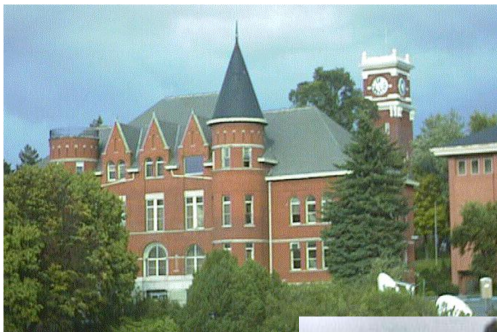
Virtual Education

Manifesto



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VIRTUAL EDUCATION MANIFESTO

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Preface

Education is an extremely important aspect of society – perhaps the most critical to its *long-term viability*. The information superhighway or cyberspace is changing society. Educational processes and organizations must respond to this changing environment in order to insure the success of the societies which they underpin.

Virtual education realizes a new synergy among people and their information technology tools. Virtual education transcends boundaries – space, time, and organizational boundaries. As Bill Gates says, we may soon have "friction free" capitalism. For education this means that any student and any teacher can be connected whenever they want. However, we also want cradle to grave seamless, relevant education. Such standardized, global education seems to call for massive organizational overhead. Addressing this dialectic is the purpose of this manifesto.

About What?

This book is on the one-hand a review of how technology might be used in educational organizations. On the other hand it is a manifesto for a particular kind of change. This change involves reaching students at home and the workplace and helping teachers cooperate across previous organizational boundaries.

The book is designed for those who want to use technology to extend the educational reach of organizations. A psychologist or health care practitioner would define virtual as:

> Existing in the mind, especially as a product of the imagination (American Heritage Dictionary, 1994).

An information technologist would define virtual as:

> Often used to refer to the artificial objects – like addressable virtual memory larger than physical memory – created by a computer system to help the system control access to shared resources (Free Online Dictionary of Computing, 1997).

To the liberal artist the term "virtual" may connote something less than desirable. However, to the technologist the connotation is of overcoming limitations. This book takes the technologist's positive view of the term "virtual". To be *virtual* is to transcend limits.

Information technology and people can together transcend limits. Certain, new *human+technology educational organizations* are virtual educational organizations. This book should help you distinguish those virtual educational organizations that are on the right path from those that are on the wrong path.

Three Parts

The book begins with an introduction to the history of education and of technology and ends with a look to the future. In between this beginning and ending are three major parts called:

I. Learn and Teach,
II. Administer and Author, and
III. Marketing.

The seven *chapters* within these three parts are titled: Learning and Courseware, Teaching and Classrooms, Administering Schools, Authoring Courseware, Corporate Marketing, State School Marketing, and Brokering Education. Learning is viewed from the individual perspective; teaching, from the group perspective; and administering and authoring, from the organizational perspective. This relates to a model in my earlier book *Interactive Media* which would have been more aptly called "Interactive Media: Individuals, Groups, and Organizations". In this book the emphasis is on individual students learning, groups in classrooms, and educational organizations.

Part I applies theories of learning to courseware and anticipates a strong, long-term future for intelligent, virtual reality tutoring systems. This chapter on learning is followed by a chapter on teaching and the virtual classroom. The virtual classroom will increasingly help students and teachers assume more complex, specialized roles and promote various sorts of person-to-person mediated interactivity.

Part II concerns organizations as they are administered and as they produce courseware. The chapter on administering examines the theory of virtual organizations and applies this to educational organizations. Models of educational organizations are advanced and related to the information technology that supports such organizations. Quality control can be further mechanized in such organizations. The chapter on authoring addresses the strategies that organizations use to produce courseware. This reflects work in my book *Developing Educational Hypermedia: Coordination and Reuse*.

As virtual education spreads, incompatible methods and tools across organizations will become increasingly unacceptable. Each chapter calls for *standards* that will support exchangeable components in the infrastructure of the virtual educational organization. Students may ultimately be able to participate seamlessly in education from various organizations across space and time boundaries.

Part III focuses on the evolving marketplace. By considering the extent to which students are captive to a particular educator, we arrive at four categories of captive student:

- full-time employees of a company may be captive to mandatory education from the company,
- customers of a company may be captive students for that company when those customers want education about what the company sells to them;
- state residents are relatively captive to the state schools, if they want to take advantage of the taxes that they pay for the state schools, and
- students of a broker arranged student-teacher alliance are temporarily captive to that alliance.

For each category of captive student and educator, this book provides analyses of what is educationally happening and presents detailed case studies.

At the presentation level, we might note that the book has an index term for essentially every paragraph of every chapter. More importantly, about five hundred *exercises* are evenly distributed through the book at the end of most second level sections. These exercises are divided relatively evenly among three types: true-false knowledge exercises, and doing exercises. The knowledge exercises ask you to write brief essays about material in the book. The doing exercises ask you to engage in some creative thinking and to write brief essays to reflect that creativity. Answers to all the exercises are presented in the penultimate chapter of this book.

What the Book is Not!

Virtual education is popularly viewed as occupying one of two extremes on the spectrum from a self-contained, intelligent, interactive, hypermedia course to a simple electronic supplement of a paper-based correspondence course. The challenge with the intelligent hypermedia version of virtual education is the large, up-front investment. Making a self-contained product can easily cost hundreds of thousands of dollars. A virtualized correspondence course can in the extreme be nothing more than the traditional course plus some email dialogue between the teacher and students. Most of the current activity is of the latter electronic correspondence course type and here is the greatest opportunity for short term penetration of the marketplace. Accordingly, this book pays relatively little attention to sophisticated *hypermedia courseware*.

Virtual education can apply to pre-school children, to working adults, and to retired citizens. *Children* may be particularly well served by attractive, self-contained CD-ROM products that allow them to explore basic abilities such as spelling or addition. However, the role of virtual education may have the greatest immediate impact in reaching people in the workplace. This book focuses on higher education in the sense that the students have finished their high school education. We include training under the heading of education but pay much less attention to skill-based training than to more conceptually-oriented education. While much of what we have to say is relevant to education at the elementary, middle, and high school level, our focus is on higher education.

This book is not intended as a thorough review of the relevant disciplines or even a thorough review of the technological tools and applications. Rather it is intended to help people understand what technology can do for an educational organization in order that we might help create *virtual educational organizations*.

Why a Manifesto?

New market niches exist for virtual education in the workplace and at home. Important populations of these students are employees of global companies that need continuing education to perform effectively. Traditional higher education organizations are not necessarily well geared to serve the needs of such companies. Virtual educational tools may be well suited to this audience. To serve these new workplace and home educational markets we need to have a realistic *vision* and to appreciate what tools are right for what people.

One of the most pressing needs for the developed countries is for more students graduating with degrees in information technology. Students of this subject are also naturally comfort with information technology. So no topic could be more ripe for virtual education, and we are attempting to create a *Virtual Information Technology College* as an example of the best in virtual education.

Global companies need to exploit the information superhighway. As *Marshall McCluhan* has well documented "the medium is the message." By learning on the information superhighway through a virtual educational organization, students increase their likelihood of not only learning a particular topic but also of appreciating the ways of working that are typical of a virtual organization. Global companies must become increasingly virtual, and virtual education could be one key ingredient in the recipe for a successful virtual organization.

Karl Marx was concerned about the control of surplus capital. In Marx's 19th century, capital derived largely from labor. In the late 20th century capital more typically flows from information. Who controls information? Bill Gates argues that global computing will reduce the friction in capitalism through new channels of information This implies that more value will go directly to the consumer. Or will it?

Education is about converting information into knowledge in such a way that people can become more effective in society. In the information age this effectiveness is related to being able to generate or acquire information. Education has a major impact on people's ability to *control information* and in turn to determine what happens to any surplus in the society. If your organization wants to increase its influence, your organization should invest in virtual education!

Epilogue

I wrote this book to increase the likelihood that virtual educational organizations would thrive. A paper book seems hardly the key to creating virtual educational organizations. However, this book is accompanied by a World Wide Web version in which readers become active participants in the design or management of virtual educational organizations. The online form can be found via *http://members.home.com/rrada.* In the online version of the book, students share answers to the difficult exercises and interact with one another about the directions for virtual education under the guidance of the teacher. A paper book can be a useful adjunct to electronic information. A major theme of this book is that successful virtual educational organizations must appropriately use all the available tools.

I welcome opportunities to work with people who want to extend the reach of virtual educational organizations. To discuss this book, its electronic form, or directions to take, please contact me at my email address of rada@aya.yale.edu.

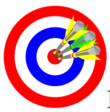
Hoping to meet you in cyberspace,

Roy Rada, M.D., Ph.D.

Roy's desktop and Roy

> The disadvantage of men not knowing the past is that they do not know the present. History is a hill or high point of vantage, from which alone men see the town in which they live or the age in which they are living. (Chesterton, 1933)

1. Introduction and History



Learning Objectives

- Understand the history of education as it relates to the purposes and methods of education over the centuries.
- Be able to predict the purposes of education in the future.
- Appreciate the history of information technology beginning with the written word and extending to interactive, networked multimedia.
- Develop a model of society and information as they evolve together.

1.1 Introduction

In this book we will be visiting the topics of virtual education from the perspective of learning, teaching, administering, authoring, and marketing. Each of these topics or activities has its own *history*. In this introductory chapter we will focus on the history of education over the past ten thousand years and on information technology advances over the same time but with an emphasis on the electronic information technology changes of this century.

The history of education is as old as intelligent life. What were the first methods of teaching and learning? Is there a pattern to the motivations of educators that is constant throughout history? We will see that educators have always perpetuated their own cultures and can thus see how virtual education can serve the continuing motivation of educators to *perpetuate their cultures*.

The history of education will also reveal changes in the methods of education. Each new era in education may incorporate the methods of earlier eras as it also introduces new methods. Principally, we see the increasing *institutionalization of education*.

One of the principal precipitators of change in education is *information technology*. The written word and later the printing press had enormous impacts on the virtual possibilities for education – on the possibilities for students to study when and where they wanted. Our focus will be on the electronic information technology tools and their impact on education. We will trace the history of changes in this century in electronic information processing – videos, computers, computer networks, storage devices, multimedia, and hypermedia.

What do we learn from the history of these technological advances about education? Education is not typically the stimulus for new advances in technology nor the first arena in which new technology is tested. Rather business or military applications tend to lead the way. Does education follow? One hundred years after the advent of the telephone, the typical classroom is still without a telephone. Computers can process information, while telephones just carry information.

Will computers follow a different path of *acceptance* in the classroom than the phone did?

What are the major factors that determine the rate of technological progress? What role do standards play in the rate of acceptance of new information technology tools? What has been most amazing about information technology since the advent of digital computers is the rapid pace of advance and the enormous impact on daily activity of people who work with information. As we study the *pace of technological change*, we are amazed at its potential impact and must prepare ourselves for the impact on education.

Most generally, the history of education and of technology manifests a common theme of building on the past to be better prepared to deal with the changing environment. This fundamental *evolutionary process* is behind all history. We present an evolutionary model of organizations that applies both to entire cultures and to individual educational organizations within them. This book will repeatedly draw on this evolutionary theme to account for the changing educational scenery.

1.2 History of Education

At the social level, education aims to perpetuate the culture. At the individual level, education aims to change the models inside a person's mind so that those model's more accurately conform to the standard models of the culture. The way children learn from parents by imitation is an example of education. What have institutions, such as state or church, done over the centuries to extend this method of teaching by imitation? What role can students themselves play in supporting wide-spread education? To what extent has distance education become an increasing reality in the 20th century?

1.2.1 Millenia Past

To understand the educational practices of primitives of more *than seven thousand years ago*, one might look at the records which anthropologists have collected and documented about the few surviving primitive tribes of recent times (Mulhern, 1959). One such tribe is the Arunta tribe of Central Australia. There boys and girls under the age of twelve live in the woman's part of the camp and accompany their mothers into the scrub. With toy digging sticks, they mimic the operations of the women as they dig for roots and small animals. The children help the women to carry back to camp lizards, rats, grass-seed, and such. At about the age of twelve, boys pass in the charge of men, whom henceforth they live with and accompany on hunting expeditions. The boy makes and uses toy versions of a man's weapons. Language is also learned by imitation and social context. Formal education only comes in the form of various, infrequent but elaborate initiation ceremonies. In the Arunta culture there are no formal schools, teachers, or students, but rather a life of *learning by imitation*.

About *five thousand years ago* the Egyptians developed *formal systems of schooling*. The vast majority of the population was not privy to this formal education as it was restricted to the privileged classes and ultimately controlled by the priesthood. The Egyptian civilization was advanced for its time and included extensive agricultural irrigation, building of massive architectural monuments to the aristocracy by armies of slaves, and enshrinement of education paths for the select few. A cultural and vocational educational system was maintained that helped perpetuate the civilization.

Throughout the educational process the few Egyptians who were students learned by *imitation of traditional forms*. The child spent the first few years at home and then was at school during the days. The memorization of texts was emphasized. Discipline in schools was severe and could include flogging and solitary confinement in prison for months for mere neglect of duty.

The Chinese educational system has a history remarkably different from that of the Western World. Two thousand years ago the Chinese had already standardized their educational system. Students were tested on fixed curricula at certain ages in every village and could slowly pass from one level of education to another as they were able to reproduce from memory certain documents. The most successful students were tested in the nation's capital under precise conditions that included locking each student in a fixed-size brick cell for several days. "By requiring set standards and prescribing teaching methods and uniform syllabuses, and by establishing controlling bodies of literary superintendents, the examination system assumed a systematic comprehensiveness unknown in the West before the mass education systems of the early nineteenth century" (Cleverley, 1991). Textbooks, tools for writing, classrooms, and exams were all highly institutionalized by the state.

1.2.2 Medieval Times

One thousand years ago in the Western World formal education was dominated by the church and for the purposes of the church. Each bishop and abbot exercised educational control under authority delegated to them by the pope. Support of monastic, cathedral, song, and parish schools came, in part, from church revenues and, in part, from fees paid by students, and from gifts of their relatives and friends to teachers and schools. Despite a seeming variety of schools, the masses were illiterate.

There was no compulsory education. The ecclesiastical and feudal nobility viewed the servile condition of laborers as a reflection of God's will. Although lay teachers were allowed, the preacher was the primary teacher, and *religious education* was the main goal.

It was the enrichment of the program of some cathedral schools that led to universities. The *first university* was the University of Bologna in Bologna, Italy in the *twelfth century A.D*. This and other universities while affiliated in some way with the church tended to have relative liberty to do as they saw fit in the teaching of non-religious topics.

The universities grew up to prepare men for the professions of law, medicine, theology, and teaching. Some study in the arts faculty was typically a prerequisite to study in the other faculties. The *authority of Aristotle* was viewed as final on all subjects on which he had written. All teachers used the method of lecture with syllogistic argumentation settling issues even in medicine and law. Books were few, and students relied much upon class notes, which they often *memorized*.

The first universities had no building of their own, or equipment, and their teachers lectured wherever they found a room or a vacant lot. Paris gave its faculty of arts a small street for school purposes. The first professors were supported by student fees paid directly to the professor. This was a kind of *medieval virtual university* in that it transcended fixed physical structures.

When a student had produced his masterpiece, he was inducted into the gild of master scholars. The degree of the master craftsman in learning came to be called the Master's or Doctor's degree, the latter coming to be used for graduates of the `superior' faculties. The title of Bachelor arose of the practice of permitting students, after four or five years of study, to lecture on the *Organanon* of Aristotle for a few years prior to their graduation. Such a lecturer was called a *Bachelor*, a title long borne by younger knights in the service of older ones. The typical student when he became a bachelor was about nineteen years old.

University students were a motley group of old and young, rich and poor. Aimless ones drifted from school to school and teacher to teacher. *Organized gangs* of wandering students roamed between universities begging and stealing as they went. Many masters encouraged their students to take work in other universities and they themselves frequently went to other institutions to enrich their experience. University education was a *male privilege* and women were not allowed often to even enter university grounds.

The teacher was one holding the degree required for membership in the faculty in which he taught. Theoretically, the number of teachers on any faculty was unlimited, since any one with the necessary degree had a *right to teach*. This is another aspect of a virtual university that has been largely lost in the modern day.

The early universities were more liberal towards new knowledge than the church schools of medieval times. Yet, they were highly traditional in many ways. Their curriculum was narrow and their methods of presenting truth highly formalized. To the discovery of methods of accumulating knowledge, they added almost nothing. They were, however, a great source for the *spread of existing knowledge* as they were centers of book trade and their students and teachers traveled widely.

1.2.3 17th through 19th Century

Massachusetts was founded as a Biblical commonwealth almost 400 years ago. To help make children Puritans, the General Court of Massachusetts required by law the selectmen of towns to see that all children were properly employed and were able to read and understand the *principles of religion*. The Court ordered every town of fifty families to employ a teacher of reading and writing whose fees should be paid either by the parents or by the town.

The Puritan made no distinction between the child and the adult. Children of six years were dressed as adults and expected to act as adults. The *Bible* was the chief book for children, and they were required to read and study it from beginning to end. Some read it in its entirety four times a year. The other books for children were all of a religious nature. *Harvard College*, founded by the Puritans in 1636, was the first higher institution of learning in the American colonies. It was established and run by both the state and the church to supply Puritan pulpits with learned ministers and the colony with teachers and magistrates.

Early 19th century education was driven by the industrial revolution to find more efficient ways to teach larger numbers of students in a formal way. At the beginning of the 19th century Joseph Lancaster founded a school in a poor section of London. In order that he might extend the benefit of his teaching to as many children as possible, he hit upon the device of using older pupils as assistant teachers for the younger children (see Figure 1 "Monitorial Method"). He first taught the lesson to these *monitors*, and each of them in turn taught it to the group of children that had been placed under his control. The methods of teaching were highly oriented to memorization and rigid discipline (Duggan, 1936). With this monitorial system a single teacher was able to direct the instruction of a very large number of pupils. Lancaster himself thus cared for an entire school of 1,000 children.

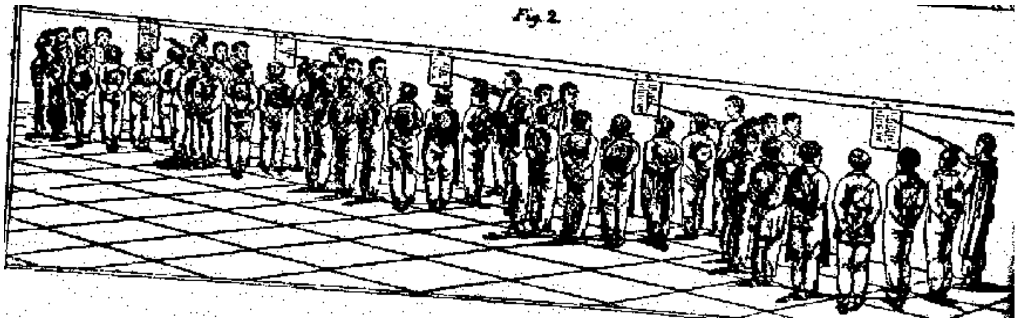


Figure 1: Monitorial Method Five senior students or monitors are giving instructions to five classes. The junior students are assembled at the draft stations, their toes to lines cut in the floor. With pointers the senior students are giving instruction from lessons suspended from the lesson rail.

In 1814 under the leadership of Lancaster a Society was formed to spread the monitorial teaching method in England. The *Anglican Church* feared the non-sectarian teachings of these monitorial schools and developed a counter educational system that also used the monitorial method of older students teaching younger students but emphasized the teaching of religion. The educational activities made practical by the use of the monitorial method raised the interest of the public in education. Those activities were thus partly responsible for the subsequent efforts by the government to organize education in England.

The monitorial system was introduced into the *United States* in 1806. It spread with great rapidity throughout the country. Its comparative low cost appealed to the charitable societies that were most prominent in attempting to spread education to the poor. The monitorial method was widely adopted for elementary schools and secondary schools throughout the first half of the 19th century in the United States.

So what happened to the monitorial method? As material wealth increased and the people became better informed about the needs of students and were willing to contribute funds to education, the *mechanical methods* that had become part of the monitorial schools were abandoned. The mechanical methods were considered inferior to the guidance of expert teachers.

1.2.4 20th Century

In the *20th century* the techniques of the Industrial Revolution were applied to improving the welfare of society. In the Western World the living standards and evolutionary opportunities of almost every man, woman, and child have been raised. Change has accelerated. The idea of a complete preparation for life is now guaranteed to be illusory. Whatever one learns today will be of conditional value. In relation to film, television, computers, and vast stores of new scientific and techological information, the individual teacher is increasingly a servant rather than a master. The teacher has become increasingly specialized (Boyd, 1968).

Despite the huge cost of various social services, education nowadays in advanced countries usually claims a bigger share of the *gross national product* than any other investment except defense. Government-based planning commissions are common place, and tax-supported education dominates the general offerings of education. The First and Second World Wars brought to the fore the importance of total mobilization. This experience along with the increasing globalization of industry have led to increasing specialization and organization. Much of education is now professionally provided and state guaranteed.

With the advent of radio and television countries increased their interests in distance education. Places such as the Open University in England and National Radio Institute in the United States were created in the mid 20th century. These institutions help students access quality teachers and information despite being bound to home or work in someplace distant from the teacher and the original source of the information. The Open University in England in the first 30 years of its existence had already granted 200,000 degrees through combinations of television shows, paper mail, and other distance communication devices. In the United States over 100,000 million Americans have used *distance education* methods during the 20th century.

A national sample of U.S. households was surveyed by telephone in the spring of 1995 (Dillman et al, 1995). The *survey* was based on a probability sample of random telephone numbers, designed to represent the states according to population size. The questionnaire included roughly 110 questions and the average interview was about 20 minutes. Over 1,100 interviews were completed and the approximate sampling error is within 3%. The findings are summarized with this list:

The attitudes and behavior of people from all age groups, income levels, and backgrounds indicate that a large majority of adults recognize the value of lifelong education.

Getting educated once is not enough in our knowledge-based economy.

