in higher education courses. The information and ideas presented will help you to obtain an education that will be useful to you throughout your life in our rapidly changing Information Age world.

**Change** is an underlying theme of this book. You are living at a time of a rapid technological change. The rate of change is increasing. Such change brings with it both threats and opportunities. You can shape your informal and formal education to diminish the threats and increase the opportunities.

**Gaining a competitive advantage** is another underlying theme of the book. Whatever your areas of interest, you can gain a competitive advantage by developing a higher level of expertise in the areas and by developing an increased level of expertise in using computers in the areas. Computer technology is a powerful aid to representing and helping to solve problems and accomplish tasks in every academic discipline.

This book is a companion to *A Faculty Member's Guide to Computers in Higher Education,* which is available free on the Website http://uoregon.edu/~moursund/Books/Faculty/Faculty.html. The two books share many of the same ideas, but these ideas are presented from two quite different points of view.

## Copying Rights

# About Dave Moursund, the Author

"The wisest mind has something yet to learn." (George Santayana)

- Doctorate in mathematics (specializing in numerical analysis) from the University of Wisconsin-Madison.
- Instructor, Department of Mathematics, University of Wisconsin-Madison.
- Assistant Professor and then Associate Professor, Department of Mathematics and Computing Center (School of Engineering), Michigan State University.
- Associate Professor, Department of Mathematics and Computing Center, University of Oregon.
- Associate and then Full Professor, Department of Computer Science, University of Oregon.
- Served six years as the first Head of the Computer Science Department at the University of Oregon, 1969-1975.
- Full Professor in the College of Education at the University of Oregon for more than 20 years.
- In 1974, started the publication that eventually became *Learning and Leading with Technology*, the flagship publication of the International Society for Technology in Education (ISTE).
- In 1979, founded the International Society for Technology in Education ). Headed this organization for 19 years.
- Author or co-author of about 50 books and several hundred articles in the field of computers in education.
- Presented about 200 workshops in the field of computers in education.
- Served as a major professor for about 50 doctoral students (six in math, the rest in education). Served on the doctoral committees of about 25 other students.
- Founding member of the Math Learning Center. Served on the MLC Board of Directors since its inception in 1976, and chaired the board for several years.
- For more information about Dave Moursund and for free online, no cost access to 20 of his books and a number of articles, go to http://uoregon.edu/~moursund/dave/.

# Table of Contents

# Preface

"Fortune favors the prepared mind." (Louis Pasteur)

This book is for students currently enrolled in higher education and students thinking of going to college. It is designed to be read online, although if you want to take the environmentally unsound approach of printing out a copy, I guess I cannot stop you. Many of us find it hard to break old habits, or to replace old habits with new habits.

Over the long run, you will likely gain considerable benefit by learning to be a fluent, online reader. Hardcopy books are not going to disappear during your lifetime or the lifetimes of your children and grandchildren. However, a rapidly increasing amount of the material being published throughout the world will mainly be available online.

## Prerequisites for the Reader

The prerequisite computer knowledge assumed in this book includes some experience in using a word processor, email, a browser, and a search engine on the Web. The book is not specifically designed to increase your specific computer-based skills. Rather, it is designed to help you make decisions throughout your educational experiences—decisions that will help you to get a better education.

There is another prerequisite. It is that you have the mental maturity (a level of cognitive development and self-responsibility) to take a high level of responsibility for your own education. **Important question: did you stop and reflect on what the term *cognitive development* means and whether you have a level of mental maturity that is up to the task of reading and learning from this book?** If the expression *cognitive development* is not part of your working vocabulary, look it up on the Web. Take responsibility for your own education!

## This Book Tells a Story About Change

Many years ago, you began the long process of becoming a fluent reader. If you are like most students, this was a rather difficult task, taking a number of years before you had a reasonable level of fluency at decoding squiggly marks on a page into meaningful patterns in your brain.