Teaching only in the traditional classroom will not meet the public's demand for tailored educational services.

No single educational approach or technique will make lifelong learning accessible to everyone, because different people face different obstacles.

Distance education strategies have the potential to overcome significant barriers to lifelong learning.

The power of computers and telecommunications have increased and increased. To the extent that learning can be formalized and modeled on the computer, the computer can play an active role in education. Information technology can support the menial and other tasks of the classroom. Entire educational organizations can operate in quantitatively and qualitatively different ways.

These fascinating possibilities of technology to influence education must ironically be balanced with the *shortage of trained people* in the information technology fields. In 1997, according to the Information Technology Association of America, 190,000 information technology jobs are vacant across the United States, and a prediction by the U.S. Department of Labor indicates that new and expanding technologies will account for 80 percent of new jobs between 1997 and 2007. The opportunities to juxtapose the need for information technology training with the tools of information technology are many.

1.2.5 Exercises

True or False

1) All children learn by imitation. For early cultures this was also the full extent of education at all stages of life -- learning was by imitation.
2) Medieval universities had large physical plants and bureaucracies.
3) 17^{th} century American education was driven by scientific concerns.
4) The competition between educational organizations teaching secular versus religious content with the monitorial method led to government involvement in education.

Knowledge Essays

1) What is the purpose of education in society most broadly speaking?
2) In primitive cultures children learn largely by imitation. What does this mean?
3) What were characteristics of education in Ancient Egypt?
4) Trace the role of religion in the history of education.
5) Elementary schools today often employ teaching assistants in the classroom but these are adults rather than other elementary school students. Compare and contrast this situation to that of the monitorial method.

Doing Essays

1) How would you have education in virtual mode support learning by imitation?
2) The Ancient Egyptians physically punished students who were tardy in their school work. Would you use such methods now and why or why not?
3) To the extent that lecture and memorization dominated teaching in the medieval university, to what extent do modern universities teach differently and why?
4) Why not let the student pay the teacher directly and thus create a kind of market pressure to have teachers that students like?
5) The success of the non-secular monitorial method precipitated the church's further support of education and then government support. How would you build on such a lesson from history to stimulate further support for education today?
6) Think of a private company that has an educational branch, and suggest how that educational branch perpetuates the company ideals.

1.3 History of Technology

The focus in this book is the future impact of technology on higher education. Humankind manifests a striking evolutionary progression of tools to manipulate the physical and informational world. Tools to manipulate the physical world in some chronological order include the ax, the wheel, the plane, and the nuclear power plant. Tools for information include natural language, numbers, the written word, clocks, the abacus, the printing press, the computer, and the world wide web. What are the lessons from this information technology history?

1.3.1 Document

As we have discussed, the earliest education was by imitation. When language was developed, it became a

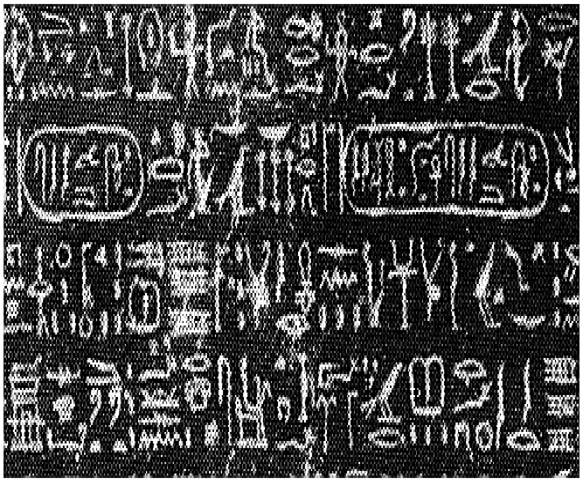


Figure 2: Hieroglyphics on Rosetta Stone

popular medium for education. How did the *written word* reach its eminent position in education?

As the written word became important for business and culture, the documents containing these words naturally became part of education. We say naturally, but *evolution* is not without growth pains. Some of the greatest ancient teachers thought that the written word was inferior to the spoken word and that education would be forever inferior when it was based on the written rather than oral word. The interactivity of a spoken dialogue is missing in written communication. However, the written word brought supported education in virtual mode, and that proved important for some people in learning some subjects. The document helps people be free from space and time constraints. In fact, many educators would now say that education depends on documents.

A document is generally any recorded body of information. The terms text and *document* are synonymous, and while they predominantly contain natural language in the form of alphabetic characters, they also contain graphics. A document is a medium for the transmission of culture and science and may be of arbitrary size. In its various forms, documents are one of the cornerstones of education. Textbooks, assignments, reports, papers, books, and software are examples of documents.

Documents have a *history* of thousands of years. Six thousand years ago a Sumerian might, for instance, have kept a *record on clay* of the number of sheep he owned. The Egyptians made records on papyrus at around the same time. To increase the durability of these records they were sometimes chiseled into stone (see Figure 2 "Hieroglyphics"). Educational uses of documents were secondary to their use in more immediate concerns of the society, such as business and politics.

Documents prepared in the middle ages often included complex, artistic letter forms, as they were painstakingly written by hand. To reproduce such a document manually was a time-consuming task. The *printing press* was developed about 600 years ago and allowed copies of a document to be produced efficiently. In the early days of the printing press, the printers continued to use complex letterforms. Furthermore, they used erasers and paintbrushes to doctor what the printing press produced, so that the text would look like an old-fashioned manuscript. Many years passed before printers accepted that the new documents didn't need to look like documents which had been written by hand.

The history of documents shows gradual change. Some text written on papyrus was transcribed to stone 500 years later. In the first century of the printing press, text continued to look like it had before the printing press appeared. The lesson to be learned from the preceding history is that change occurred slowly. A new technology for producing documents may take root slowly because society has an enormous investment in traditional methods.

Whatever changes may occur in the form of documents over time, we can expect that the change will in certain ways need to be *gradual*. People have developed great familiarity with documents. When information is placed in newer electronic forms, the producers can be expected to maintain certain paper forms, like the table of contents, just as the early printing press users would change characters to make them appear hand written.

1.3.2 Many Documents

Throughout history the *information explosion* has been perceived as outstripping people's ability to manage information. One partial solution has been to build archives of documents and to index the documents in a standard way. Egyptian documents such as the *Book of the Dead* were so important that already several hundred years before the birth of Christ, the Egyptians had a library for such books in Alexandria.

Bibliographies are pointers or links to documents. Simple *bibliographies* were published in the middle ages. By the 1700s, scholars had prepared bibliographies exhibiting a variety of approaches both by author and subject. The *Repertorium* is a subject index of the publications of the seventeenth and eighteenth centuries and took 20 years to publish. However, the effort required to build the Repertorium was so great that it was hard to imagine how one could update such a subject index. In his annual report for 1851, the Secretary of the Smithsonian Institution in the United States called attention to the fact that about twenty thousand volumes … purporting to be additions to the sum of human knowledge, are published annually; and unless this mass be properly arranged, and the means furnished by which its contents may be ascertained, literature and science will be overwhelmed by their own unwieldy bulk.

Index Medicus, which began in 1879, represented new methods of dealing with information and addressed the problem of updating indices. In 1874 John *Billings* began indexing the journals of the Surgeon General's Library in Washington, D.C. By 1875 he had accumulated tens of thousands of cards. Those from `Aabec' to `Air' were published by the Government Printing Office. The object of the publication, Billings wrote, was

to show the character and scope of the collection, to obtain criticisms and suggestions as to the form of catalogue which will be most acceptable and useful, and to furnish data for the decision as to whether it is desirable that such a work should be printed and distributed.

The implications of the last phrase become apparent from the letter that accompanied sample copies sent to prominent physicians around the United States. As Billings hoped, these physicians used their lobbying skills to help persuade Congress to appropriate the necessary funds to publish a full index (Blake, 1980). After the first full index appeared, Index Medicus appeared as a monthly periodical supplement to cover newly published material. The publication of Index Medicus continues unabated today. One of the keys to the success of the Billings' approach was to obtain government sponsorship for the maintenance of the index.

The notion of a computerized large volume document system begins in the 1930s, when *Vannevar Bush* started to argue the importance of applying modern technology to the production of information tools. Bush firmly believed inthe power of tools to facilitate information sharing. Bush said that more social value would be obtained from an improved method to share progress than would be obtained by any single new result.

In Bush's *memex machine*, which was designed but never built, printed materials were stored in microfiche. Pages of books were selected for viewing by typing an index code to control a mechanical selection device or by moving levers to turn page images of the selected item. Any two items in the memex could be coded for permanent association. Bush called this coded association a trail, analogous to the trail of mental associations in the user's mind. Bush argued that this trail of associations would help people understand material -- to learn -- because the trail would correspond to the person's mental model.

The *National Library of Medicine* which is responsible for Index Medicus also built the first large-volume, computerized document retrieval system. The retrieval system was called the Medical Literature Analysis and Retrieval System and first operated successfully in the mid-1960s. It began with about 100,000 journal articles and in its first year processed thousands of queries. To obtain citations a health professional first conveyed an information need to a search intermediary at the National Library of Medicine. The search intermediary then formulated an online query, and a list of relevant citations was then printed and mailed to the health professional. The turn-around time was one month.

The *1970s* witnessed the advent of inexpensive, long-distance communications networks, inexpensive fast terminals, and inexpensive large storage devices. These three factors combined so that users could operate on a terminal in their office and get citations instantly in response to their queries. There were over 300 bibliographic retrieval systems by the late 1970s, storing tens of *millions of citations* and receiving millions of queries each year. Access to these databases was made available in the United States largely through commercial suppliers (Hall and Brown, 1983).

A statement chiseled into the wall of the Yale University Library says "the library is the heart of the university". Large collections of documents are central to the function of a research university. However, libraries of documents are not vital to the traditional education of an individual student. An individual student needs a rather smaller collection of documents. On the other hand, for an *educational system* to be able to choose documents to offer to students, a library in some form is important. Having such libraries online allows schools to operate in virtual mode and match content with teachers and students in ways that would not be practical without libraries of educational documents from which to choose.

1.3.3 Hypertext

Education tries to convey models of knowledge that will be incorporated into the knowledge in the student's mind. A linear, paper document has limitations in how such models can be represented. The memex machine of Bush was to provide links different from those in traditional documents. The linking of components of a document creates hypertext. When the hypertext is stored on a computer, then the links are interactive. The computer software that supports the interactivity is called a hypertext system. Authors for centuries have tried to create implicit, non-sequential links in their documents. The efforts to use computers to facilitate the creation and access of *hypertext* is necessarily much more recent.

The first hypertext system, the *Augmentation System*, was developed in the 1960s by *Douglas Engelbart's* group (Englebart and English, 1968). The facilities for browsing text were particularly sophisticated. The hardware facilities were also impressive for the time. Among other things, the mouse was invented to support this hypertext system. The working information in the Augmentation System was organized into files, with flexible means for users to set up indices and directories, and to hop from file to file by display-selection or by typed-in file-name designations. The system's creators believed that the symbols one works with are supposed to represent a mapping of one's associated concepts, and further that one's concepts exist in a network of relationships as opposed to the essentially linear form of actual printed records. Accordingly, the concept-manipulation aids derivable from real-time computer support were enhanced by structuring conventions that made explicit the various types of *network* relationships among *concepts*.

In the late 1960s the Hypertext Editing System was developed on a mainframe computer. At the time the normal technology for editing on mainframes was batch cards. The Hypertext Editing System supported branching text and automatically arranged branches into menus. Authors could specify which branches to follow when printing was to occur. The Hypertext Editing System failed in the *marketplace*. In 1968 the Hypertext Editing System was demonstrated to staff at two major *publishing corporations*, whose staff felt, however, that the Hypertext Editing System was too complex. The idea of sitting behind a computer terminal and authoring and editing was more than the managers at that time were willing to believe (Dam, 1988).

The 1970s were marked by the continued development of ideas that were first implemented in the Augmentation System of the 1960s. One system allowed users to interact with programs through a menu-selection interface (Akscyn et al, 1988). The slow-response terminals were, however, inadequate for comfortable use. Numerous developments in the 1970s and 1980s failed to gain major market share. The machines were inadequate and/or the software was not widely enough available. In the *1990s* the use of computers to deal with text in richly linked ways has become commonplace.

1.3.4 Media

Formal education involves communication which in turn involves media. A communication system encodes

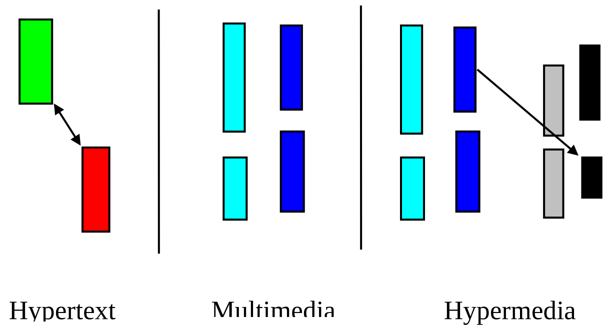


Figure 3: Hypertext, Multimedia, and Hypermedia. The leftmost column shows a link from an anchor within one hypertext node to another anchor in another hypertext node. The middle column shows two media types that should begin presentation at the same time with time going from top to bottom. Each media type experiences a delay before resuming but the delays are not at the same time. The rightmost, hypermedia column indicates two multimedia composites and a link from one composite to another.

a message from a source and sends it through a communication channel to a destination. A *medium* is the technical or physical means of converting the message into a signal capable of being transmitted along the channel. Information sources may use presentational or representational media to encode a message. Alternately, a message in presentational or representational form may be further encoded by mechanical media.

The presentational media include the voice and gestures. Representational media include books and photographs. Mechanical media include computers and telephones.

The medium of printed paper may contain pictures and text – each of which is a different encoding. Encoded information can itself serve as a base for another medium. For example, in a photograph of a street sign the base medium is a photograph that carries an image. The image carries the name of the street represented as text. When media are discussed these differences among *presentational, representational, and mechanical media* are useful to remember.

Media are received by people through the senses including sight, sound, touch, and smell. Multimedia are synchronized media, such as moving images with sound. Hypermedia is interactive or linked multimedia. Hypertext as one specific type of hypermedia is interactive text or linked text. Hypermedia helps people organize and access information. The vastly increased availability of computing power has allowed the implementation, elaboration, and exploration of the ideas underlying hypermedia (McKnight et al 1991) (see Figure 3 “Hypertext, Multimedia, and Hypermedia”).

The term `hypermedia' should properly refer to the contents, such as an interactive video, which a hypermedia system presents. Hypermedia systems manipulate links between discrete pieces of media and synchronize those media in time. Often, however, the term `hypermedia' is used loosely to refer both to the information content and the technological delivery platform.

1.3.4.1 Audiovideo

Audiovideo is a kind of multimedia in that it connects images in time with sound. Video was considered early in the 20th century to be potentially an enormous influence on education. We note in a textbook from that time (Duggan, 1936):

> Two new kinds of equipment which have already influenced teaching and are likely to influence it further are the radio and the motion picture. ….. The motion picture as an aid to teaching began to attract attention early, but the expense, the lack of suitable films and of an efficient manner of using them long prevented their introduction into schools. The matter of expense has become less burdensome by the development in recent years of a standard narrow (16 mm.) film which produces pictures large enough for class use at a greatly reduced cost and which can be shown by means of a portable projector and without fire hazard.

In 1936 people predicted great impacts of new advances in *audiovideo technology* on the classroom use of audiovideo tapes, but these predictions were not realized.

The combination of telephone links with television links allows people to hear and see one another at the same time. The first commercial application of the telephone plus television was called the *PicturePhone*. When AT&T introduced the PicturePhone at the 1964 World's Fair the product was expected to sell very well. Julius Molnar, executive vice-president of Bell Laboratories wrote in the Bell Laboratories Record in 1969:

> Rarely does an individual or an organization have an opportunity to create something of broad utility that will enrich the daily lives of everybody. Alexander Graham Bell with his invention of the telephone in 1876, and the various people who subsequently developed it for general use, perceived such an opportunity and exploited it for the great benefit of society. Today there stands before us an opportunity of equal magnitude, PicturePhone service.

Regular users of PicturePhone over the network between Bell Laboratories and AT&T's headquarters agreed that conversations over PicturePhone conveyed important information over and above that carried by voice alone.

The enthusiasm for PicturePhone from its creators at AT&T was not, however, shared by other users. These new users felt self-conscious about being on television and didn't feel that the value gained by the extra information outweighed the equipment or social costs. In one assessment use of the PicturePhone was described as `talking to a mentally defective foreigner' (Egido, 1988). The PicturePhone was a *commercial failure* and highlights the difficulty of predicting how high technology will work.

The history of videoconferencing provides a good lesson for developers of educational technology (similar to the lessons from the `PicturePhone'). By the 1970's the enthusiasm misplaced for the PicturePhone had been replaced by a somewhat similar enthusiasm for videoconferencing, which was to allow groups of people to see and hear each other through electronic media and thus avoid large travel costs. *Videoconferencing* has not become as popular as many predicted it would become. The reason for this is partly that people prefer the face-to-face contact that meetings in person support. In two studies of the early 1970's, it was concluded that 85 per cent of physical meetings could be replaced with videoconferencing, while a very similar study concluded that only 20 per cent of the meetings could be thus substituted. The latter study had taken the extra step of asking people whether they would choose to use videoconferencing as a substitute for a face-to-face meeting (Egido, 1988).

1.3.4.2 Multimedia

While the popularity of multimedia has grown enormously in the 1990s, the history of multimedia naturally traces to earlier years. One of the first major engineering accomplishments with combining video and computers was the work with the Augmentation system in the mid-1960s that was already introduced in our subsection on hypertext (Engelbart and English, 1968). The *Augmentation system* supported synchronous video conferencing. Around the same time, a different group developed the Spatial Data Management System which synchronized video screens and other projection devices through joysticks, a touch screen, and stylus. Auditory cues were used to help people navigate in an information space (Bolt, 1980).

The *storage space* needed for multimedia may be enormous. A simple photograph can require more storage space than an entire book. One alphanumeric character can be stored in 1 byte of the computer. An average word is 4 characters, and a typical page of text contains about 500 words. If a book is 200 pages long and has only alphanumeric text, then it occupies about 200 x 500 x 4 bytes or 400,000 bytes. The storage space for a photograph is surprisingly large in contrast to that for a book. A photo may contain 1,000 by 1,000 dots or pixels. If representing a dot in color requires a byte, then the storage space for one photo would be about one megabyte. Thus storing one high-resolution photograph may require more space than 100,000 alphanumeric characters require. Silent video may contain about 30 photos or frames per second. Thus a minute of the video occupies about 60 x 30 megabytes or 1,800 megabytes. Thousands of text books without pictures would occupy no more space than one minute of video.

Text is highly symbolic and a description of the operation of a company might be portrayed in a few pages of text, whereas video of the company operation might have difficulty in conveying the same kind of information. People do not yet have a language for abstracting information from images, instead images are stored as zeroes and ones with no semantic significance. Methods do, however, exist to compress the information in an image. If a large space in the image is of a constant character, then this constancy can be encoded so that less space is required to store the image. Of course, in later presenting the image to a viewer, the computer must decode or decompress the image. Techniques for compressing and decompressing media are vital to the success of hypermedia. *Compression* can be remarkably effective and might reduce the space required to store an image from a megabyte to a kilobyte.

The concerns about the number of bytes to represent an image versus text is not directly relevant to the paper-based world. An image may take about as much space as a paragraph and thus be roughly equivalent to one hundred words from the perspective of someone preparing a *paper document*. However, with digital representations the concerns about the number of bytes and how to store them is crucial and will influence the design decisions of educational content producers.

1.3.4.3 Multimedia Hardware

The first digital computers were built in the 1940s and were used for government purposes. The computer occupied an entire room of a building and people communicated with the computer in a primitive machine language. By 1980 the hardware had become so compact and powerful that the possibility loomed of building machines that would fit conveniently on an individual's desk, provide software packages for everyday use, and be inexpensive. These machines are called *personal computers* and are now commonplace. Their wide availability supports the goal of computer-supported education being possible on everyone's desktop.

Computers speak *languages* at various levels, such as the level of a memory device communicating with a central processor and of a word processor communicating with an operating system. Each developer or user of a personal computer component or application faces the difficulty of selecting the language that will prove most popular for the longest time. This problem is particularly acute in the 1990s for the development of multimedia components and applications.

Various *hardware and software* products are often incompatible to each other (Miller, 1992). To overcome compatibility problems, several major vendors jointly created the *Multimedia Personal Computer Marketing Council* about 1990. They produced and now maintain a Multimedia Personal Computer standard. This standard specified minimal conditions for a personal computer to be considered adequate in its support of multimedia. The standard requires a computer to have a CD-ROM drive, audio capabilities, and certain speed of a processing unit and size of main memory. Baseline software capabilities and media formats for such multimedia computers are also specified.

As an example of the historical complexity of evolving hardware, we describe the evolution of storage devices leading to the CD-ROM used in the multimedia personal computer. In the 1980s the popular physical medium for transfer of computer software and content was the diskette that stored about 1 megabyte. On such a diskette one could have one quality image and nothing more. A book with multiple images would typically not fit onto one diskette. Engineers proceeded to find solutions to this problem in the form of different kinds of diskette.

The development of a laser in a light emitting diode in 1962 signified the beginning of work on a storage disc that was based on laser reading of the disc content. In 1978 the videodisc was commercially launched. Subsequent videodiscs were 12 inches in diameter and could store about 2 hours of video. Information is encoded in analogue form and interactive video and audio are supported by devices that access the videodisc (Botto, 1992). Interactive educational products that incorporated video frequently stored the video on videodisc. The computer connected to the videodisc drive can jump to any portion of the video instantly on command whereas with the videocassette recorder on tape moving from one segment of video to another may take minutes of forwarding or rewinding the tape.

In 1982 *Compact Disc Digital Audio* (CD-DA) was launched. The Philips and Sony Corporations developed standards for storing information on these discs and by 1990 the CD-DA had virtually eliminated production of the vinyl disc record. The mass production of CD-DA has considerably influenced the development of CD-ROM.

Compact Disk-Read Only Memory (CD-ROM) was announced as an information storage medium by Philips and Sony in 1983. *CD-ROM* is an important technological development that has supported the spread of multimedia education (Oppenheim, 1991). The salient characteristics of CD-ROM are (Fujikawa, 1990):

- High information density. The disk can contain almost 1 gigabyte of data on a disc less than five inches in diameter.
- Low unit cost. Because disks are manufactured by a well-developed process similar to that used to stamp out long-playing audio records, unit cost in large quantities is less than two dollars.
- Read only medium. CD-ROM is read only. It is an electronic publishing, distribution, and access medium.
- The technology of the CD-ROM is based on small-holes burnt into a disk by a laser beam that store any kind of digital information.

While the CD-ROM does not have the capacity for storing two hours of video as the videodisc does, the CD-ROM has been the preferred medium for storage of interactive, multimedia educational product in the 1990s. The CD-ROM holds both computer programs and multimedia and its widespread usage has meant that per unit production costs are very low. As engineers continue to develop new devices for storing interactive multimedia, the CD-ROM will become outdated. The CD-ROM can not effectively store more than small clips of video. Already diskettes are being marketed that can store much more than that. However, the impact of these new devices will be a complex function of not just there technological capabilities but also of their acceptance into the marketplace. The technology of the CD-ROM was available years before its use became common.

As technology evolves, the standard for the multimedia personal computer also evolves. The existence of such *standards* help developers and users better understand and anticipate the characteristics of the tools in the marketplace. This is a vital concern of educators. Educators are not themselves trying to develop new technology but rather to use what is available and will remain available. If educators invest in a technology solution that proves incompatible with subsequent market trends, the educators suffer loses.

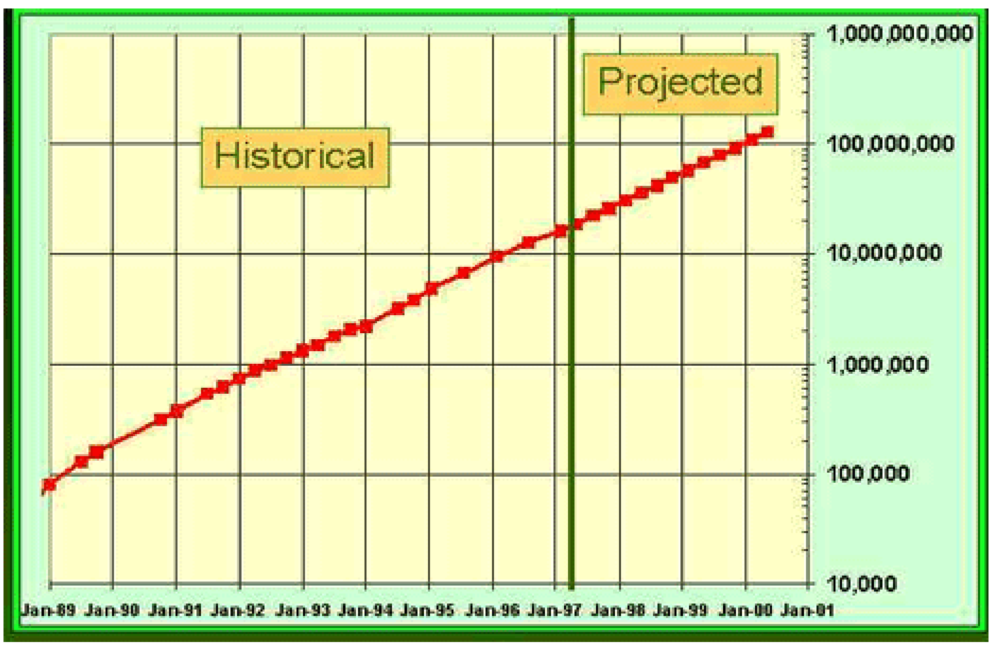


Figure 4: Internet Hosts Number of internet hosts are plotted against an x-axis with dates from January 1989 through January 2001 and a y-axis with numbers from 10,000 to 1,000,000,000 on a logarithmic scale**.**

1.3.5 Internet

The information technology revolution of the 1990s uses applications on the Internet. To appreciate the direction of this phenomenon consider that the Internet is an application of computer networking. The next step to realize is that applications can rest on applications -- like the World Wide Web on the Internet!

A computer network is a set of computers communicating by common conventions, called protocols, over communication media (Quarterman, 1990). Protocols are used to manage the exchange of information in the network over the physical medium, such as wires or radio waves. Information is exchanged in discrete units called messages. Because of size limitations of either the physical medium or the protocol, messages are fragmented into packets. Packets may be routed into different networks and be reassembled into the original message when they reach their destination node.

The computers in a network must share a common language or protocol. Given the complexities of this communication, the common language is broken into parts or layers. To manage the complexity of network protocols, layering schemes have been developed that allow a classification of protocols ranging from those close to the hardware to those close to the user.

The most popular computer network protocol is called the Internet Protocol (IP). The network that uses this protocol is called the Internet. In the United States in 1969 the Advanced Research Projects Agency (ARPA) demonstrated the viability of the first IP computer network called ARPAnet. The original motivation for development was resource sharing, as ARPA noticed many contractors were tending to request the same resources.

Researchers almost immediately began using the ARPAnet for collaboration through electronic mail and other services. The high utility of the network led people to want increased connectivity. Many organizations in which these networks were placed wanted to connect the ARPANet to their local network so that each user of the local area network would also through that network have access to the ARPANet. By now the Internet is all the networks using the IP protocol that cooperate to form a seamless network for their collective users (Krol, 1992).

The Internet has a strong `grass roots' character. The ultimate authority for the direction of the Internet rests with the Internet Society. The Internet Society is a voluntary membership organization whose purpose is to promote global information exchange through Internet technology. The Society appoints a group of volunteers to approve new Internet standards, to develop rules about the assignment of addresses, and to take other management-like positions. This group is called the Internet Architecture Board and is again composed of volunteers.

The Internet is not owned by any one company. Instead everyone owns and pays for their own part. A college or corporation pays for its connection to some regional network, which in turn pays a national provider for access. This arrangement is somewhat like the international telephone network. Internet growth has been phenomenal.

While the Internet was originally developed for research-related purposes, by May 1994 commercial users had exceeded 50% of the connected base and commercial usage was growing most rapidly. The number of internet hosts is increasing at an exponential number with no apparent immediate limiting factor (see Figure 4 “Internet Hosts”). In 1989 the world had about 100,000 internet hosts but by 1997 that had increased to 10,000,000 and is predict to reach 100,000,000 by the year 2001.

The Internet has been used in education from its early days. In disciplines, such as computer science, where teachers and students routinely had access to the Internet, email has been used for communicating between teacher and student since the 1960s. However, the Internet alone was not useful enough to most disciplines to have much impact on education. It was the wide-spread of an application that rides on the Internet that led to the major impact of the Internet in educaiton. This application is the World Wide Web (also called simply the web).

The web began at the European Particle Physics Laboratory in Geneva, Switzerland about 1990. There scientists collaborate with many other scientists around the world on the subject of high energy physics, and the web was developed to facilitate electronic collaboration (Berners-Lee et al, 1994).

Key features of the web include:

- the address system,
- a network protocol, and
- a hypertext markup language.

These features are extensions of the Internet and fully compatible with it. They allow properly structured Internet information to have a new kind of accessibility. The address system is based on Universal Resource Locators (URLs). URLs are strings which address objects on the web. The Hypertext Markup Language (HTML) was designed to be sufficiently simple to be easily produced by both people and programs. In addition to the hypertext links which readily take one from one section of text to another, HTML readily links to sounds, videos, or other kinds of information.

Since the first web browser was developed, many browsers are now freely available. There is an amazing growth in the number of web hosts too (see Figure 5 “WWW hosts”). In 1993 the world had roughly 0 WWW hosts, but by the end of 1996 that number had risen to 400,000 with no limit in sight (Rutowski, 1997). When one studies the distribution of this phenomenon, one discovers that it is occuring in all sectors, such as commercial, government, and education, and in all parts of the world

1.3.6 Information Systems

For the purposes of identifying a consistent framework for discussing the components of an information system, we identify three levels of abstraction:

- Strategic specification: This level of abstraction is mainly addressed to decision makers and education professionals and provides an overview of the fundamental objectives, characteristics and requirements of the Education Information System, up to a level suitable for understanding its major capabilities and planning its implementation;
- Conceptual specification: Starting from the strategic specification, this level of abstraction refines the description of the system by detailing the concepts through formal descriptions, independent from any specific technological environment. The conceptual specification is addressed to both education professionals and technicians.
- Physical specifications: These levels of abstraction are mainly oriented to technicians and developers, and refine the conceptual specification, detailing the characteristics of the Education Information System with respect to the types of technological solutions, and the specific products and configurations adopted for practical implementation.

Figure 5: WWW Hosts. The x-axis shows dates from 1993 through 1997 and the y-axis is number of WWW hosts from 0 to 450,000

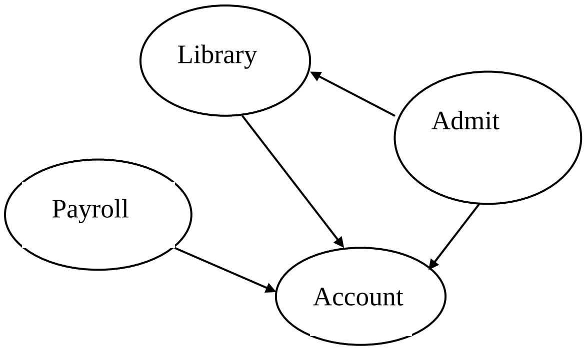


Figure 6: Centralized, monolithic approach

In this book we will move from one abstraction to another rather freely. We are interested ultimately in the strategic view. However, our approach to build a system of technology and people from the bottom to the top means that we need to consider the physical and conceptual levels too. Education information systems have significantly evolved during the past few years. The first generation of education information systems was mainly concerned with administrative and accounting issues, i.e. payroll, enrollment, general ledger, and was structured as a set of batch procedures, highly proprietary and with very limited capabilities of exchanging data (see Figure 6 “Centralized, Monolithic Approach”).

With the second generation of information systems, the scope has been extended to the support of a limited set of activities, mainly registration and some information services, related to the student. The concept of integration between procedures has been introduced, with the aim of improving the effectiveness of the overall organization and individual units, through a better exploitation of the integrated information history available in the education organization.

The third generation puts the focus on the student needs and professional aspects, in order to construct, incrementally, a homogeneous and consistent set of information. The objective is to evolve from isolated support to the individual units to the optimization of the cycle of activities related to the education of the student. Thus, the structure of the information system has changed from a set of autonomous fragmented procedures, first generation, to a closed proprietary block of functions, second generation, up to the modular, distributed and open environment which represents the objective of the third generation of information systems. Such modularity and openness supports a marketplace that evolves quickly and better supports educators and students. Individual products may be selected, evolved, and maintained independently even by different suppliers.

1.3.7 Artificial Intelligence

The history of artificial intelligence is an older one that of the internet. Still I put artificial intelligence here because it is in a way the unrealized dream. While hundreds of textbooks have been written about artificial intelligence, I will not attempt here to give an impartial scholarly account from those books but will rather present a potted personal view.

If we go to Charles Babbage and the loom we have the first evidence of a computer. The loom had patterns which determined what it would weave. John von Neumann in his seminal computer work of the 1940s already conceived of self-reproducing and evolving machines. Checkers programs of the 50s were able to perform as well as human experts.

Our understanding of human behavior and the role of chemicals and electrophysiology in controlling behavior, both simple and complex, has contributed to our belief that we can understand learning, thinking, and creativity. Having understood them, we are able to model them. If those models are precise, then why can we not program a computer to behave in the same way?

In the 1950s enormous attention was given to *perceptrons* as way for a computer to learn by trial and error. The perceptron work became unpopular in the 1960s and was replaced in the 1970s by an interest in knowledge-based systems. Into a knowledge based system a human was to pour large amounts of codified knowledge and the computer would then reason with this information. Substantial progress has been with such knowledge based systems but the amount of effort required to create one is great and the system has been typically rather brittle.

The 1990s saw a variety of trends. One the one hand, *neural networks* as a kind of resurgence of perceptrons became again popular. The idea here is basically that the computer is given very simple knowledge but through many many trials and with feedback from the environment, the machine learns and gets better and better at recognizing various patterns.

Another important trend of the 1990s has been to add artificial intelligence to programs that participate with people in group and organizational activities. The *work flow* of people is often now reflected in computer transactions whether they be simple email messages or more codified interactions with databases. If the computer has a model of social interaction or work flow, it can monitor these human-human interactions through the computer networks and suggest steps to take that would otherwise require an intelligent person to suggest. This kind of artificial intelligence has great potential to influence education.

1.3.8 Exercises

True or False

1) A document is a recorded body of information.
2) The first large-volume, digital document retrieval system was developed in the 1930s.
3) Hypermedia is a kind of hypertext.
4) CD-ROM is an abbreviation for Compact Disk
5) Random Order Memory. The number of Internet hosts grew at an exponential rate throughout the first half of the 1990s.

Knowledge Essays

1) If documents transmit culture and education perpetuates culture, what is the relationship between documents and education?
2) How many bits or space on a computer is required to store a one-hour long video?
3) Was there optimism for enormous video impact in the 1930s? Was that optimism realized?

Doing Essays

1) People across different historical periods fear the information explosion is most severe for them? Is this true now, and how might virtual education help reduce the anxiety induced by this fear?
2) How might one persuade the government to invest in new combinations of technology and education?
3) What kinds of learning, if any, might be supported by large document retrieval systems? And how would you use the MEDLARS system in a virtual education program?
4) How do you see the evolution of artificial intelligence and the World Wide Web coming together to influence the path of virtual education?

1.4 Conclusion

Education is crucial to society. Society builds tools to manipulate information, and the principles and applications of these tools are subsequently taught to students. Furthermore, the new information technologies may impact the methods of teaching. We need to understand both the *history* of education and of information technology to anticipate the future of education. While the future is uncertain, history and science both teach us that the past and the future are intimately linked. Accordingly, in this book, we have begun with a review of the history of education and of information technology.

1.4.1 Summary

Children learn initially by imitation and in primitive societies very little else exists in the form of an educational method. However, as societies have taken root and been able to invest in the future, they have developed educational institutions. These institutions may become integrated in the information age.

Apprenticeship learning is an extension of learning by imitation in which a student formally becomes associated with a professional and follows this professional in the daily activities. In the earliest universities students sometimes adopted *apprenticeship* roles relative to teachers as they extended their education.

As the Industrial Revolution took large numbers of people from the rural villages into industrial towns and put their parents into jobs at the factory, the need for systematic education by institutions of large numbers of relatively poor city dwellers increased. The *monitorial method* was introduced in England around 1800 to help deal with the large demand for education. The method used senior students to teach junior students. In this way one adult teacher could successfully manage a school with one thousand students. The church was not involved in the introduction of the monitorial method. The first monitorial teachings focused on basic principles and skills without particular adherence to a religious view. The church was concerned about its lose of influence in the school system, and subsequently introduced its own version of the monitorial method. The British government was brought into this competition and decided that the state should support education. Prior to this time in England the state had not taken a particularly active role in education.

In the 20th century people are talking about *cradle-to-grave education*.. Students from early childhood to late adolescence in many societies are enrolled full-time in public schools. Adults are increasingly in continuing education programs. Distance education has become a significant factor in certain educational marketplaces, and millions of students have now participated in some form of distance education. The new information technologies increase the opportunities for distance education.

Information technology may be broadly construed to be any artifact of people that is information-oriented. Thus natural language is an artifact for dealing with information. The written word and later the printed word are further extensions of natural language. Documents as records of the written word are thousands of years old. Enough documents existed and needed to be collected for the benefit of society that the ancient Egyptians already created a library. We note with interest the peculiar character of people that each generation believes it is faced with the greatest *explosion of information* to face mankind. People seem able to continually create more information and simultaneously find ways to somehow deal with this growth in the amount of information. Education is vital to conveying the models to the next generation which help grasp what is essential about the new information and to look effectively for new information that can be added to the existing base.

Libraries are a cornerstone of the educational process. They harbor the information which is being transmitted from generation to generation. However, for the purposes of a classroom or an individual student the library is typically only a secondary source of information. A few textbooks, the teacher, other students, and a few other sources of information are more important to the individual student than is the library. Still without the library the whole system would collapse for lack of a way to keep track of the accumulated wisdom.

The *computer* creates new possibilities for information manipulation. Not only can the computer store information and help people retrieve it but the computer can process this information in ways otherwise unique to people. For instance, the computer can help people instantly retrieve any one of millions of documents from a library. Or in dealing with single documents the computer can store links among the components that people can browse in ways not practical with a paper-based document. Such a mapping of document components in ways that reflect the associations in a model of knowledge are hoped by some to help learning from hypertext be more effective than learning from text.

Digital information can not only render text but can also render other *media*. Video and sound can be conveyed through multimedia computers. Video and sound were broadcast or recorded for distribution decades before computers existed. The impact of the telephone, film, television, and radio on education in the classroom has been much less than had been earlier envisioned. These media have, however, extended significantly the reach of distance education.

Until recently, computers were only able to efficiently handle alphanumeric characters. Developments in information technology have now made other media, particularly images and sound, amenable to computer-based storage, manipulation, and transmission. The synchronization of media gives multimedia. *Hypermedia* is multimedia with links among the components and a mechanism for moving along the links. Hypermedia has a very important part to play in communication in that it serves to make sense of otherwise discrete components and conveys an overall conceptual structure. Additionally, the links when supported on the computer can include programs that allow for complex transactions to occur each type a person chooses a link. Through such sophisticated hypermedia tools one might expect to build tutoring systems that begin to mimic the capabilities of teachers for certain circumstances.

The computer can bring together media and text in globally distributed networks that people can readily access whenever and wherever they want. Thus the *computer networks* create a vast, new distribution channel. The growth of these computer networks depends in part on an agreement on standards. The Internet is one such standard and has grown over the three decades of its existence in a largely exponential fashion. It is now accepted as a protocol of choice in computer networking society-wide. Teachers and students now frequently have access to the Internet and use it to some advantage in educational endeavors.

Electronic mail across the Internet helps people communicate. To help people access and manipulate complex hypermedia documents, *the World Wide Web* or web has come into existence. The web is an application that rides on the Internet. The web supports hypermedia documents, as well as rich forms of other interactivity. The growth of web transactions on the Internet has been exponential in the few years that the web has existed and now tens of millions of people use it daily. The web has the potential to broadly and deeply influence the structure and function of organizations, including educational organizations.

Artificial intelligence is the use of computers to deal with information in ways otherwise unique to people. From the earliest days of computers people have wondered whether the computers could be programmed to behave intelligently. To each new accomplishment in the field of artificial intelligence the reaction has been to find another activity that was uniquely human and to hold this as the next challenge to artificial intelligence. Computer programs have been repeatedly written that for certain topics were able to teach in ways that seemed intelligent. These programs have not achieved wide-scale acceptance for a variety of reasons. The promise remains that further developments in artificial intelligence will fundamentally change the character of the educational experience.

People continuously develop new information technologies. Records on clay of the number of sheep in person's flock were kept already 6,000 years ago. Our information base seems often to grow at an exponential rate and means to deal with this information explosion have confronted us at least as early as the ancient Egyptians who introduced libraries to help handle this information explosion. 18th century bibliographies were another response to a perceived information explosion. Computers that could support interactive terminals and other devices such as the mouse supported interactive documents already in the 1960s. Multiple developments in the 1970s were technically impressive but not enough users had the technology to allow for much practical impact. Now the pervasiveness of the World Wide Web and the power of artificial intelligence give people new *opportunities* to semi-automate various aspects of the educational enterprise.

1.4.2 Dialectic

We recognize the wide range of developments and the tumultuous marketplace history that has manifested itself in just a few decades. The rate of technological change and its spread through the society has accelerated over the centuries. An organization has an environment and needs to continually adapt to it. Education both helps society adapt and must itself continually adapt.

Biological and social evolution function in much the same manner. Both are processes by which biological and social organisms fill empty niches within an *ecosystem*. These niches are themselves continually evolving. The fundamental difference between social and biological evolution is that societies do not have encodable genetic structure but rather a body of knowledge and devices, such as libraries and computers. The fundamental processes of evolution in the form of variation, selection, and retention, each have their analogue in biological or social evolution. (Zammuto, 1982).

The major forces for variety are *constituent preferences* for performance. Incorporation of various constituent preferences for performance substantially complicates the life of organizational decision-makers. Different constituents will judge different aspects of organizational effectiveness. For an educational organization, constituents include at least, the students, the employers of the students, the teachers, administrators, sponsors of the educational organization, such as government, and past graduates.

In addition to the constituents, the educational organization is constrained by the environment. These environmental constraints include tradition and technology. These *environmental constraints* constitute the boundaries of an organization's niche. In short, the environment creates a broad set of constraints against which an educational organization operates as it tries to satisfy its various constituencies.

The evolutionary framework requires that organizational performance be evaluated within the context of the environment. Social organizations can change constraints and thus expand or contract the very niche in which they survive. The effective organization is a *niche expander* whose performance adds to the organization's ability to adapt to change.

For much of history people have lived at a subsistence level where the production of materials was just enough to survive. As the ability to produce far exceeded the need to survive, the quintessential questions of economics arose to ask about this surplus: its origin, its magnitude, its rate of growth, and who should get it (Wolff, 1984)?

The 18th century English economist Adam Smith argued that the most effective economic system was one in which people on an open market exchange goods based on their sense of the value to them of the goods. Thus marketplace pressures determine who gets what surplus. The 19th century German economist Karl Marx took a rather different view of who should get the surplus. Marx argued that capitalists were exploiting workers and taking more than their fair share of the surplus. He claimed that the only solution to this problem was for the state to control the capital.