Eventually you began to read *chapter books* (books made up of a sequence of chapters) and you began to learn through the process of reading. The expectation is that typical students can begin to learn by reading by the end of 3$^{rd}$ grade and will be relatively good at it by the end of 6$^{th}$ or 7$^{th}$ grade.

Perhaps during this same time, you began to differentiate in your mind between storybooks and textbooks. A storybook tells a story and is fun to read. A textbook does not seem to tell a story, and most people don't find textbooks particularly enjoyable to read. Not many people select a college textbook for their bedtime reading enjoyment!

During my professional career, I have written many scholarly, academic books. Although each tells a story, I am sure that most of my readers have considered the stories to be "dullsville," and certainly not competitive with a well-written, exciting novel.

The book you are now reading tells a story about the rapidly changing world you live in, and the pursuit of a good education for responsible and successful life in this world.

This story is important to you and your future. As you read this book, think of yourself as the protagonist. Your decision to obtain a higher education is a decision to take charge of inventing your future. This future can take many paths.

Regardless of the paths you pursue in higher education, the world is going to change substantially during your lifetime. Much of this change will be due to changes in science, technology, medicine, environment, population, and other factors that you personally, all by yourself, have little control over.

What you can do is improve your levels of expertise:

- In learning to learn in various disciplines and across disciplines.
- In useable, applicable, knowledge and skills in areas deemed important by you and/or by others.
- In being a responsible adult and lifelong learner.
- In dealing with change and helping others deal with change.

## Increasing Your Levels of Expertise

Higher education provides you an opportunity to increase your level of expertise in a variety of different areas. You probably have some goals in mind of what you will do with these increased levels of expertise. Thus, for example, you may be interested in gaining a level of expertise that will help you get a good job, to help you go on to further education, to become a better parent, or to be a leader in helping to solve a variety of global problems. You might want to gain an education that helps prepare to be a more responsible, contributing adult citizen of your rapidly changing community, state, nation, and world.

Computer technology is affecting every academic discipline in a typical institution of higher education. Computer technology is being:

1. Integrated in as part of the content of each discipline, and thus is being a change agent in the content to be learned. Because computer technology is part of the content of each discipline, it is a potential part of one's level of expertise in each discipline.
2. Used as an aid to learning and making effective use of the content of a discipline. Expertise in learning a discipline and expertise in using one's knowledge and skills are both affected by computer technology.
3. Used to augment the capabilities of people's brains.

The book includes a chapter on Human and Artificial Intelligence. Surely, you want to know more about your brain and what recent research is telling us about how the human brain functions. Surely, you want to know what your brain can do better than a computer's "brain," and vice versa. A theme running throughout the book is that of a team consisting of people and their machines (including computers) working together to solve problems and accomplish tasks. A modern education helps to prepare a person to be a productive and valuable member of such a team.

Most of the topics in this book are treated in a relatively easy to read, but scholarly, academic manner. Thus, for example, you will find a large number of items in the References section. Most of the items include links to Websites. The idea is to encourage you to take an increasing level of responsibility for your own education, to develop areas of interest that motivate you, and to get you into a habit of browsing and reading information sources in these areas.

The book contains a relatively extensive Index. One use of such an index is to check and/or review what you have learned by reading the book. After reading this book, look through the entries in the Index. Mentally, do a quick check of each in items of what you know about the topic and what the book has contributed to your knowledge on the topic.

# Chapter 1

# Introduction

> "Before you become too entranced with gorgeous gadgets and mesmerizing video displays, let me remind you that information is not knowledge, knowledge is not wisdom, and wisdom is not foresight. Each grows out of the other, and we need them all." (Arthur C. Clarke)

Sometimes students think that they can safely skip over the Preface in an academic book, since often the Preface is written mainly for the teacher in a course. In this book, the Preface is mainly intended for students. It is part of the introduction to the book. Thus, if you didn't read the Preface, I recommend that you go back and do so.