The differing economic views of Adams and Marx are linked to the issues of material production. The information age of the late 20th century does not succumb to the same physical constraints of manufacturing or farming. Education plays an increasingly critical role in a society where the economics are most intimately linked to information.

The term friction-free capitalism captures part of what is happening in the new information economy (Lewis, 1997; Gates, 1996). The term means in part that consumers and producers interact directly without a middle-man. Thus the friction or costs associated with the middle-man are removed. However, for some activities, such as education, certain kinds of administration seem essential and the model of student-teacher relationships devoid of any overhead administration would be unrealistic. So in a society in which friction-free capitalism is appearing how do educational organizations acquire the capital to adapt themselves and how does the surplus get spent?

In `Electronics and the Dim Future of the University' (Noam, 1995) the history of education is presented as one in which information was collected at educational institutions and students went to those institutions to get information. Universities must now focus on attracting students who want to share a physical community and that commercial organizations might play an increasingly dominant role in the creation and delivery of education for many students. One refinement to this argument notes that education has always been about providing a sense of community and helping students learn to contribute to that community.

Changes in the methods of storing and disseminating information require institutions to adapt. The long-standing, state-supported educational institutions have a structure that is suited in many ways to the growing outreach function of education. How will the combination of new technologies combine with the trends of history to anticipate the kinds of educational organizations that will dominate in the future.

We began this chapter with a quote from Chesterton about the importance of history in understanding the present. We close with a quote from Schlesinger (1986) about the importance of the merger between the history of technology and people in anticipating the future:

> Science and Technology revolutionize our lives, but memory, tradition and myth frame our response. Expelled from individual consciousness by the rush of change, history finds its revenge by stamping the collective unconscious with habits, values, expectations, dreams. The dialectic between past and future will continue to form our lives.

1.4.3 Exercises

True or False

1) Educational systems have changed frequently and rapidly over the centuries.
2) Information technology has grown in dramatic ways in the 20th century.

Knowledge Essays

1) Sketch the history of education.
2) Sketch the history of information technology.

Doing Essays

1) The history of education shows that it perpetuates the culture of those organizations which sponsor the education. Why will this observation remain important for interpreting the purpose of new education initiatives and for virtual education in particular?
2) This century is witnessing a growing emphasis on cradle to grave education that occurs at school and then continues in the workplace throughout life. Information technology has developed to the extent that we can see a computer in every home and on every desktop that is connected to every other computer. How will the relationship between these two phenomena unfold?

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Part I: Learn and Teach

Part I: Learn and Teach

This part of the book examines the principles and practices underlying learning and teaching as related to courseware and the virtual classroom. The intention as throughout the book is to emphasize the mappings that are appropriate among people, their tools, and their educational needs.

2. Learning and Courseware

Learning Objectives

Figure 7: Student learning at the computer.

To understand

- the complex mapping among students, the tools and methods used for learning, and the learning problems.
- the different types of learning as reflected in the taxonomy of learning types
- the impact of learning by doing
- the impact of different media on different learning objectives.
- the history of intelligent tutoring systems,
- the components of intelligent tutoring systems, and
- standards for courseware.

2.1 Introduction

We have discussed how education from the societal perspective is about perpetuating the culture. However, from the individual student perspective education is about learning. Learning is the consumer side of the education enterprise. A business has a core competency, so that for instance the core competency of a restaurant is preparing and serving food even though the broader role of a restaurant in a community may be something else. The core competency of an educational organization is teaching and for students the principal responsibility is learning.

What do we know about learning? Under what conditions does learning occur? In addition to taxonomies of learning that have been well established, what are the popular conceptions of the conditions under which learning best occurs? Might we find interesting patterns in that ways of learning from centuries past are in some sense returning to the scene as individualized, learning-by-doing opportunities are facilitated by the new information technologies.

Courseware is the embodiment of educational material in a computer system. The dream of courseware developers is that students can interact with the computer in ways that would have otherwise been restricted to the interaction between the student and the teacher. How long has this dream been in existence and what has happened in the marketplace?

Since at least the 1960s some educators have been attracted to the possibilities of using computers and networks to support learning. Have the anticipated impacts followed the expectations of the enthusiasts? People have a long history across generations of dealing effectively with paper forms of information. Should we expect to replace paper with computer forms? Or might the better solution be complementary combinations of the media with paper still an integral part of the solution?

A courseware system that behaves like a teacher is sometimes called an intelligent tutoring system. What are the basic components that such systems must have to be effective? Developing intelligent tutoring systems is very costly. Are there tools that facilitate the creation of intelligent tutors?

As the knowledge of students, the domain, and teaching are incorporated into intelligent tutoring systems, where else can such systems go for heightened features? One direction is the incorporation of further hypermedia features to give the student the sense of being embedded in a real-world situation despite only being on the computer. Such virtual reality systems have what future in education?

As we review the wide range of tools available to educators, we must ask what experience has been gained in their application to learning. Unfortunately, the wealth of experience does not distill easily into detailed guidance about what to do next. The many developments in the field have often been one without proper reference to another. Even the terminology used by the developers has not been consistent. Thus comparing one observation to another observation is fraught with difficulties of knowing whether one person's apples are the same as another person's apples or whether we are instead mixing apples and oranges. How will we come to some agreement about what has been done and what should be done?

Standards are about common languages. In the courseware arena standards are sorely needed. Even simple standards about the structure of courseware would help greatly, if they were widely adopted. This chapter focuses on how a student learns, what impact technology can have on individual learning, the design and application of courseware or intelligent tutoring systems, and the standards that apply to the design of courseware. All these things must come together for technology to make a significant impact on learning.

2.2 Learning and Pedagogy

The study of learning is well established. Cognition is studied by psychologists. Some psychologists specialize in learning psychology, but other disciplines such as education also address learning. Pedagogy is the art or profession of teaching. What is known about *learning and pedagogy*?

2.2.1 Taxonomy

A group of educational psychologists developed a classification of levels of learning. This became a taxonomy, sometimes called *Bloom's taxonomy*, that included three overlapping domains: the cognitive, psychomotor, and affective (DLRN, 1997 and Bloom, 1956).

Cognitive learning is demonstrated by knowledge recall and the intellectual skills: Bloom's taxonomy identified six levels within the cognitive domain, from the simple recall or recognition of facts, at the lowest level, through increasingly more complex and abstract mental levels, to evaluation at the highest level.

For a teacher to help a student integrate new knowledge into the student's existing models of the self or the environment, the teacher must help the student identify the relationships between what the student already knows and what is new to be learned. This is typically done by giving the students questions to answer that stretch the student's thinking about the new knowledge. Below are the six cognitive levels as they correspond to questions that a teacher might ask to help a student learn:

1) *Knowledge* involves recall of information and relates to questions such as who, what, when, where, how ...?

2) *Comprehension* involves organizing and selecting facts and ideas, and asks how would you describe in your own words?

3) *Application* is problem solving or use of facts, rules and principles. Typical questions take the form: How is...an example of...? How is...related to...?

4) *Analysis* is separation of a whole into component parts. Questions include: What are the parts or features of...? How does... contrast with...?

5) *Synthesis* is the combination of ideas to form a new whole. Questions include: What would you predict from...? How would you create a new...?

6) *Evaluation* is the development of opinions, judgements or decisions. Typical questions are: What is the most important...? What criteria would you use to assess...?

Many teachers tend to ask questions in the "knowledge" category (Cerny, 1997). These questions are not bad, but using them all the time is.

The American Psychological Association developed its own *learner-centered, cognitive principles*. Learning is a natural process that is active, volitional and internally mediated; it is a goal-directed process of constructing meaning from information and experience, filtered through each individual's unique perceptions, thoughts and feelings. The learner seeks to create internally consistent, meaningful and sensible representations of knowledge regardless of the quantity and quality of data available. The learner organizes information in ways that associate and link new information with existing knowledge in memory in uniquely meaningful ways. Higher order strategies for "thinking about thinking"--for overseeing and monitoring mental operations--facilitate creative and critical thinking and the development of expertise.

Affective learning is demonstrated by behaviors indicating attitudes of awareness, interest, attention, concern, and responsibility and ability to listen and respond in interactions with others. The depth and breadth of information processed and what and how much is learned and remembered is influenced by

- self-awareness and beliefs about self and one's learning ability (personal control, competence and ability);
- clarity and saliency of personal goals;
- personal expectations for success or failure;
- affect, emotion and general states of mind; and
- the resulting motivation to learn.

Psychomotor learning is demonstrated by grace and actions which demonstrate the motor skills such as use of precision instruments or tools.

Basic principles of learning motivation and effective instruction apply to all groups of learners. However, learners differ in their preferences for learning mode and strategies, the pace at which they learn, and unique capabilities in particular areas. These differences are a function of both *environment and heredity*.

Of the three domains of affective, psychomotor, and cognitive learning, the one most addressed by this book is the *cognitive*. We do not concern ourselves in this book with psychomotor learning. We will discuss learning in the classroom, learning in the workplace, and learning within the general context of organizations – all of which relate intimately to affective as well and cognitive learning.

2.2.2 Learning by Doing

The notion that students will learn better when they can test the models they are learning in real-world situations has been long accepted but not always practiced. Contemporary educators who are also proponents of using the computer in education claim that *learning by doing* is vital and that computers can support this -- as attested here by snapshots of the perspectives from Roger Schank and Ben Shneiderman.

Roger Schank directs the Institute for the Learning Sciences at Northwestern University (see Figure 8 “Schank”). The Institute embodies Schank's concepts for conducting leading edge interdisciplinary research in human learning and providing software solutions for education.

Schank (1997) claims that the number one problem with education today is:

> Schools act as if learning can be dissociated from doing. There really is *no learning without doing*.

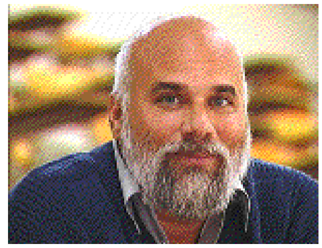


Figure 8: Roger Schank

Figure 9: Ben Shneiderman

If there is nothing to actually do in a subject area we want to teach, it may be the case that there really isn't anything that students ought to learn in that subject area.

The solution to the crisis of ineffective learning is to switch from reviewing to doing. Today's schools are dominated by the need to assess student performance. Test scores and grades measure the wrong things and thus cause the wrong things to be taught. What is important is *achievement*. Replace testing with levels of achievement that are objective, relevant, and highly motivating.

Ben Shneiderman's (1997) motto is `Real Projects for Real People' (see Figure 9 “Shneiderman”). He says: (Shneiderman, 1993):

> The post-TV media of computers and communications enables teachers, students, and parents to creatively develop education by engagement and construction. Students should be given the chance to engage with each other in team projects, with the goal of constructing a product that is useful or interesting to someone other than the teacher. Challenges remain such as scaling up from small class projects to lecture sections with hundreds of students, covering the curriculum that is currently required by many schools, evaluating performance, and assigning grades. However, there seems to be no turning back and, anyway, the children of the Nintendo and Video Age are eager to press fast forward.

Students will be engaged by writing and drawing, composing and designing, and planning and drawing. Teachers should promote engaging in the world, helping where needed, caring for others, and communicating ideas. Project-oriented learning allows the aforementioned guidelines to be realized in the most natural way.

2.2.3 Content Standards

We address repeatedly in this book the three areas of people, their educational needs, and their tools. The preceding discussion of learning taxonomies concerns the styles of people. Here we want to address further specification of educational needs specific to the *content of a domain* and the cultural imperative of a school. Schools are developing standards for what students should learn in particular domains.

The California Department of Education has developed extensive standards for what children should learn in all subjects across all the grades from kindergarten through 12th grade (California, 1995). We illustrate here a few points from the *social science standards*. Children in kindergarten are expected to develop attributes of good citizenship and learn to work with others. Specifics within that citizenship standard include the ability to discuss simple stories that illustrate good citizenship. As the students progress, the standards are considerably more specific as regards content. For instance, the 8th grade standard includes "the student will demonstrate an understanding of the principles underlying the American Revolution." One substandard is that the student understand the Declaration of Independence and its embodiment of the principle of consent of the governed.

Other states have similar standards and various professional bodies have standards that address what content should be covered in various fields of study. We will discuss in a later chapter the accreditation standards and mechanisms that exist across schools. These accreditation standards address both the process by which education is delivered and the specific content. For instance, within the realm of computer science education, we will present some of the domain specific information that a student is required to understand in order to get a degree in computer science. The importance of all these standards is that they relate to our ability to address formally and systematically the relationship among learner's abilities, what it is they are to learn, and what tools might support this learning. In other words, content standards represent educational needs and must appear in the important mapping among *people, their educational needs, and their tools*.

2.2.4 Exercises

True or False

1) At the simplest level, Bloom's Taxonomy identifies analysis and at the highest level it identifies evaluation.
2) Cognitive learning, affective learning, and psychomotor learning are different.

Knowledge Essay

1) What does "learning by doing" mean?

Doing Essays

1) Various cognitive learning taxonomies, such as the one called Bloom's and the one from the American Psychological Association, have been constructed. Present your own version of a two-category cognitive learning taxonomy.
2) Schank said that if a topic can not be taught via 'learning by doing', then the topic is not worth teaching. Give an example of a topic that you were not taught via learning by doing. If it could have been taught via learning by doing, how?

2.3 Courseware

Simply delivering information by computer has relatively little advantage over delivering by paper in many cases. However, with the computer one can gain *interactivity* that is not possible with paper. By placing some intelligence into the computer so that the interactions it provides do some of the work of a teacher, one gains a kind of cost effectiveness in education. An enormous amount of work has been done to help establish the principles and practice by which computers can assume the role of the teacher in interacting with students (Wenger, 1987).

2.3.1 Historical Snapshot

For several decades using computers to support education has been popular. The early years of traditional *computer-assisted instruction* were revealing along many dimensions. First, we learned that courseware as a stand-alone tool can be effective under certain circumstances. Second, the development of pre-planned, tutorials proved far more difficult than we had thought it would when the movement hit its stride in the late 1960s and early '70s. Third, students often became frustrated with non-interactive linear or lockstep instruction over which they had very little control. Even so, some of the early computer-aided instruction was effective, and the lessons from it are worth remembering. The technology-aided instruction of today is taking on a decidedly different pedagogical flavor from these earlier efforts (Cartwright, 1993).

We describe one medical school example from the 1980s that integrates several tools and methods. In 1985, the Cornell School of Medicine began experimenting with the idea of using computers to make the learning process more efficient (Diaz 1991). As a result, students taking the course *Introductory Pathology* could enroll in an electronic version PathMac of the course. Macintosh computers tied into the PathMac database were scattered throughout the campus for student access. Students could study online textbooks, run simulated laboratories, or test their mastery of physiology by viewing online dissections.

PathMac provided online access to approximately seven gigabytes of images and bibliographical material that can be searched intelligently, cross-referenced, and printed. A selection of materials was available for biochemistry, anatomy, neuroscience, parasitology, physiology, radiology, and pathology.

One online application was an electronic pathology text called *HyperPath*, which included large portions of a version of a well-known book textbook. Professors could add text and graphics. A visual archive called Carousel included thousands of images. Carousel images could be paired with questions.

Another program was used to perform *simulated laboratory experiments* that otherwise would be performed on live cats. The system could be set up to test the response of various drugs on simulated cat muscle. The students chose which drug to inject, in what quantity, and then electrically stimulated the muscle and recorded the results on a simulated strip chart. Much more control over the results could be achieved than is possible with live muscle.

One kind of simulation uses *flowchart logic*. For instance, in one courseware a young man who presented with a severe asthmatic attack after a walk (see Figure 10 "Flowchart"). The season is spring and the walk was in the countryside, both facts suggesting an allergic etiology of the disease. If the student's choice is to perform the case history or the skin tests, the computerized tutor comments that the choice is wrong given that the priority is to relieve the patient's symptoms. An essential physical examination and appropriate treatment should be immediately performed. Once the prescription of the correct medication results in normalization of the respiratory sound and congratulations from the tutor, a case history may be taken. The tutor emphasizes the key questions that should be asked in order to determine the possible allergic origin of a respiratory disease. The student performs the skin tests and evaluates the reactions. Diagnosis of the allergy pollens may be made and a correct hyposensitizing treatment planned. After usage with medical students, the teachers concluded that hypermedia was an effective and powerful learning environment that could be used to supplement, but not replace, traditional methods.

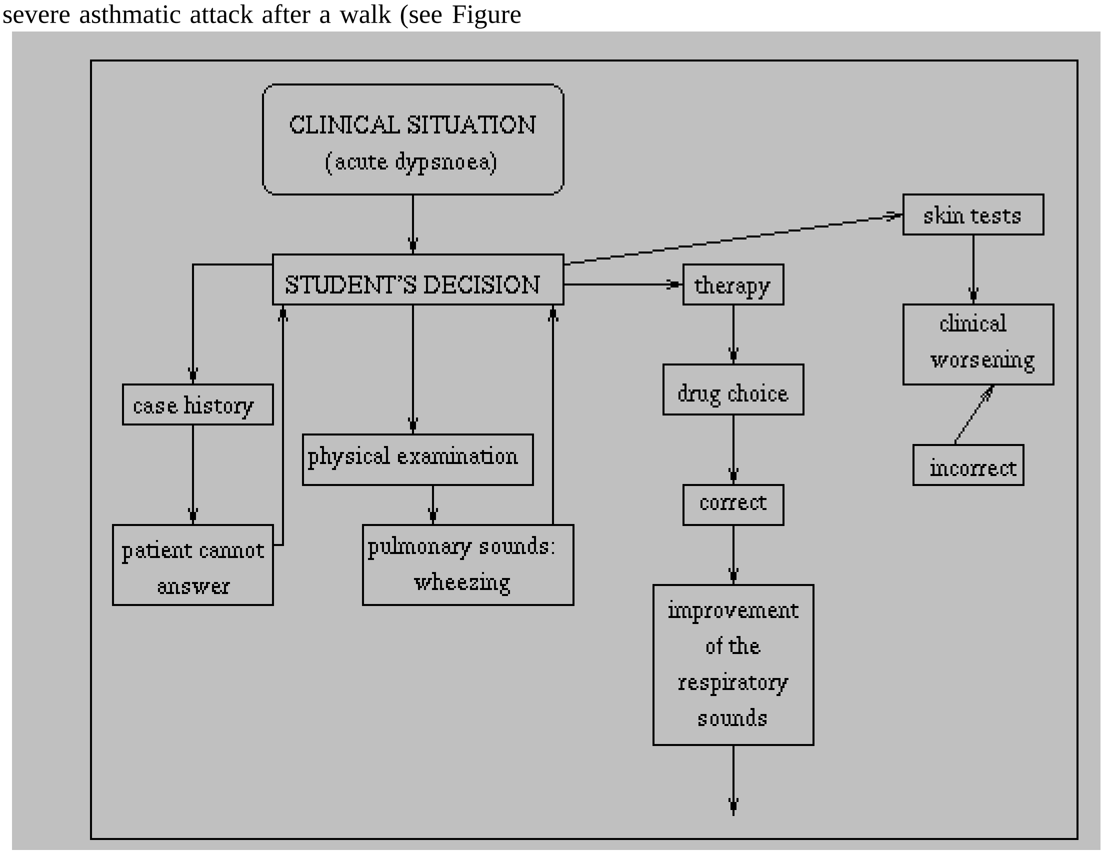


Figure 10: Flowchart describing all routes that the student may follow managing the simulated patients affected by allergic asthma (Corvetta et a1, 1991).

2.3.2 Hypertext versus Paper

While progress with the use of computers in education has been considerable over the decades, there remain many occasions when paper or other media are more appropriate. Take, for instance, the case of paper and contrast that with its electronic counterpart of hypertext. *Paper* is a well known delivery channel. It has the wonderful characteristics of familiarity, tangibility, and ease of reading. Essentially everyone can handle paper products. Hypertext is text with links in it that is delivered on a hypertext system, namely a computer. It has some capabilities not present in paper, such as the ability to interact with the user but lacks the familiarity, tangibility, and universality. We will explore here some of the tradeoffs.

While hypertext systems and networks of text may be powerful tools for communicators in certain situations, in many situations they are not as effective as paper. What is the market niche for hypertext? People have an enormous *competence with paper* documents based on years of practice. A good document flows smoothly, as a theme introduced on one page is carefully continued on the next page. References from one sentence to another are important. For example, in

> "Nick hit the ball with his club. It went far."

the 'It' in the second sentence refers to the 'ball' in the first sentence. More subtle and powerful references occur across paragraphs and across sections, and their potency depends on the reader taking a path through the document which the author has anticipated. With hypertext the path which a reader is expected to take is not specified, and thus a given text block must be flexible enough to make good sense when reached from one of many possible directions. Perhaps one can not write good hypertext which can also be seen as good text.

In our studies, we note the type of user, the type of task, and the type of hypertext system. Our subjects were expert and novice students at our university who were asked to answer search or browse questions with various *hypertext and paper versions* of our book. (Rada and Murphy, 1992). The results are surprising.

A question such as

> "On what date did Vannevar Bush publish his hypertext paper?"

requires the reader to find one fact and may be easily answered with a hypertext system that provides a strong search capability. On the other hand, to answer a question such as 'How did the work of Vannevar Bush compare with the work of other hypertext pioneers?' may require browsing several parts of the book. The first type of question we call a *search question*, and the second type of question, a *browse question*.

Experts were asked search and browse questions. Their answers were marked for quality and time-spent. Users of a hypertext version of the book got the highest-quality answers to search questions, while for browse questions, paper was best.

Novices were given the same search and browse questions which we had given our expert subjects. The quality and speed of the answers were best when the students used paper. For these `novice' subjects the values of paper outweighed any advantages of hypertext.

Paper is a powerful medium whose familiarity, tangibility, and portability make it more attractive than computerized hypertext for many tasks. Hypertext systems are useful for searching tasks, and when the links for browsing are tuned to a particular task. In some cases, rather than asking whether hypertext systems will replace paper or not, we should be looking for the ways

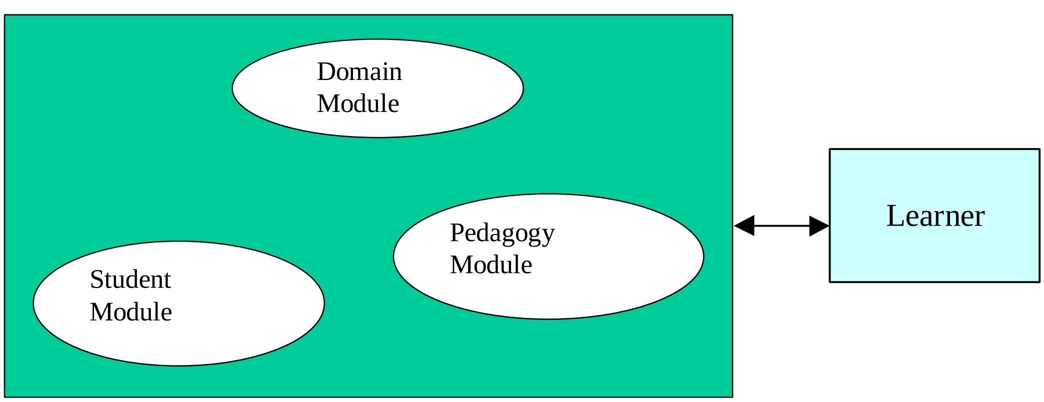


Figure 11: Intelligent Tutoring System and Learner

in which the two media can *complement one another* (Rada, 1991a).

2.3.3 Intelligent Tutoring

When we have reason to believe that a paper version of a course or a hypertext version are not optimal media for delivering the content, then we begin to imagine the components of the tutoring system that we might create or use. In terms of generally powerful intelligent tutoring systems, a set of basic *components* is needed. In general, all intelligent tutoring systems have a similar architecture comprised of an expert or domain module, a student module and an instructional or pedagogical module (Vasandani and Govindaraj, 1995; Murray, 1997). The domain module contains the domain expertise which is also the knowledge to be taught to the student. The student module contains a model of the student's current level of competence. The pedagogy module is designed to sequence instructions and tasks based on the information provided by the domain and student models (see Figure 11 "Intelligent Tutoring System").

How might we represent the *domain module* in an intelligent tutoring system? Much interest in expert systems did not result in many practical, complex systems. Hypertext systems have proven more popular. One way to implement an intelligent tutoring system is to use intelligent hypertext. With intelligent hypertext some of the *expertise* of people which is otherwise outside the computer system is moved into the computer. Expert systems are built by knowledge engineers and experts who together translate expertise into a knowledge base plus inferencing mechanism (see Figure 12 "Expert System"). While the *expert system* may directly solve problems, it also communicates knowledge from an expert to a user (Hayes-Roth et al, 1983). A hypertext system is built by a hypertext engineer who works with a writer to convert experience into a text base plus links plus browser. With a *hypertext system* a writer communicates with a reader (see Figure 13 "Hypertext System"). These parallels suggest a gradual path from representing domain knowledge in a hypertext systems to representing that knowledge in an expert system.

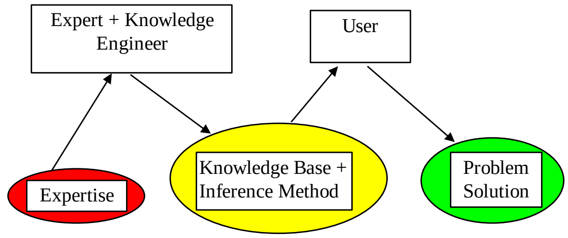


Figure 12: Expert System

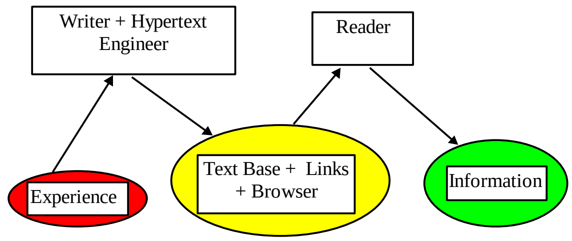


Figure 13: Hypertext System

The *student module* in an intelligent tutoring system maintains a model of the student's current understanding of the domain. It stores actions taken by the student and has some means of representing the student's knowledge derived from recorded actions. Representation of data in such a student model must facilitate its comparison with the domain model of the task to enable evaluation of misconceptions in the student (Van Marcke, 1995).

The *pedagogy module* of an intelligent tutoring system is responsible for several activities. Its primary function is to control the curriculum, that is, select the material to be presented and its form of presentation. In addition, the pedagogy module evaluates student's misconceptions based on observed actions. The pedagogy module makes use of rules pertaining to presentation methods, query response, and conditions for tutorial intervention.

An intelligent tutoring system models a student's understanding of a topic as she progresses through tasks, and compares this against a model of what an expert in that domain understands. If there is a mismatch, it can use its domain model to generate an *explanation* in that domain that will help the student understand. Broad actions considered by the pedagogy module include:

- Give help,
- Motivate learners,
- Give exercise,
- Guide with explanation, and

```
Learner-system interaction
 Mode of interaction
    Menu
    Text
    Speech
    Virtual reality
 +Communication roles
    Teacher-Learner
    Master-Apprentice
    Collaborative partners
 +Content types
    Problem
    Question
    Example
 +Control
    In-turn
    Free dialogue
    Case-oriented
```

Figure 14: Learner-system Interactions. A part of the taxonomy with just 3 bottom-level children.

- Assess student progress.

As evidenced from an extract of a taxonomy of intelligent tutoring systems (Mizoguchi et al, 1996), the interactions between the tutoring system and the learner must specify the mode of interaction, communication roles, and content type (see Figure 14 "Learner-system Interactions").

Based on the model of an intelligent tutoring system, we could either design a new system or examine existing systems. For instance, we might examine a historically interesting piece of courseware called WEST and describe it in terms of the models of tutoring systems that we have presented (Mizoguchi et al, 1996). The *WEST courseware system* is well documented in the literature. It selects and presents a problem to the student (Brown and Burton, 1978). Based on the student response, WEST updates its student model and determines whether the student has mastered the problem or not. If WEST knows a better rule for solving the problem than the student seems to have invoked, then WEST presents the superior rule to the student along with an explanation.

Given the great effort required to build an intelligent tutoring system, one question naturally arises as to the extent to which the computer can be programmed to build on its experiences so as to improve the domain, pedagogy, or student modules. Machine learning is relevant to intelligent tutoring in multiple ways. For one, we are trying to help students learn and we might expect that insights about machine learning and human learning would be cross-fertilizing. Also an intelligent tutoring system that had a machine learning component might improve its ability to deal effectively with different students.. In one model of a learning system the *environment* supplies information to a *performance element* which uses a knowledge base to perform its task (Forysth and Rada, 1986). A learning element uses this information to make improvements in the knowledge base (see Figure 15 "Learning System"). To extend this model, the environment is seen as providing student interactions and the performance element decides what pedagogical material to present next to the student. Based on the environmental feedback to the performance element, the learning element operates on the knowledge base so as to produce better knowledge.

2.3.4 Tutoring Shells

While the inherent complexity of intelligent tutoring system applications results in many benefits over those found in more traditional computer-aided instruction approaches, these benefits have historically come at the expense of undesirably high development, delivery, and maintenance *costs*. A reasonable approach to reducing development costs is through the use of an tutoring shell, a specialized construction tool. The generality of such shells can vary greatly and there may be different types

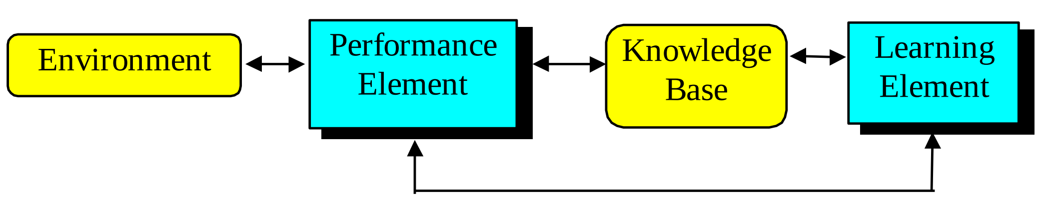


Figure 15: Learning System. The environment is the basis for performance feedback to refine the knowledge base.

of generality. The shell might attempt to be very general, or it might restrict the resulting tutoring systems to a particular domain (e.g. electronics) or it might restrict the tutoring systems to a particular type of task (e.g. conversing with another human over the phone).

A *tutoring shell* can be placed along a continuum of the amount of generality it allows in the resulting systems. An excellent opportunity for understanding the difficulties associated with very general tutoring system shells can be seen in the history of general purpose expert system shells. As with tutoring system shells, expert system shell development has been driven, in part, by the need to reduce system development costs. Early expert system shell development attempted to follow the `more is better' approach and incorporated many features within one tool. This approach allows a shell to meet the needs of more users, but often at the expense of any particular user. In later expert system shells, many of these features were deemed unnecessary and removed. This evidence suggests that it may not be advisable to construct general purpose, "one-size fits all", tutoring system shells, but rather to concentrate on shells with general features for a specific domain or type of task.

With shells that restrict the type of tutoring system that they can produce, one type of restriction is the *domain area* within which a tutoring system can be developed. For example, a shell might be developed that includes a great deal of domain knowledge about electronics and allows instructional designers to develop a variety of intelligent tutoring systems within that domain. The resulting systems could vary according to the age and background of the target learners and also according to type of learning environment best suited for the particular aspects of the domain being addressed.

Another way to use limitations on the generality of a shell (to produce higher quality resulting systems) is by restricting not by domain area but by the *type of task* that the learner is asked to perform. For example, a system can be used to produce a variety of intelligent tutoring systems, but each will be centered around the task of a learner conversing with another human over the phone. The learner might be someone training to be a customer sales, service or repair representative, a travel agent or a human resources specialist.

While end-users (students) may not need to know the linkage between the "upper models" and implementation details, the tutor developers do (Yum and Crawford, 1996). The trouble with conventional development of tutoring systems is that their abstraction layers are mainly for internal (largely computer science based) consumption. As a result, the abstraction is too involved for use by other experts who are not in the computing field. To overcome such barriers for generic tutoring system development, tools are needed to provide handles for the developers to input their *upper model specifications*. For example, if the purpose is to support the specifications of a tutorial strategy, the collaborative development system may need to provide three major functionalities:

- a simple database front-end interface for the instructional designers to input or import their tutorial rules;
- a dialogue box to allow the developer to select from a list of tutorial rule firing strategies; and
- a rule invocation tracer to track the firing of rules.

The remainder of the system may be hidden away from the instructional designer. Some intelligent tutoring systems already have some of these capabilities (Yum et al, 1995).

2.3.5 Standards

The extent to which common practice in the world has produced intelligent tutoring systems that have interchangeable components is minimal. This means that intelligent tutoring courseware prepared in one toolset is typically not *compatible* with courseware produced from a different toolset. Teachers are reduced to worrying even about whether simple matters such as image format will be compatible. To address these needs the aviation industry which heavily invests in courseware, has produced some standards (AICC, 1995).

2.3.5.1 Importing and Exporting

The aviation standards for courseware recommend guidelines for the interchange of the elements that occur in courseware. These elements include:

- Text,
- Graphics,
- Video,
- Audio, and
- Logic.

The standard recommends the use of authoring systems able to export and import courseware elements in standard formats. Specifically, the authoring system must be able to:

- Export and import all basic elements to individual files in standard industry formats
- Export and import lesson logic to a text representation

The *recommended formats* for courseware elements emphasize the common ones. As this book has not discussed the specifics of graphics, video, or audio formats, we will not repeat here the details from the standard as to which media format is most suitable. A little example for the advanced reader would say that images can be in bitmap format and audio in wav format. We will however render next the specifics about courseware logic.

Logic elements can be stored in one or more plain text files per lesson. The text files may contain programming language code, a scripting language, or standard generalized markup language tagged text. The content, in whatever format, must be comprehensive and clear enough to enable a person with a good understanding (of the scripting or markup language) to reproduce (without any other information) the exported courseware completely

We shall specify some rather simple but nevertheless potent criteria for description of the *components* of a piece of courseware. A course may be as simple as a few lessons to be viewed sequentially, or it may be as complex as hundreds of lessons, some of which are prerequisites to others and some of which may be experienced in any order.

In the aviation standard, courses have *pedagogical and structure components*. The pedagogical elements are all the lessons, tests, and other assignable units in the course. Frequently, these elements also include all of the objectives to be mastered in the course. In defining a structure, the developer frequently groups lessons for assignment. In other cases the designer defines complex lesson hierarchies.

Files can be used to describe a course's content and structure. The level of complexity determines the number of files required and the amount of information required in each file. The following list briefly describes the contents or purpose of several of the files:

- Course Description File: Information about the course as a whole including a textual description of the course, and general makeup of the course -- the number and type of elements.
- Course Structure File: The basic data on the structure of the course, including how the elements are organized.
- Objectives Relationships File: Objectives have complex and variable relationships to other elements of a course. This file defines all of these relationships.

Files are the most common data structure in computer science and by asking that the courseware structure be represented in files, the standards developers have reached to the lowest common denominator among the target audience, as standards developers are expected to do.

In addition to the aviation industry, other organizations are concerned about the standardization of educational technology. Educom is an association of higher education institutions that tries to improve the use of technology in education. Educom has produced a standard called the Instructional Management Systems (IMS) *Metadata Specification* (Educom, 1997). This specification is directed toward describing learning resources that are accessible, or perhaps just catalogued, online. The IMS Metadata Specification consists of three primary parts: a dictionary of terms, a description of learning resource types, and a system for managing the Specification. The IMS Dictionary identifies the terms that constitute IMS Metadata. These are the terms that are used to label the learning resources. IMS Metadata is broken down into fields and corresponding values. All of the proposed available fields are defined in the dictionary and their values are enumerated. These fields include author, credits, interactivity level, learning level, objectives, platform, prerequisites, price code, user rights, and user support. The hope of Educom is that all higher education institutions will use this metadata format to characterize their online educational material. Educom is working with the World Wide Web Consortium in the introduction of metadata information into the specification of the World Wide Web itself so that this metadata standard is conformant with other efforts at standardizing metadata formats across all web content.

2.3.5.2 Implications

Authoring systems can have different levels of *compliance* with the standard. We mention here the minimal and the most comprehensive levels. At a minimum, an authoring system must be able to export, in an automated fashion, all graphic, audio, and text elements from a lesson. For comprehensive compliance, in addition to meeting all compliance criteria of the minimal level, an authoring system must be able to import, in an automated fashion, the logic contained in text files and all accompanying graphic, audio, and text elements. The logic description must include the course description, the course structure, and the objectives relationships files.

The purpose of the aviation courseware standards is to facilitate the movement of courseware content from one environment to another. This ability enables the courseware owner to:

- *Reuse* elements of an existing program that were developed in one authoring system in a new program being developed in a different authoring system.
- Reduce *maintenance costs* by moving all courseware into one authoring system so that a staff with expertise in multiple authoring systems are not required to maintain an organization's courseware.

Obtaining these goals of reuse and reduced maintenance costs are noble but only reachable when the standard is widely followed.

To what extent are these aviation-industry courseware standards being followed by the developers of courseware authoring tools and of courseware itself? Since the advent of the *World Wide Web* the standardization of text, graphics, audio, and video has become more widespread. Now there is such a large marketplace of information that contains these different media types that the limited types commonly supported by web browsers have effectively led to market-type enforcement of a standard in this area.

When the web was just linked blobs, the logic of the linking reflected rather simple domain models. However, programs are increasingly being written and used that convert a link into an active procedure. The program gets executed when the user selects a link. These active links can be a source of great power in web-based courseware. However, this power also means that the logic of the computer's behavior can be obscure to the user. The authors and users of courseware want powerful, pedagogically-sound systems. At the same time we want systems whose *logic is clear* to people who need to understand what the system is doing. As web servers become more powerful, we want to increasingly request clear explanations of the domain and pedagogy models behind courseware.

2.3.6 Virtual Reality Tutoring

We have been emphasizing the abstract aspects of courseware. Intelligent tutoring systems require student models, domain models, and pedagogy models that are expressed as computer algorithms and data structures – very precise and abstract. For the student to learn effectively, the student must feel engaged, and the tutor can increase that sense of engagement with the appropriate use of *media* and of simulations that involve the media.

Multimedia engages the student through communication channels. Virtual reality enables the real world to be simulated and manipulated in realistic ways without, necessarily, the danger, inconvenience, or cost consequences of action in the real world. An early example of artificially representing the world is flight simulation used for training pilots. Computer-generated graphics rather than actual video often provide the visual aspect of the virtual reality world. The user knows that the virtual reality world is simulated but can accept its objects such as landscapes, rooms and corridors as representations of the real world. Some tactile sensation is also being offered in some virtual reality systems by the use of touch sensitive pressure pads. Hand gloves may be used to manipulate objects in this way. Movement in this artificial world is commonly synchronized with the user's actual bodily movements of walking, jumping, and running. The *virtual environment* can be defined as a multi-dimensional experience which is totally or partially computer-generated and can be accepted as cognitively valid (Jense and Kuijper, 1993).

In virtual reality group applications, individuals directly interact and collaborate within a simulated world. The virtual office gives teleworkers an impression of being in a familiar place in the presence of co-workers and with access to the usual office equipment. Trainee surgeons may acquire some of the skills required to perform *keyhole surgery* by practicing on virtual patients. Keyhole surgery is already performed remotely, by means of microscopic cameras which can be connected to monitors displaying close-up images of the patient's tissue. The keyhole method of surgery is beneficial to patients in terms of minimizing surgical intervention and improving recovery rates but it is difficult to teach. Real patients may not be used for practice. A virtual reality patient displayed on the monitor can, however, provide a good simulation, enabling the surgeon to learn the required techniques by doing surgery.

By way of further illustration, we describe a virtual reality tutoring system that supports students inside a three-dimensional setting derived from a ship's engine room, to train on maintenance and operation tasks using simulations (Stiles et al, 1996). There are several benefits associated with an immersive *ship-board training simulation*. The software-based simulator could replace most of what is accomplished in mockups. Maintenance training procedures could be done without bringing down systems and allow training on other ship-variants before change in duty. If the system uses Internet standards it could enable effective distribution of training revisions, bypassing delays in printing, training instructors, and distribution.

One or more students, each with an associated viewer, are immersed in this ship engine room environment (see Figure 16 "Virtual Reality Environment"). Objects in the environment, such as control systems, actuators, and other equipment, are simulated for training. Other team members, or an instructor, are also simulated. As students select and manipulate objects in the virtual environment, they cause simulations to change the state of the world, and these changes are sensed by *agent systems*, which can intervene, explain, or demonstrate tasks for the student. The changes caused by the student, the objects being simulated, and the agents representing other people, are all managed by the computer.

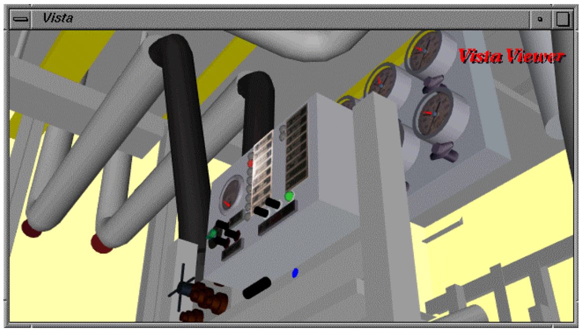


Figure 16: Virtual Reality Environment. The screen from Virtual Reality Tutor (Stiles et al, 1996) is part of what students see.

The costs of developing an intelligent tutoring system are high. The *costs* of developing an intelligent virtual reality tutoring system are even higher. The examples given of successful applications in ship board engine maintenance and keyhole surgery are examples were the costs of traditional training are very high. Thus the expense of the intelligent virtual reality tutor is willingly born by the organization that otherwise has to pay for the regular teachers and equipment. Based on these examples alone one might suspect that relatively few situations are appropriate for such high-end tutoring systems. What other considerations might effect the cost-benefit analysis?

With large audiences, the *per student cost* of a virtual reality tutor declines. A science class for children may not be expensive to teach to a few students, and thus the school is not willing to spend millions to have a virtual reality tutor. However, given that millions of children every day are studying science, a successful intelligent virtual reality tutoring system could cost millions of dollars to develop but still cost each school only a few dollars. However, another challenge is whether the student will have access to the necessary computers to run the system. Currently, most schools are not well equipped to support intelligent virtual reality tutoring systems. As the technological infrastructure of the society continues to advance, the extent to which even children in school will have equipment that supports virtual reality systems will increase.

2.3.7 Meta-analysis

Many studies have been done on the efficacy of intelligent tutoring systems or courseware on the learning of students. The area is so complex that very differing conclusions are possible to draw. One approach to collecting the results from many different investigations is to use a *meta-analysis*. To do a meta-analysis one first identifies dozens of studies on the same phenomenon. For our interest, the phenomenon is the efficacy of courseware. Then one identifies common variables across all the studies. Finally, one analyses and interprets the results of the different studies on the common variables. For instance, if 25 studies showed a significant improvement in student performance when using courseware versus when learning in the traditional way and only 5 studies showed a decrease in performance, then we could conclude that the use of courseware corresponds with improved student performance. The meta-analysis technique is particularly popular in the health care area where one needs to know whether a particular treatment that has been studied many times but with different results is truly a helpful treatment or not. Some meta-analysis have also been done in the realm of the efficacy of courseware.

Some meta-analyses have shown that computer-assisted instruction is equal or superior to conventional instruction on the following *variables*:

- student achievement, covering both immediate and long-term retention;
- attitude toward the subject matter and the instructor; and
- time to complete the task.

The generalization is that students taught via courseware realize *higher achievement* in significantly less time than the conventionally instructed students (Cartwright, 1993).