Information and Communication Technology (ICT) is a powerful change agent. This chapter expands on the introductory materials presented in the Preface.

Technology and the underlying mathematics and sciences are cumulative, vertically structured disciplines. New developments build on the old. Improvements in transportation and communication make it easier for people to learn about and build upon the previous work of others. Some of the developments, such as the invention of writing, the development of mass produced books, and the computer make significant contributions to speeding up the world's rate of technological and scientific development and scientific. Increasing population and improvements in worldwide education also make significant contributions to the pace of technological and scientific change.

Consequently, you live at a time when the rate of technological change is higher than it has ever been, and when the rate of change is steadily increasing.

## Taking Responsibility for Your Own Learning

The fact that you can read and understand this written text indicates that you have a high level of thinking and learning ability. The fact that you are thinking about your current and future education means that you have the wisdom and foresight that I find so appealing in good students. (See the quote from Arthur C. Clarke given above.)

Your decision to begin reading this book indicates that you are inquisitive, and that you are seeking ways to improve your current and future life. Your current level of education and maturity means that you are capable of taking considerable responsibility for your learning now and in the future.

Unfortunately, one of the problems that you may face is overcoming the many years of previous schooling in which others told you what to learn and how to demonstrate your learning. Our precollege education system is slanted toward producing students who say: "Tell me what to learn, how to learn it, and how to demonstrate that I have learned it. Then, I will do what you

have told me to do." In some sense, our educational system tends to take self-responsibility away from students.

Higher education has some propensity to reinforce the concept of *tell me what to do and I will do it.* Consider a different path, a path is called **Being a Responsible Adult Learner.** On this path, you decide what you want to learn. You make use of what you have learned in the past, including what you have learned about how to learn. You focus on strengthening your learning capabilities in areas that interest you. You make use of the myriad of resources designed to help you learn. (College courses are but one of many such resources.) You set your learning goals, and you achieve them at a level that is satisfactory to you.

Being a responsible adult learner is a lifelong challenge. As you and the world you live in change over the years, your learning interests, needs, and capabilities will change. The life of a dedicated, lifelong learner is a challenging, but awesome and rewarding journey.

Information and Communication Technology (ICT) has given us new aids to learning. For example, the Internet is a broad-based network of computer networks, a powerful aid to communication. The Web is the world's largest library, it is growing very rapidly, and it is accessed through the Internet. The Internet and the Web together are a powerful aid to learning. It is important to your future that you become skilled in making use of the Internet and the Web as aids to communication, learning, and making use of your learning.

## Writing for Online Reading

You are living at a time that is often called the Information Age. The storage, retrieval, and use of information are more important than ever. We are in the midst of a profound change, going from hardcopy storage to online storage of the collected knowledge of the human race. This change affects authors of academic books such as this one, and it affects readers of such books.

For example, as an author it costs me nothing to publish the book—that is, to make it available free on the Web. It takes only a few minutes to accomplish this task. Moreover, I can readily correct errors and update the book whenever I want.

Publishing online brings another important advantage to authors and readers. As an example, later in this book I will mention a few people who have made profound and lasting contributions to ICT. Raj Reddy of Carnegie Mellon University is an example of such a person. He has been a major world leader in robotics and Artificial Intelligence throughout his long career.

How much more should I say about Raj Reddy? I include him in this book because he is a good example of a person who has made a difference in the world of ICT. However, there are lots of such people. Thus, I certainly don't expect that you will memorize his name and accomplishments, and remember them many years from now.

This person was raised in India, has risen to prominence in the United States and the world, and is working to improve the lives of rural people in India and throughout the world. He is a good example of a *citizen of the world*. Suppose that there is something about what I have said about Raj Reddy that peaks your interests. If so, you can:

- View a video focusing of Reddy's ideas on bringing computer connectivity and technology to poor people in third world countries, http://scil.stanford.edu/video/RajReddy.mov.