However, other meta-analyses have yielded different results. What has been surprising is the dominating influence of the *motivation of the student* and other particulars of the student situation that are quite independent of the courseware per se. Highly-motivated students responded well to material presented on the computer and less highly motivated students responded less well (Chen and Rada, 1996).

The challenge is to be clear about the specifics of the student situation, the learning objectives, and the attributes of the courseware being used. We have not yet well established what the language should be to describe the different attributes of students, learning objectives, and courseware. We do know, however, that the *mapping* among these three entities is very complex. For any given students or learning objectives, the tools that will be appropriate may be different.

2.3.8 Exercises

True or False

1) Paper is better than computer as a delivery media for some learning tasks.
2) The PathMac tutoring system was first developed in the 1990s.
3) In many cases searching is better done with the computer and browsing with paper.
4) An intelligent tutoring system includes a student module, a pedagogy module, and a domain module.
5) The difference between a hypertext system and an expert system is in the use of video.
6) The use of tutoring shells could reduce the cost to produce a tutoring system.
7) A meta-analysis may look at the result of one classroom experiment and determine the general conclusions.
8) Virtual reality systems give users a sense of being in a real world situation when in fact they are not.

Knowledge Essays

1) Under what circumstances might paper be a better medium than the computer for delivery of educational material?
2) What are the similarities and differences between an expert system and a hypertext system and how are they useful for virtual education?

Doing Essays

1) Say that you want to use a combination of paper, interactive multiple choice quizzes, and computer animations to teach a subject. What subject would you chose and why?
2) If you were to design an intelligent virtual reality tutoring system, what high level components would your system include and how would those components interact with one another?
3) When a student starts to use an intelligent tutoring system, how can the system know what the student already knows in order that it can best guide the student?
4) Given that developing an intelligent tutoring system is expensive, what factors influence the decision as to whether or not to develop an intelligent tutor for a particular topic?

2.4 Conclusion

For *cognitive learning* one essentially wants to augment the knowledge in a student's mind with knowledge that better reflects the reality and thus helps the student behave effectively. The learning strategies can emphasize a spectrum from rote learning at the one end to very creative learning in which old knowledge is most extensively modified through learning. By connecting the learning to real world experiences, the students are better positioned and motivated to make extensive changes to their internal model.

Hypertext is basically linked text and has certain uses in presenting information but does not per se address the complex and challenging questions of providing quality education. In fact, when a student has basically to understand a textbook and the textbook is available as linked hypertext or on paper, experience shows that the paper is the better medium.

The courseware is more powerful as it incorporates models of the pedagogical process, of the domain, and of the student. Then it can take on new interactions with the student that guide the student to improved learning as a teacher ought to do. Many *intelligent tutoring systems* have been developed in research laboratories and some have had practical success, but the spread of them has been limited by a lack of standardization, high start-up costs, and the small marketplace (due to incompatible, non-standardized systems).

The standards that exist show the low-level to which we must go in order to find a *common denominator*. We have no good way to talk uniformly and rigorously about the computer language for sound pedagogy. So the standard only asks that the courseware system can export an understandable description of how it works and use media types of a common format.

We have not tried to review the vast amount of literature on courseware but rather focused on the part that most allows the computer to assume the role otherwise played by the teacher. The cost of producing sophisticated courseware is substantial. One justification for it is a large audience or a content production organization that is highly motivated to develop a particular course. We are recommending that the emphasis be on producing courseware that satisfies the simple standard described in the penultimate section of this chapter. Through such a *common language* we might enlarge the market for these products and from there develop gradually better systems and more extensive standards.

The preceding analysis of trends in the development of courseware has assumed a marketplace analysis consistent with a capitalist view. However, we can push the discussion of the dialectic between the capitalist and socialist view directly into the pedagogy realm with the following arguments. In the *socialist* view the state has determined the knowledge which the students should learn. This would be consistent with examinations of students that had fixed correct answers. In the *capitalist* view, the proper distribution of surplus is not a priori known and is a result of complex market forces. The individual demonstrates learning by showing an ability to improve models. This relates to what Schank and Shneiderman mean by learning by doing. This capitalist-socialist dimension could be explored in other ways, such as the capital invested in courseware production and the cost to buy courseware.

In the end, there will be some kinds of courseware that are appropriate for teaching some subjects to some students. And other kinds of courseware that are appropriate for other subjects and other students. The mapping among the components of this triad are complex and evolving as the characters of the components themselves evolve. We must be ever vigilant of the tensions that occur when a mapping is imposed on a particular student that is inappropriate.

2.4.1 Exercises

True or False

1) Students learn by evolving their models of themselves and their external world.
2) An intelligent tutoring system contains exactly two models, one of the student and one of pedagogy.
3) The cost of making a course as an intelligent virtual reality tutor is great in part due to the relative dearth of relevant standards.

Knowledge Essays

1) Intelligent virtual reality tutoring systems are an extension of knowledge-based tutoring systems to include the incorporation of rich multimedia that simulates reality. Critique this statement.
2) What standards have been developed for courseware?

Doing Essays

1) Develop 6 questions relevant to the book that represent one each the 6 categories of Bloom's cognitive taxonomy.
2) Develop a scenario in which technology facilitates learning-by-doing and another scenario in which it hinders learning-by-doing?
3) Paper may still be the best choice for people engaged in understanding tasks. What technological changes would you encourage, if you wanted to have digital media be the best choice for understanding tasks.
4) Computers can represent models of reality and make these models come to life for students in an effort to teach the student about the models. What are the limiting factors in getting more of these models successfully incorporated into computers and delivered to students?

Figure 17: Classroom.

3. Teaching and Classrooms

Learning Objectives

- Understand the opportunities afforded by teamwork in the classroom.
- Explore the backend and frontend to groupware – software that supports users working together.
- Appreciate that different communication channels fit into different kinds of group situations.
- Study in detail one case study of an asynchronous classroom.
- Understand the impressive efficiency and effectiveness results of a studio course.
- Extend the normal asynchronous and synchronous classroom results to the case of groupware support for specific roles.
- Know that standards could support the development of virtual classrooms.

3.1 Introduction

Teaching typically occurs with one teacher and more than one student. Traditionally, this occurs in the classroom. In higher education, the teacher typically lectures, and the students listen.

Are the teachers and students in the classroom engaged in a formal group activity? By definition each member of a *formal group* should be responsible for one or more distinct activities such that the sum of the activities accomplishes some group objective. Traditional higher education classrooms are in this sense barely group activities.

In one-to-one computer-based tutoring, the system interacts with one student and attempts to personalize the tutoring to the needs of the student. On the other hand, in a one-to-many collaborative learning environment, the system interacts with a group of students, imparting the subject knowledge using a classroom strategy. In principle we could take the most sophisticated intelligent tutoring system designed for a one-to-one interaction and augment it for the group setting or classroom setting. However, *intelligent tutoring systems* are generally not available and certainly not ones that also account for group interactions.

What we will emphasize in the *virtual classroom* are means for students to interact with one another or with the teacher. How might computer networks support these interactions? What kinds of interactions do we specifically want? What is the evidence that student-student and student-teacher interactions are beneficial for learning?

Collaborative learning plays a major role in cognitive development. *Piaget* (1928) felt that interaction between peers is equally shared. This contrasts with adult-child or teacher-student interactions, where usually the former is in control and the latter follows what the former professes, thus not following her own natural learning process.

During *student-student interactions*, high-ability students tend to assume a teacher's role. They summarize and explain the material to peers and answer peers' questions about the information. Low-ability students, on the other hand, tend to assume the role of learner. They listen to peers' summaries of the information, compare what they know with the information being presented by peers, and ask questions about parts of the material that are initially unclear. In this way students are able to interact, collaborate, and learn from each other (Miyake, 1986).

Even students who prefer working alone expressed that their involvement in collaborative activities in their courses was helpful for their work (O'Malley & Scanlon, 1990). An examination of 226 studies comparing cooperative learning with individual learning showed net advantages to cooperative learning. While much remains unknown about the relationship between interaction and learning in classrooms, many researchers agree that *cooperation and achievement* are positively related (Edelson et al, 1995; Novick and Fickas, 1995).

We could study collaborative learning on various tasks. Let us look for instance at the writing task. *Collaborative writing* in the classroom can be beneficial for both students and teachers (Shackelford, 1990). These benefits are based on the principle of feedback and include the rhetorical sense of audience, the psychological power of peer influence, and the transfer-of-learning principle. When students receive feedback on their writing by their peers, it is more likely that they will improve the sense of audience. Feedback can help students sense the progress of the writing.

3.2 Groupware

The term *groupware* means: software tools that support and facilitate a group's work (Johnson-Lenz and Johnson-Lenz, 1991). To match groups to groupware technology depends not only on an understanding of groups but also on an understanding of groupware. Groupware systems are composed of a large number of interacting components (people, workstations, information) and must process information concurrently (Hewitt, 1986). This involves not only computer database and interface concerns but also other technologies for sharing information.

Groupware may support either *synchronous or asynchronous* coordination (Johansen, 1989). Some tasks (e.g. brainstorming) require synchronous interaction where all the collaborators are present throughout the task. On the other hand, in some tasks, like group writing, collaborators often work in an asynchronous manner. In addition to time considerations, groupware is characterized by the support it provides for the geographical distribution of its users (Rodden, 1991). Group members may work in the same place (e.g. face-to-face meetings) or in different remote places (e.g. software development teams). Groupware systems could be designed to support groups across both time and space boundaries (see Figure 18 "Time and Space").

	Same Time	Different Time
Same Place	Face-to-face	Library
Different Place	Audiovideo-conference	Email

Figure 18: Time and space dimensions of group work. An example of the type of interaction is indicated in the inner boxes with dimensions labeling the columns and rows.

3.2.1 Distributed Information

When a virtual classroom is created, one of the first concerns is about the *backend*. Where will the class information be stored and who will control it? Everything could be on one central machine under the teacher's control. Alternatively every student could have whatever information was needed on their local machine and the teacher would visit each student's machine in order to learn about what the student was doing.

The informal description of the ways of distributing information across machines can be formalized. There are three architectural alternatives for constructing software that might support *distributed information*: the centralized, replicated, and hybrid approaches (Greenberg et al, 1992). The centralized architecture contains a single central program that controls the distributed work of all users, while a replicated architecture executes a copy of the program at every workstation. A hybrid approach combines features of both.

In the *centralized approach*, a single program which resides on one machine controls all input and output to the users (see Figure 19 "Centralized Server"). Server processes residing on each person's workstation are responsible only for passing user input events to the central program, such as mouse movements, and for displaying output sent to the workstation from the central program. The advantage of a centralized scheme is that synchronization among users is easy, as information about user activity is located in one place. One of the disadvantage is that the distributed system is vulnerable to problems with the possibly overworked central server.

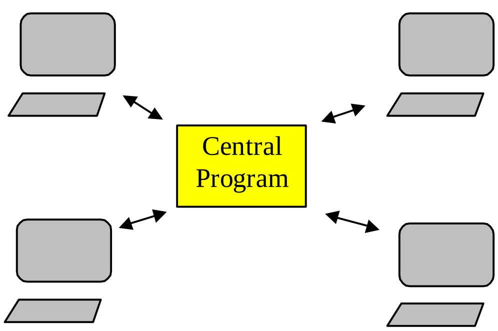


Figure 19: Centralized Server. Coordination among the four workstations is controlled by the central program.

In the *replicated approach*, each application program is replicated on every machine and the replicated programs are synchronized by communicating directly with each other (see Figure 20 "Replicated Architecture"). Each replicated program is totally responsible for its local user and for exchanging any needed information with other workstations. The system is no longer vulnerable to overwork of a central server but may have difficulties in adequately coordinating the work across the workstations.

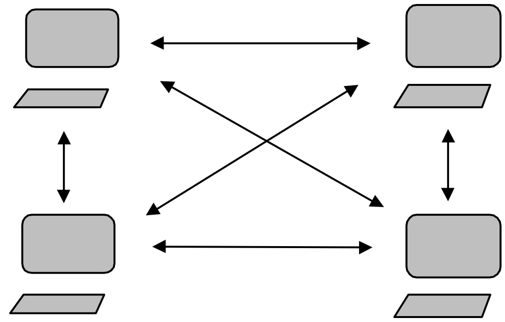


Figure 20: Replicated Architecture. Each workstation has all the software and other information which it needs to support the user. Coordination with other users is done through communication with each and every other user workstation.

Many *hybrid architectures* are possible. For instance, the individual workstations may use the central machine only for synchronization matters. All other activities would be performed only within and between the participating workstations.

The typical virtual classroom is a web site of information collected by the teacher that students browse and read. As the teacher-created information is stored on one server or central program, the backend architecture is of the simple centralized variety. The typical client-server architecture of the web gives the student as a client the current view of what is on the server. The early *Lotus Notes virtual classrooms* were based on a replicated approach. Students downloaded a program that contained the guts of the Lotus Notes groupware. Before beginning a particular session, the student would visit the central server and update her local server. After completing her session, the student would send her updates to the central server. This approach allowed the student to engage in intensive calculations supported by Lotus Notes without needing at the same time a continually active connection across computer networks to the central server.

3.2.2 Interfaces

The *interface* to the computer is what the student and teacher see. For a virtual classroom this interface becomes the common meeting ground. People might exchange information in different time patterns and different media. They might share their screen contents across a distance with others or elect ot have their screen contents be private.

Groupware interfaces offer opportunities which paper can not. A group of people can not simultaneously write and read from the same piece of paper but can simultaneously write and read the same page of text on the computer (see Figure 21 "Hands"). *What You See Is What I See* (WYSIWIS) environments allow multiple authors to simultaneously type into the same screen image. Each user has his own physical screen, but the users share the screen image. WYSIWIS refers to the presentation of consistent images of shared information to all participants. It recognizes the importance of being able to see work in progress (Stefik et al, 1987). In the alternative of relaxed-WYSIWIS a change on one workstation, such as adding an entry, is not immediately broadcast to all others. Instead, new information is automatically retrieved and the screen updated on the next user action.

Allowing *private windows* and control of placement of windows on an individual screen seems advantageous for the flexibility it gives the user. Yet, in practice the users may be frustrated by not being able to see what others are doing in their private windows and needing to manage screen layout options. In trials of one WYSIWIS system, those who developed the system liked its flexibility, but other users thought the technology was too complicated (Stefik et al, 1987). The proper trade-off between simplicity and flexibility depends in part on the class of users.

Sharing information on the computer is a key aspect of groupware but this approach must not exclude the complementing of computer support with other technological aids to collaboration. Experience has shown that simply being able to see another's workspace can be helpful in collaboration and that *television* may provide this kind of information sharing without necessarily being connected directly to the computer.

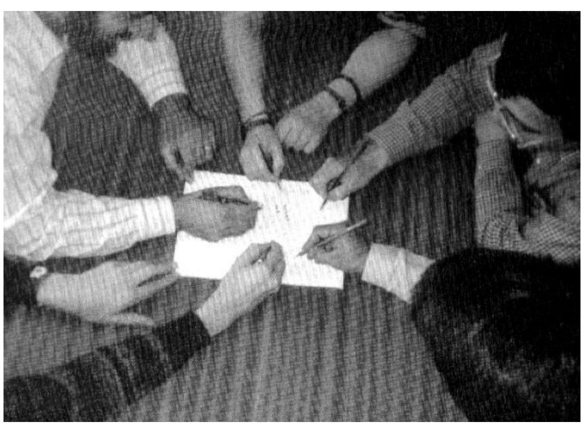


Figure 21: Hands. Several hands can not easily work on one piece of paper.

3.2.3 Social Dimension

Groupware may also be characterized by its assumption about the control relations among people. For instance, in a classroom the teacher has strong *control* over the students and the students officially have little control over one another. Should the virtual classroom provide well-defined roles and monitor their enactment or not?

Along the *social dimension* we might have:

- mechanistic groupware that imposes and constrains people to work through explicit forms and procedures; or
- context groupware that supports the structuring and browsing of social knowledge.

The mechanistic approach to groupware is based on the social theory that human interaction is deterministic and can be modeled in terms of certain procedures. The context approach assumes groups prefer to self-organize.

Mechanistic groupware should provide well-defined mechanisms for interaction. *The Coordinator* (Winograd and Flores, 1986) system is an example of *mechanistic groupware*. It imposes and constrains group communication to a predefined set of actions and commitments. Communication is mediated through electronic mail. Several message types are defined, and the recipient of each message has to commit to taking an action. People's reactions to The Coordinator are extreme and contradictory. Employees at the World Bank found the system very supportive. On the other hand, employees at Hewlett-Packard resisted the use of the system and called it `Naziware' (Hayes, 1992). Mechanistic groupware suits only certain situations. Mechanistic groupware might be successful in organizations which already base group work on strict rules and procedures. In more flexible organizational cultures such systems may reduce effectiveness and creativity.

Groupware as context reflects the opposite approach to mechanistic groupware. It is based on the social theory that human systems are self-organizing and encourages open, unrestricted interaction (Johnson-Lenz and Johnson-Lenz, 1991). Systems in this category do not focus on group dynamics. Their main focus is on user interface tools and tools that allow the structuring and the browsing of social knowledge. Many web sites constitute examples of context groupware. People can visit the site and learn what they want and perhaps contribute to an archived electronic discussion. This characterization applies to the majority of virtual classrooms. However, the trend is to more control supported by the virtual classroom and thus a more mechanistic groupware.

3.2.4 Exercises

True or False

1) Groupware includes software to support groups.
2) Centralized databases have straightforward synchronization rules.
3) A WYSIWIS interface means What You See Is What You Get.
4) Mechanistic groupware focuses on supporting unstructured browsing.

Knowledge Essays

1) Describe the four categories of groupware in terms of space and time sameness and give an example application of each.
2) Discuss the difference between a distributed database and a centralized database as regards its support for groupware.
3) What are the pros and cons of a replicated architecture backend for a virtual classroom?

Doing Essays

1) Suggest some categories of students in terms of what kind of groupware would be appropriate for their classroom.
2) For classes that you would take would you prefer mechanistic or context groupware and why?

3.3 Communication Channels

We have noted that part of learning depended on *communication*. Telecommunications links can provide a useful means of communicating when face-to-face communication is not feasible. Today business meetings are often held via audio facilities. However, these meetings are focused on tasks, such as simple problem solving, information gathering, information exchange, and discussion of ideas. For more complex tasks, such as conflict resolution, people often prefer face-to-face meetings. Is a classroom learning situation on this scale a relatively simple or complex task?

3.3.1 Telephone Conference

Telephone conferences are simpler and initially more engaging than computer conferences. For students, the most successful and popular element of a class is often the part that is technologically simplest: the use of a speakerphone to enliven class sessions with outside guests. This is done by plugging a speakerphone into a regular phone jack and making a pre-arranged, long-distance call.

The Department of Geography at Boston University experimented with several phone-based, undergraduate courses (Annis, 1992). The Department of Geography offered a course which explored the relationship between poverty and environmental degradation in Central America. It examined the causes and consequences of environmental deterioration, debates among scholars and policy makers, and the range of policy and institutional responses that are attempted in the region. The course was designed to be half \`traditional' and half \`phone-based'. In the \`traditional' mode, readings were assigned, lectures were given, and seminar-like discussions were held one day a week. Students viewed the *phone-based tools* as complementary and enriching, not as a substitute for more familiar classroom instruction.

Guests were selected on the basis of real-world experience. Despite some initial awkwardness, most guests expressed pleasure at the opportunity to interact with college students. Presentations and discussion with the guest usually lasted about an hour. When the call was completed, the class then usually discussed the presentation for another 20 minutes.

Most of these talks were planned and arranged beforehand in accordance with the structure of the course syllabus. However, some themes developed a life of their own. For example, after a lecture and readings on rainforest issues, the class interviewed a distinguished tropical ecologist who was helping to develop an international Biosphere between Costa Rica and Panama. This discussion in turn raised a new set of issues about the politics of conservation. The class then spoke with a leader in Costa Rica, who articulately explained why he bitterly opposed the formation of an international Biosphere. Such dynamics would be difficult to achieve without the telephone conference.

In this section on communication channels we are emphasizing some of the functionality that can be achieved with various technologies. We should hasten to remind ourselves, however, of the fundamental theme of the overall document -- namely that a technology must fit into the work flow of those who are to use it. Despite the example of a successful telephone conference use in a classroom, the fact remains that most classrooms do not use telephones. Yet, telephones are extensively used in most homes and offices. Why does the telephone not fit into the *workflow* of most classrooms?

An analysis of the culture of classrooms indicates that they are very importantly conveying the hierarchical structure of organizations with teachers having supreme authority and in turn reporting directly to some supervisor of a set of teachers. The technologies that succeed in this environment are those which support the *hierarchical relationships*, such as whiteboards which allow the teacher to further control the dissemination of information. Hodas (1995) says:

> We might also consider the school intercom system. Ideally suited to the purposes of centralized authority and the one-way flow of information, it is as ubiquitous in classrooms as its polar opposite, the direct-dial telephone, is rare. … In general, resources that can be administered, that can be made subject to central control and organization, will find more favor from both administrators and teachers than those that cannot.

So while one teacher in one classroom might report positive results with the use of phones or phone conferencing, the evidence is meager that such approaches are popular. The explanation for the failure of the phone to make large inroads into traditional classrooms might be this interpretation of the *culture of the classroom*.

3.3.2 Video Conferencing

We've talked about students and teachers exchanging text messages and engaging in telephone conferences, but from the technological perspective a richer mode of synchronous interaction would include a video link. If we could reproduce the sense of physical presence that a traditional classroom gives through quality *audiovideo connections*, what else would we need to make the virtual classroom as good as the real classroom?

Research results indicate that video conferencing could be adequate in situations involving giving or receiving information, asking questions, exchanging opinions, solving problems, and generating ideas. In addition the video may allow users to have a sense of presence of other people. The *sense of presence* is an important factor that may affect individual performance within the group. The sense of presence depends on the size of the video screen. The feeling of `presence' is low for normal television screens. A large projection display increases the feeling of presence.

Nevertheless, compared with face-to-face interaction, *video has limitations*, mainly affecting the coordination of interaction (Isaacs and Tang, 1993). Interacting remotely through video makes it difficult for participants to control the floor through body position and eye gaze (it is not possible to ascertain exactly at whom other participants are looking when all the other participants appear on each participant's screen). By the same token users have difficulty pointing at things in each other's space.

To promote interactivity in a videoconference arrangement for classrooms, *guidelines for teachers* have been designed as follows (Woodruff and Mosby, 1997):

- Include the participants in the conference within the first 5 minutes. Involve them early so they don't turn away. Try a name game, or ask a compelling question that taps their affective domain.
- For group work, select individuals at each site to participate on inter-site teams.
- Using the pre-obtained roster, call on students at both sites by name. Encourage discussion.
- Take as many questions from the distant site as you take from the local site and encourage students at distant sites to answer.
- Devote 30%-65% of each hour to student activity.

Asking a question can be daunting for students, especially if it means they must get the attention of a remote teacher and talk to a television screen. Teachers can help by noting the body language of remote students and taking the time to query when students seem puzzled or disinterested. Eye contact and use of names both help make students feel more comfortable. These people skills are obvious and natural in a "live" classroom, but may seem awkward in a distance learning situation. "Eye contact" means looking at the camera and the monitor rather than local students, and teachers might have to make a special effort to attend to remote learners.

We've discussed the pragmatics of maintaining audiovideo virtual classrooms but have avoided technical issues. To understand better the options one needs to appreciate the technical constraints. A *broadband satellite connection* with studio-quality equipment produces an excellent full-motion video connection, but the equipment and transmission expense is great. Compressed video systems, which transmit information via the Internet or telephone network, greatly reduce the cost of videoconferencing.

What allows videoconferencing over regular telephone lines? The *codec* (short for coder-decoder) takes the analog video signal and codes (digitizes and compresses) it. The codec also has to decode (decompress and un-digitize) the received transmission, and this kind of processing takes its toll on the picture and sound quality. The most obvious consequence is a "jerky" picture and an audio time delay of 0.5-2 seconds. Although compressed video is not broadcast quality, it's adequate for many videoconferencing situations.

Adding videoconferencing facilities to a home multimedia personal computer that is already connected by telephone to the Internet is not an expensive step. For less than *one hundred dollars* one can buy a videocamera and connect it easily to the computer. Free software is available such that various numbers of people can then see one another and across the Internet. As indicated in the preceding technical paragraph, the quality of the images may be low and both the audio and video will be delayed by a second or so.

The extensive discussion of video technologies and how to use video in a classroom are not meant to suggest that video is the appropriate tool for any particular classroom. Depending on the tools readily available to the students and teachers and on the type of learning that is to occur -- and more generally the *culture of the classroom* -- one might or might not be well advised to include videoconferencing in the virtual classroom.

3.3.3 Group Hypertext

Hypertext that is shared and updated by multiple users is an opportunity for students and teachers to communicate asynchronously. Intermedia was a networked hypertext system developed at Brown University in the mid-1980s (Landow, 1990). `Context32' and `In Memoriam' were two applications of Intermedia for education.

Students in English at Brown used Context32, as part of the Intermedia corpus, to supplement assigned readings. *Context32* was a mixture of materials, study guides, summaries of state-of-the-art scholarship, introductions to basic critical concepts, and original scholarly and critical contributions. The development of Context32 was undertaken by five individuals, who each wrote documents on a set of authors and topics, and gathered graphic materials. Some materials created by others were modified and linked to the original contributions. The student made contributions to Context32 by:

- creating links among documents present on the system;
- creating text documents (and linking them to others); and
- creating graphics documents (and linking them to others).

Student users created new concept maps in the form of overview or literary relation files, and used earlier ones as templates, making minor modifications and changing the texts.

Tennyson's In Memoriam is a complex, experimental Victorian poem, that was an attempt to create new versions of traditional major poetic forms from 133 separate sections. Each section is a poem that can stand on its own. It is particularly appropriate for hypertext representation as it makes extensive use of echoing, allusion, and repetition. The entire poem was placed in Intermedia and linked to:

- variant readings from manuscripts,
- published critical commentary; and
- passages from works by other authors.

In 1988, members of a graduate seminar added more than a hundred documents, each commenting specifically on one or more sections of the poem and on one another's work. The first assignment for the project required them to create five documents to append to individual sections of the poem. Each week members of the seminar read the contributions of others, added more documents and then made links. The final assignment of the project involved students putting online the texts of poems by another poet that had obvious relevance to individual sections of Tennyson's work. The In Memoriam project was successful in promoting collaboration.

3.3.4 Bulletin Boards

A *bulletin board* or computer conference is a kind of structured and archived, asynchronous, email discussion. One such system was developed at San Francisco State University and is called COW for Conference on Web (Klavins, 1995). COW is organized into three main levels. The first level is the class. Each class is organized into topics, (the second level), where the coursework is contained. The third level contains conversations between students and instructors in response to the material presented in each topic (see Figure 22 "COW"). COW has been used in numerous courses at San Francisco State University.

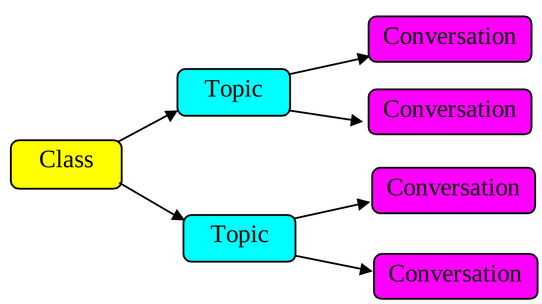


Figure 22: COW, the Conference on Web system has a hierarchical structure of a class that includes topics and conversations.

The *Geography course* at Boston University, which was described in another section for its use of telephone conferencing, also extensively used computer conferencing. The management of the course, assignment-giving, and considerable interaction between instructor and students was conducted through a semester-long computer conference. The course was structured so that major syllabus topics were introduced by lectures, class discussions, and the long-distance speakerphone presentations. Students also corresponded on topics in the computer conference. Students added comments, raised questions and carried on student-to-student debate, and wrote short critiques of assigned readings and of each other's work. As students became more skillful network users, they would reinforce the computer conferences by importing relevant material from the hundreds of other conferences on the electronic highways. Often, vast amounts of highly up-to-date, technical material could be found that would carry the discussion far beyond the initial class presentation.

At the outset of the semester, students tend to participate in these conferences somewhat passively. They relate to them as if they were books -- reading messages, taking notes, and sometimes importing (`downloading') information for general use within the class-only conference. Gradually, however, they learn that they can *talk back* from their keyboards; and they begin to engage more aggressively in two-way communication.

A special facility was created by a graduate student who applied her background in tropical ecology and computer programming to construct the shell and initial biological population for a *virtual rainforest*. This is a text-based simulation of a rainforest environment, something like the popular adventure games on personal computers. In this case, a `player' receives messages something like, "You hear a fluttering screech and look up through the green canopy where you see a troupe of howler monkeys . . ." Though kinetically less dramatic to students than the competition in video arcades, such `games' are intriguing for several reasons. They can be freely accessed through the Internet from virtually any networked campus computer, they can accommodate hundreds of players in real time who are working interactively within the created environment. Their educational content could be developed in highly sophisticated ways by succeeding generations of players and rainforest-makers. For example, the plant and animal population of the `virtual rainforest' could be biologically expanded; the forest could be populated by slash-and-burn farmers, cattle ranchers, and ecotourism operators; and so on.

The aforedescribed 'virtual rainforest' facility extends the notion of computer conferencing into what some call MOOs. A *MOO* is a MUD Object Oriented, and a MUD is a multi-user dungeon. The multi-user dungeon is a game that people play across the Internet in real-time or synchronously. The Interface is based on a text-based communication application called telnet. By adding programs to the MOO program one can extend the text chat facilities so that various messages or actions get invoked on the basis of a single command introduced by a participant. Entire virtual classrooms can be based on MOOs (Diversity, 1997).

3.3.5 Multiple Channel

We've looked at cases of connection via bulletin boards, via audio-videoconferencing, or via hypertext authoring. These and other *methods can be combined* in one virtual classroom. What benefit would putting all the tools into one classroom have? One experiment to address this question is described next.

Three groups of students at geographically distinct locations were asked to solve an engineering design problem using a rich, multimodal, groupware system (Gay and Lentini, 1995). Students were given two hours to design a windmill which would produce two volts under the forced air from a hair dryer. The groups were given tasks analogous to those of a main contractor and two subcontractors, but the specific tasks of each group were left ambiguous to force the students to negotiate the boundaries of their tasks.

The groupware system consisted of *multiple communication technologies* and multimedia databases. The communication resources were all three-way, and each channel was active throughout the session. The resources were as follows:

- a three-way, closed circuit video-conferencing system which allowed all groups to see and hear all of the activities in the other groups,
- a terminal conferencing system which allowed students to type messages on their computer and send them to their collaborators, and
- another part of the terminal conferencing system which allowed the students to draw a design on one screen and have it appear on the other two.

The multimedia databases included:

- an interactive multimedia database of engineering information which contained information on each of the subject areas the students would need to address in their design: gears, structures, aerodynamics, power, and generators, and
- scanned engineering textbooks, which also covered the subject areas that would need to be addressed by the students.

There was a link between *student activity and technological resource* used, and this was a critical part of how the students used the system. The multiple channels were used by the students to either increase the depth of the discussion or increase the breadth of the discussion. Using multiple channels to increase depth involved using more than one channel to converse about one topic, while using multiple channels to increase breadth involved conversation on multiple topics, with each topic on one channel.

The ability to use multiple representations allowed the students to supplement a mental and video representation of the design artifact with a drawing that showed details not immediately obvious from looking at the assembled design. Increasing the depth of the interactions allowed students to more effectively communicate their meanings and create much richer representations of the designs. The use of multiple channels to increase breadth proved especially useful when one group member was engaged in a time-consuming activity on one channel. Using the breadth available via multiple channels also became important near the end of the session when the groups had to transmit a great deal of information in very little time. Thus we see again that the *mapping* between the technology that is appropriate and the student learning objective is a complex mapping. No one technology is right for all learning objectives.

3.3.6 Exercises

True or False

1) Phone-based tools can be used to bring interesting guests via audio into the classroom.
2) Participants in a videoconference can not see another participant's facial expression.
3) Group hypertext for classroom learning was first used in the early 1990s.
4) When comparing various channels of communication in the virtual classroom, the conclusion is consistently that video connections are the best for all kinds of learning.

Knowledge Essays

1) The telephone has been available for over a century but what impact has audio-conferencing had on classrooms and why?
2) How are the guidelines for managing classroom videoconferences different from the guidelines for managing face-to-face classrooms?
3) Compare and contrast a) group hypertext in which students add comments to an evolving document and b) classroom, electronic bulletin boards?

Doing Essays

1) Plans exist for massive, high bandwidth satellite networks and low-cost Internet devices. What communication modes should then become more popular in classrooms?
2) The multiple channels, virtual classroom experiment began to develop a mapping between media types and learning objectives. What mapping generalizations might you infer from the results of such experiments?

3.4 Asynchronous Classrooms

An *asynchronous classroom* is one in which the students and teacher interact without needing to be synchronized. Thus the teacher might put an assignment on the web one day, a student read it anytime later, and answer it yet later. Typically there is a broad time schedule in that course starts at some date and over some weeks students must submit certain exercises and take certain tests. A correspondence course handled by paper mail could be an example of an asynchronous classroom but students in such a course might not have any interaction with other students.

Studies of the effectiveness of distance education courses have been ongoing for many years. In 1928 R. E. Crump published "Correspondence and Class Extension Work in Oklahoma". In the work of the 20's and 30's the emphasis was on correspondence courses and moved later into television and radio. Of course, contemporary emphasis tends to be on Internet supported courses. In one listing of hundreds of studies done since the 1920s, the fundamental conclusion is that no fundamental differences in quality between face-to-face classrooms and virtual classrooms has been demonstrated (Russell, 1997).

2.4.1 Virtual Classroom

We will next describe the New Jersey Institute of Technology *Virtual Classroom™.* The special software structures incorporated in the system were specifically designed to support collaborative learning, including discussions, student presentations, joint projects, debates, and role-playing games (Turroff, 1995). Participation is generally asynchronous and participants may dial-in from any telephone system. Students can study a complete BA in Information Systems or B.S. in Computer Science via the virtual classroom.

3.4.1.1 System

A Virtual Classroom *conference* is a stored transcript of a discussion. It has a membership list and a comment-reply structure. There is a full indexing capability for each conference that is especially useful since a typical class discussion may exceed one thousand comments. The conference automatically tracks for the member what is new and what activities or assignments the members has or has not seen or done. In the Question-

Answer Activity, if the instructor asks a discussion question, then every student must supply an answer before he or she can see the answers of the other students. This feature forces each student to do independent thinking about the issue.

A Virtual Classroom environment can be used in many different *media mixes*:

- Face-to-Face plus Virtual Classroom: This can vary from adding system use to enrich on-campus courses conducted by traditional means; to distance courses where system use is supplemented by one or two face-to-face meetings.
- Virtual Classroom as the sole means of delivery: with the use of print media in the form of textbooks or course notes, in addition.
- Multi-media: Virtual Classroom plus Videocassette; or Virtual Classroom plus CD-ROM.

The Virtual Classroom in each of these modes requires different management than a traditional course requires.

3.4.1.2 Student Experiences

The Virtual Classroom has been used in teaching many courses. One of the salient conclusions is that students must be *actively guided*. It does not 'work' to simply make the Virtual Classroom available and tell students that they can use it to ask questions about the readings or discuss aspects of the course at any time. If it is not a 'required' and graded, integral part of the course, the majority of the students will never use it at all; and those who start to use it, will generally decide that 'nothing is going on there' and will stop using it.

For distance education students, the increased ability to be in constant communication with other learners is obvious. But even for *campus-based courses*, the technology provides a means for a rich, collaborative learning environment that exceeds the traditional classroom in its ability to "connect" students and course materials on a round-the-clock basis. If students who take most of their courses on campus are permitted to, they may choose to take a significant portion of their courses via a "distance" mode such as Virtual Classroom. This is because they experience scheduling conflicts with other courses, their jobs, or their family obligations, which mean that they either must take a "distance" course, or take longer to complete their degrees. In the fall of 1995, for instance, about half of the students enrolled in the Virtual Classroom + Video undergraduate courses took the majority of their degree courses on campus, and half were "distance" students who took the majority of their courses in distance modes.

Some of the courses use standard public television courses, such as "Discovering Psychology," produced by the Public Broadcasting System. However, most video segments are filmed by New Jersey Institute of Technology in its "candid classroom" and then distributed to remote students on videotape, or via broadcast on a cable channel or satellite. In all *video variations*, the Virtual Classroom is used for all assignments and additional discussions.

Numerous studies have been done of the reaction of students to the Virtual Classroom. One can conclude that

- mastery of course material in the Virtual Classroom is equal or superior to that in the traditional classroom, and
- Virtual Classroom students report higher subjective satisfaction with the Virtual Classroom than the traditional classroom on a number of dimensions, including improved overall quality.

On post-course questionnaire, students were asked a series of questions about their course, the instructor, and their experiences. Most of the items showed *no significant differences* among modes. The differences in course and instructor ratings are evidently more affected by factors other than mode.

Virtual Classroom students were asked to compare their experiences to those they had in traditional courses. Virtual Classroom students report that they are more likely to *stop attending class* when they are busy with other things. Since the class does not meet at any particular time, it is easy to postpone it, and this procrastination all too easily turns into falling seriously behind.

3.4.1.3 Teacher Costs

What are the *costs of teaching* with the Virtual Classroom. Teaching with the Virtual Classroom and videotapes can be more demanding than traditional face-to-face lectures. The first time one prepares the materials for weekly Virtual Classroom modules and moderates the conferences, this is much more work than just delivering lectures face-to-face.

Once the course has had its basic delivery materials and videotapes developed:

- If the class has less than 25 students, the actual amount of work to conduct it is about the same as for a traditional class.
- The amount of work is directly proportional to the number of students, since there is no limit to the amount of time each student can ask questions.

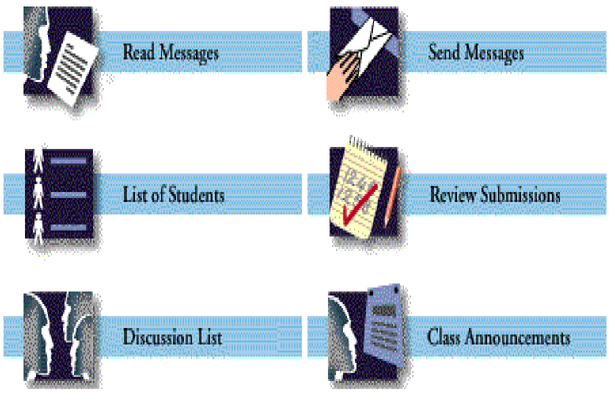


Figure 23: TopClass. This window of the TopClass system is seen by the instructor. It includes options to read and send messags, list students, and review submissions.

- For more than about 30 students, class conferences have to be divided to be manageable, thus increasing the faculty workload substantially.

Institutions may initially think that virtual classrooms are a "cheap" way to deliver education. If done right, with full time faculty conducting courses, it is actually *more expensive*. There is much to be done in discovering which tasks can be offloaded from faculty to lower priced teaching assistants, without substantially decreasing the quality of the product delivered.

3.4.2 Another Toolset

Numerous systems have been developed to support asynchronous operation of a classroom. The emphasis is often on the handling of email messages. We describe briefly one other such product called *TopClass*.

TopClass connects students or learners with each other as well as their instructor. Connectivity is web based (see Figure 23 "TopClass"). It is possible to have multiple *discussion lists* in a course providing moderated discussion, threading, and file attachments.

Students may be asked to take *interactive quizzes*. These quizzes are automatically graded on the server and the student will get his or her results instantaneously. The software tracks each individual user, and the status of all their transactions with the system, including every message that they read and send.

TopClass includes a *course outliner* with which the teacher can develop course material to be read on the web by students. The teacher can also import or export units of learning material into or from the course (Black, 1997c).

TopClass was developed as part of a European Union project and is now marketed by *WBT Systems* based in Ireland. The State University of New York has signed an agreement with WBT Systems whereby all members of the university system have access to TopClass on all platforms (WBT, 1997).

3.4.3 Other Studies

While virtual classrooms are being used more and more frequently, confusion still reigns as to when such teaching is or is not appropriate (Black, 1997a). One of the first controlled, *quantitative studies* is next discussed. In 1996 students in a Social Statistics course at California State University, Northridge were randomly divided into two groups, one taught in a traditional classroom and the other taught virtually on the World Wide Web. Text, lectures, and exams were standardized between the conditions. Quantitative results demonstrated the virtual class scored an average of 20% higher than the traditional class on both examinations (Schutte, 1997).

The traditional class met every Saturday over 14 weeks from 9:00 am to 1:30 pm.. The virtual class met only four times through the semester. The traditional class solved common weekly problem assignments submitting them each week and had no requirements for interaction with class members. The virtual class had four *assignments* each week:

1) e-mail collaboration among randomly assigned groups of three students in which they generated weekly statistical reports and sent them to the instructor using e-mail;
2) bulletin board discussion in which a weekly discussion topic was responded to twice a week by each student;
3) forms input via the web which allowed for student submission of the same homework problems being solved by the traditional class; and
4) a weekly moderated Internet relay chat in which student discussion and dialogue were performed in real time in the virtual presence of the professor. Traditional office hours were held for both the virtual and traditional students on Saturday afternoons.

In the answers to a *post-course questionnaire* there was no consensus as to the effectiveness of the four Internet technologies. Students in the virtual class were randomly distributed in their ratings of the impact of the four techniques. Further, post-test results indicate the virtual class had significantly higher perceived peer contact, and time spent on class work, but a perception of more flexibility, understanding of the material and greater affect toward math, at semester end, than did the traditional class.

Much of the performance difference is attributed to student collaboration rather to the technology itself. In fact, the highest performing students in both classes reported the most *peer interaction*. The amount of student-student and student-teacher interaction was not the same in the two groups studied. Students in the technology group were required to communicate with one another and the teacher extensively. Students in the traditional classroom situation had no such explicit requirement. This kind of confounding variable is common in virtual classroom experiments and makes rigorous comparison of one method of teaching to another difficult. Faculty must pay attention to the issue of collaboration, whether in the traditional classroom or in the virtual classroom.

Studies continue to be done in large numbers. A recent study claims to be the first *qualitative case study* about email based learning (Liu, 1996). The study concerns a graduate chemistry course taught as an email discussion from the University of Nebraska to high school chemistry teachers. Twenty-one students started in the graduate chemistry course. Only 9 of the 21 students completed the course. The study concludes that the

- the causes of incompletion are technological problems and pedagogical immaturity; and
- though relatively easy and inexpensive, communication entirely via e-mail is inadequate to satisfy the communication needs of individuals involved in distance-learning courses.

The high school chemistry teachers were involved in a day-to-day world of meeting face-to-face with their own students. To engage in a course where they were the students and for which all interaction was by email did not fit into their work flow or way of life.

The bottom line is that the mapping among

- students and teachers,
- their tools and methods, and
- the learning objectives and content

is a *complex mapping*. There is not one specific tool that will be helpful for all students and all learning objectives, but rather the appropriate mapping must be carefully considered on a case-by-case basis. We are still uncertain about the right questions to ask.

Russell (1997) assumes that no significant quality difference between virtual and traditional education is a negative result for the virtual mode. However, if one considers the opportunity costs of students to be educated at home or the workplace, then it might be that maintaining the quality of education would be a positive result. Should we not measure the benefit to students of not needing to leave work or home in order to participate in an education.

3.4.4 Exercises

True or False

1) An asynchronous classroom does not require students to meet at any particular time.
2) The trademarked Virtual Classroom was developed at New Jersey Institute of Technology and has been used for years in teaching full courses.
3) Students felt they learned less from Virtual Classroom courses than from traditional courses.
4) The costs to teachers for courses with more than 30 students is less with the Virtual Classroom than with traditional classrooms.
5) The TopClass virtual classroom software was developed in Europe and has been used by the State University of New York.

Knowledge Essay

1) What were the strengths and weaknesses of the quantitative study done in the California State University Northridge Sociology course.

Do Essay

1) Would you use opportunity cost in assessing whether the virtual classroom method of teaching was better or worse than the alternatives?

3.5 Studio Course

In some disciplines, particularly the science and engineering disciplines, a course will often require students to meet in different types of rooms for different types of work at different times. The lecture may include hundreds of students at one time. A laboratory session may occur one afternoon each week, and students would work under loose supervision in this laboratory to explore hands-on some aspect of the course. A recitation session may additionally be held each week in which students meet as a small group with a teaching assistant to discuss problems with the reading material or textbook assignments. When these three course activities are combined and students meet always in the same room at the same time and face in the one meeting a combination of lecture, recitation, and lab, then we have a *studio course*. What's important about studio courses for us? With the addition of courseware the studio course method has been shown to have very impressive educational results. We will next explore the details of the Physics Studio Courses at Rensselaer Polytechnic Institute.

3.5.1 Studio Course Structure

The structure of the *Physics Studio Course* at Rensselaer involves two facets:

- on the one hand, it is a method of meeting with students face-to-face and
- on the other hand, it is a courseware infrastructure.

The structure of the studio course is unrelated to the lecture based courses that preceded it. There are four contact hours instead of the six used by the lecture course (RPI, 1997).

The course is worth four credits, and is taught in two sessions of two hours each. A single facility serves all of the contact hours, instead of having separate facilities for *lecture, recitation, and laboratory*. In the facility, the mentor is assisted by a graduate student. This permits a different personal and cultural approach to small group attention and feedback. The assisting presence provides a 'safety net' for instructor-student interactions, filling in if the mentor is unavailable or unable.

The role of the student in the classroom is one of *localized control*. The students are responsible for each activity to which they are assigned, and perform several activities each class. The exact style in which this is accomplished is flexible to each student, allowing for differences in gender, race, culture, learning style, interest and preparation. Because they have local control of the tools, a student may explore opportunities to approach the subject matter from different directions, should the need occur. Students are encouraged to work together to solve a problem, or achieve understanding. The Studio builds socialization skills that are necessary to succeed in a team environment.

The role of the instructor in the Studio Course is different from that in a lecture. The instructor is actually a *mentor* that guides the students through a series of self-controlled discoveries. The students are required to exploit their role as experimenters. The mentor focuses on guiding the progress of the class, correcting pitfalls, and expanding on questions that rise from the material.

The Physics Studio course uses courseware. This is particularly appropriate to physics due to the nature of the subject matter. Increasingly, university physics departments are using personal computers as part of introductory physics courses. A key reason for this trend is the computer's ability to help students understand various *representations of physical phenomena*. The leap from representation to representation is daunting to most students yet critical to the conceptual understanding of the phenomenon. The Physics Studio Course uses excellent courseware that allows the student to view the many different physics representations and all at the same time.

The Physics Studio Courses are taught with the help of The Anderson Center for Innovation in Undergraduate Education at *Rensselaer Polytechnic Institute* (see Figure 24 "Studio Course"). This Center has been responsible for bringing the courseware called the Comprehensive Unified Physics Learning Environment to fruition. This courseware is based on the conviction that students and faculty would benefit from sophisticated materials that would be comprehensive in their approach to the various aspects of physics education; that would be unified in their ability to work together and exchange data; and that would present nearly the same user interface for all materials.

Figure 24: Studio Course and Wilson. Jack Wilson is dean for undergraduate and continuing education at Rensselaer Polytechnic Institute. Wilson joined Rensselaer in 1990 as founding director of the Anderson Center for Innovation in Undergraduate Education and professor of physics. Here he is shown within a studio course setting.

3.5.2 Results

Experience with the studio course shows that students were able to *complete the material faster and learn it better* than the same group taught in the traditional way in the previous year by the same instructor. These results have been repeatedly confirmed at Rensselaer Polytechnic Institute with the studio courses. Students also prefer these classes over the traditional courses.

Additionally, the Studio Courses have been shown to *cost the university less* to teach. The arguments behind this reduction in costs follow. First we look at the cost of the traditional class in terms of hours of faculty and staff time and then at the same variables for the Studio Course:

- The traditional method requires 6 sections of 48 students each. Each section meets 3 times a week for 1 hour over 10 weeks. This 30 hour per term per section time gives 180 lecture hours. Six student assistants are also utilized, each at 12 hours per week.
- For the studio course the standard format of 30 one-hour lectures per term is replaced by 10 two-hour studio sessions, where 48 students meet with the mentor in a workstation-equipped classroom. Students are expected to learn independently to a substantial degree, using the studio, other computer labs, or their own machines. Student assistants work as previously.

The high-cost labor of the faculty has been reduced from 30 hours/term/section to 20 hours/term/section. This major reduction has to be weighed against the technology costs (Massy and Zemsky, 1995). However the technology costs can be amortized, whereas the faculty costs are fixed and recurrent. One expects that the technology costs will be less than the faculty costs in the long-run, if not in the beginning.

There is much interest in the results of the Studio Course method of teaching. Certainly a teaching method that simultaneously *reduces costs and improves learning* is worthy of support. The number of agencies supporting the Rensselaer Polytechnic Studio Course work is impressive:

- Hewlett Packard Corporation, 1996, $500,000, "Technology Enhanced Learning: StimuLinc@Distance,"
- National Science Foundation, 1996, $200,000, "Recognition Award for Institution-wide Reform of Undergraduate Education".
- National Science Foundation, 1996, $850,000, "Computing Infrastructure for Research and Education".
- National Science Foundation, 1995, $4 million, "Mathematics and its Applications in Engineering and Science: Building the Links".

This contribution of over $5 million from funding agencies indicates their conviction that the Studio Course method should be pursued.

3.5.3 Another Toolset

LearnLinc™ is a *commercial, virtual studio course toolset* that is an outgrowth of Rensselaer Polytechnic experiences and is designed to support Studio Courses (ILINC, 1997). LearnLinc provides desktop videoconferencing, application sharing, scalable class size, enhanced multimedia authoring tools, and multimedia resource management tools. For the positive experiences with using LearnLinc, the reader is referred to the description of the Office Depot experience with training employees with LearnLinc.

At the top of the *LearnLinc screen* are a variety of tools that instructors and students can use to launch applications, content books and multimedia presentations, and join live, interactive sessions. Students have tools that allow them to open courseware, register for and join interactive sessions, and launch applications that are registered with LearnLinc. Instructors have all of the student tools, as well as the ability to schedule and edit sessions. Authors and administrators have additional tools that allow them to work with authoring tools, add multimedia resources to the system, and perform system administration tasks. Teachers can author material with popular commercial courseware authoring tools.

A *Synchronization Agent* is designed for a specific application. Essentially, the Synchronization Agent shows the floor holder's actions within a synchronous application. The floor holder can navigate through multimedia content, move a shared pointer, highlight significant text, or launch multimedia clips embedded in course material -- and all of these actions are shown in real-time on each participant's workstation.

QNA is one of LearnLinc's application that heightens the interactivity of a session by allowing the teacher to anonymously *poll the session participants*. QNA allows the teacher to ask a question with up to five multiple choice answers. As the participants enter their answers, the teacher can view their responses immediately, in the form of percentages. The teacher can also ask a question verbally, and request a show of electronic hands. That way the teacher can get a rough idea of how well the class is following the course material.

LearnLinc allows students to meet *across distances* at the same time and still interact with one another through various means. The students may also go into courseware to explore the specifics of the content of the particular course. However, the teacher can monitor what every student is doing continually. Thus some students can be in the same room with the teacher but other students could be at arbitrary distances and the general features of the studio course should still attain.

An extensive use of LearnLinc will be presented in the *Corporate Marketing* chapter. LearnLinc has been used in a large retail company for training of staff that are widely distributed across the many stores of the company. One trainer stays at the central facility and trainees participate from remote sites. The company has been pleased with the results and intends to extend usage.

Other toolsets are being developed and being applied in wide-ranging contexts. Large projects funded by the American *National Science Foundation* have developed collaborative learning environments that children use in elementary or high schools. The children access content online and also interact with their own classmates and students from other schools. The students still attend their physical classroom but the computer serves as a tool to help them interact with other students and to access additional online instructional material. The projects have worked very successfully in schools in affluent neighborhoods and under the careful nurturing of additional government funds. An effort is now underway to test the extent to which such computer-supported collaborative learning would apply in schools in otherwise disadvantaged neighborhoods.

3.5.4 Exercises

True of False

1) A Studio Course combines lectures, recitations, and labs.
2) Students work alone at home and have no face-to-face meetings in a Studio Course.
3) The Rensselear Polytechnic Studio courses have shown reduction in school costs and unchanged quality of learning.
4) LearnLinc is a commercial software product to support the interactions of a Studio Course across distances – in other words a Virtual Studio Course.

Knowledge Essay

1) In what ways does LearnLinc combine synchronous and asynchronous modalities?

Doing Essay

1) The studio course method has been shown to work well in physics. In what other disciplines do you think it would work well and in what not and why?

3.6 Group Roles

As the teacher shifts from being the sage on the stage to being the guide on the side, the importance of roles for students and others becomes increasingly apparent. Furthermore, the information technology support for education, particularly via the World Wide Web, facilitates the computerized support for student-student and student-teacher interactions in ways that can be finely defined and tracked (Rada et al, 1989). Essentially one wonders whether the technologies of groupware and artificial intelligence might become an aspect of the *intelligent virtual classroom*.

3.6.1 Principles

We've learned that collaborative learning can be good for students. What might we say pedagogically about the aspects of collaborative learning as they are important to attempting to put further intelligence into the computerization of the classroom. Collaborative learning systems can be classified along various dimensions. Borrowing from the work of Kumar (1996), we next describe the dimensions of control, tasks, domains, and roles.

The *contro*l of collaborative interactions refers to the mode of delivery of the collaborative environment by the system. A collaborative learning system can take an active part in analyzing and controlling collaboration or act just as a delivery vehicle for collaboration. Depending on the amount of control embedded within a system, collaborative learning systems can be classified anywhere in the range between active and passive.

In a given collaborative learning environment the collaborating peers could be faced with different types of *tasks* to perform. The tasks could be enumerated independently of the subject domain that has been taught. For individual learning a popular taxonomy of tasks looks at eight different learning tasks from simple fact acquisition to sophisticated generation of new information. For our purposes, these eight tasks are reduced to three tasks: 1) fact-learning tasks, 2) problem-solving tasks, and 3) designing tasks.

In general, collaborative learning is found effective in *domains* where peers engage in skill acquisition, joint planning, categorization, and memory tasks. In collaborative learning domains, the domain knowledge to be imparted is complex, hierarchical, and requires deep understanding of each level in the hierarchy. It is difficult to observe a conceptual change if the task is purely procedural and does not involve much understanding. Some domains are less shareable than others, like solving anagrams since the processes involved are not easy to verbalize. Domains like air-traffic control are inherently distributable and hence can be effectively learned with the support of collaborative learning systems (Dillenbourg et al. 1994).

In a collaborative learning environment, where the goal is split into subtasks to be carried out by individual peers, peers may be assigned *roles*. In general, the two most obvious roles are those of executor and reflector, where executor solves the problem and reflector observes and comments on the problem solving (Blaye et al, 1991). For a peer, the system should maintain a model of these two roles and support them differently. In addition to this breakdown by task-specific roles we might include breakdowns along other criteria. Might one team member be the leader and another a finisher? How would the computer help select the right person for the role and then help the role be properly executed?

3.6.2 Assessment and Management

A sequence of `collaborative learning systems' was developed under the name of MUCH for *Many Using and Creating Hypermedia* (Rada et al, 1991). The interface revealed primarily a split screen with the outline in one window and detail in another. The selection of a heading in the outline causes the corresponding information to appear in the detail window. Whenever a node is selected by others, the node gets a `node selected credit', and the author and all updaters of the node gets a `user selected credit'. The `selected credit' is intended to indicate how often a node is `read' by others.

The MUCH system was used in teaching classes at the University of Liverpool. Students met in a computer laboratory where each student had a graphics workstation on the same network. During the class the students and the professor would discuss the contents of an online textbook and use the MUCH system to help illustrate points. Each week the students were given exercises to do and were required to use the MUCH system for those exercises. Two *assessment* exercises in particular merit description here: one involved credit assignment and the other a further qualitative peer-peer assessment.

The first assignment of the class was for students to answer a brief essay question. They were told that their grade for this exercise would be based on how other students responded to their work. More specifically, this response from other students would be measured by how often what the student wrote was `read' by other students. `Read' meant *selected*' because the computer kept track of every selection but did not know whether or not information was actually `read'.

The results of the exercise were quite interesting. First the range of selection credits was wide. Second, phenomena that one sees in the *advertising world* were employed by students to get more credit:

- flashy node names and blob contents were used to get attention.
- students tried to place their nodes near the top of the outline so that other students were more likely to see them.

Subsequently another window was developed through which students could assess the quality of another student's submission in the MUCH system. After students were required to evaluate one another with this new feature and asked what they thought of the experience, they reported that such grading is fair.

On the basis of experiences with collaborative learning and the MUCH system, formal *management models* were introduced into collaborative learning. The aim was to encourage students' natural role-playing tendencies. In one course a health clinic management model was employed for collaborative learning. An out-patient clinic in a hospital is required to perform many functions and utilizes many resources, the scarcest of which is the medical experts' time. The clinic has been operationally modeled as a queuing system, with serial and parallel queues. The simulation proved valuable in an educational sense. It enabled the managers, doctors, nurses, and other clinic staff to explore the issues involved in clinic management. The people who take part in running the clinic have gained a better appreciation of the factors that can lead to bottlenecks. A formal management model of the clinic has been implemented in MUCH so that clinic participants (including interested patients) are able to play various roles collaboratively, from manager to patient. This collaborative learning is designed to let the participants explore different clinic scenarios.

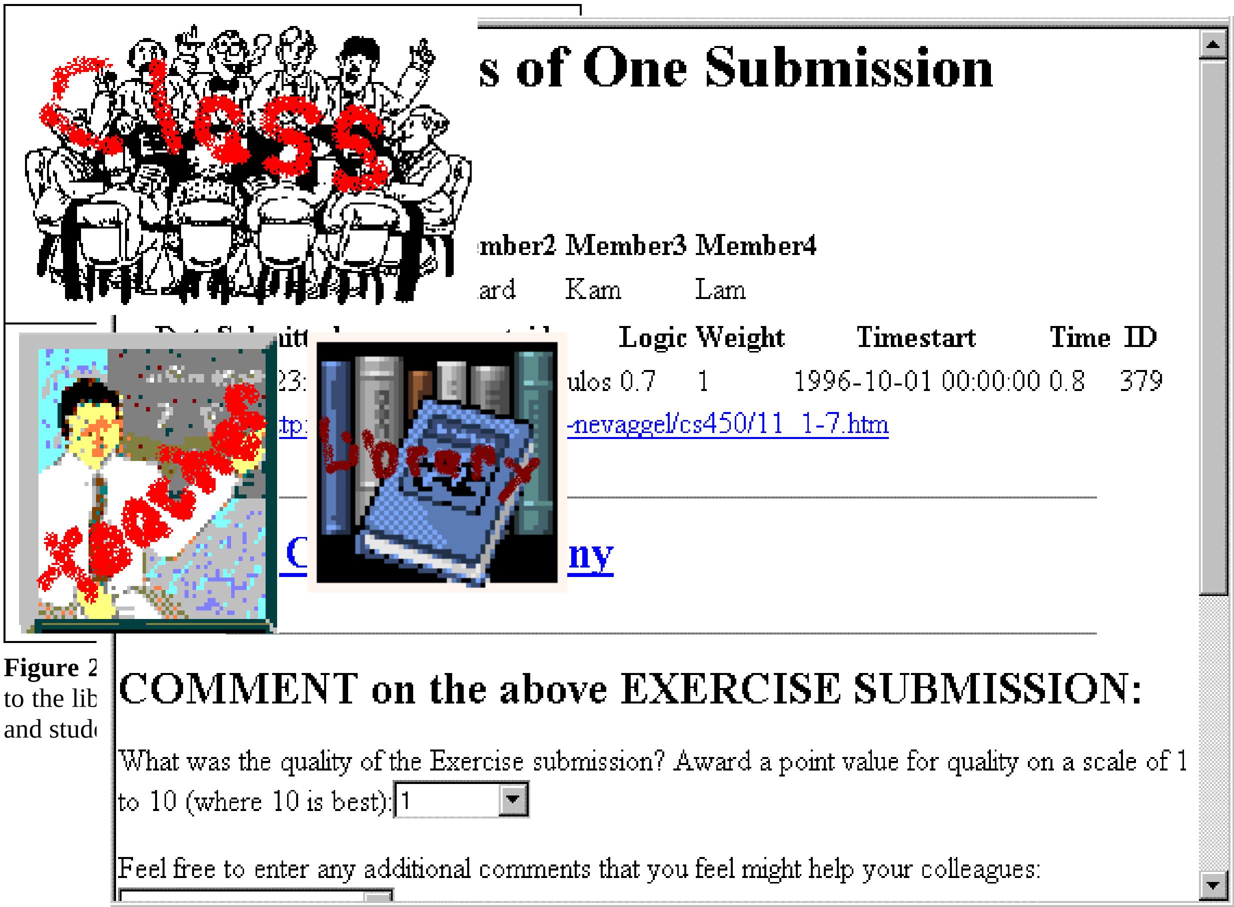


Figure 2 to the lib and stud

Figure 26: Comment Screen. This screen shows a submitted exercise answer and the opportunity for a student to comment on and score the other student's work.

3.6.3 Classroom Game

Mechanistic, game-playing groupware helps students compete with one another in exercise answers and comments in constrained ways. Can mechanistic, game-playing groupware in a studio course improve efficiency and effectiveness? *Efficiency* relates to the ratio of student-student/student-teacher interactions. *Effectiveness* is defined as perceived quality. The Classroom Game system is asynchronous and focuses on students having assignments, doing exercises online, and giving feedback to one another, as they compete for the better grades which are determined competitively. We next describe experiences with three systems and courses that manifest various degrees of mechanistic, game-playing groupware.

3.6.3.1 Spring 1996

The Spring 1996 Course had no lectures and all material was on the web. The home page 3 icons (see Figure 25 "Introductory Icons") were:

- "Class" to Hypermail archive.
- "Teacher" to addresses, assessments, and announcements.
- "Library" to weekly readings and assignments.

For each topic there was required reading and exercises. Exercise answers, comments, and other dialogue was maintained over email and automatically archived on the web by *Hypermail*. Students and the teacher did substantial discussion over email about coordination of the course. However, all this occurred in the first half of the course.

Submitting exercise answers was optional, though the grade was to be proportional to quality and quantity of student submissions. Data about the email submissions shows a bimodal curve of activities with many submissions at the beginning, few in the middle, and a flurry again at the end. This pattern corresponds to student's perception over time of the importance of contributing to the class in order to achieve a certain grade. The teacher's experience suggests that students should be more strictly required to meet the deadlines in order that the *rhythm of the course* is better maintained.

For the teacher the *coordination effort* required in the first few weeks was more time consuming than lecturing would have been. The teacher did not enforce strictly tardiness penalties and keeping a sense of rhythm in the course for the students was difficult. As email was the only medium for direct interaction, the email archive grew and grew. After about 50 email messages, Hypermail indices proved inadequate, and the teacher needed to manually maintain additional indices.

Standard school evaluation forms were used and students awarded the course an average score of 4.63. The average school score is 4.1. The teacher felt the students had learned, and student grades were high.

3.6.3.2 Fall 1996

Another course was taught in the Fall of 1996. It was titled the "Design and Analysis of Algorithms" and had 33 undergraduates students in a required course for graduation. A standard paper textbook was used with the course. Students worked in dynamically adjustable teams and submitted their work online.

Retrieved submissions show a comment form from which someone can comment on another person's exercise answer or comment (see Figure 26 "Comment"). The entity-relationship diagram for the system shows students submitting exercise answers and comments on those answers or other comments (see Figure 27 "Flowchart"). Students can request the computer to calculate the current grade of the student at any time. This grade is computed according to several parameters. For every day after the due date a submission loses 10% of its value. The average score assigned to the submission by other students is also directly proportional to the value of the submission. Thus this course *semi-automated grading*. The students graded one another's work with the help of the computer that monitored the time of submissions and tallied all results.

The teacher spent very little time *preparing lectures*. Instead the students were expected to bear the weight of any discussion that occurred. The textbook was assumed to provide the expertise about the content. The teacher guided the work by having created the mechanism of the course and by monitoring for fair and productive performance by all.

Student teams submitted 472 answers and 136 Comments. The ratio of comment submissions to exercise submissions was 0.3. This is relatively *inefficient* in terms of how few comments were made.

The students were asked to complete a *course evaluation* form. The school average score was 4.1 but the average in this class was only 3.34. Students were not satisfied with the course and, among other things, wanted to see further evidence of the expertise of the teacher and made comments like "more lectures would be better".

3.6.3.3 Spring 1996

Another course refining the methods of the two previous aforementioned courses was offered in the Spring of 1997. The grading program now took note of whether students had completed a predefined minimal amount of work per topic. This extended the *mechanistic assessment* part of the system.

The teacher was available to meet with students as a group twice a week, but this attendance was completely optional. The teacher did not need any special preparation for the discussion sessions. About 1,000 exercise submissions were made and about 2,000 comments. The ratio of comments to exercise submissions was 2.0 which is highly efficient. Class evaluations were done on a monthly basis and showed an average effectiveness rating of 4.85 on a scale of 1 to 5 were 5 was best and the average in the School was about 4.0. Thus this course was both *efficient and*

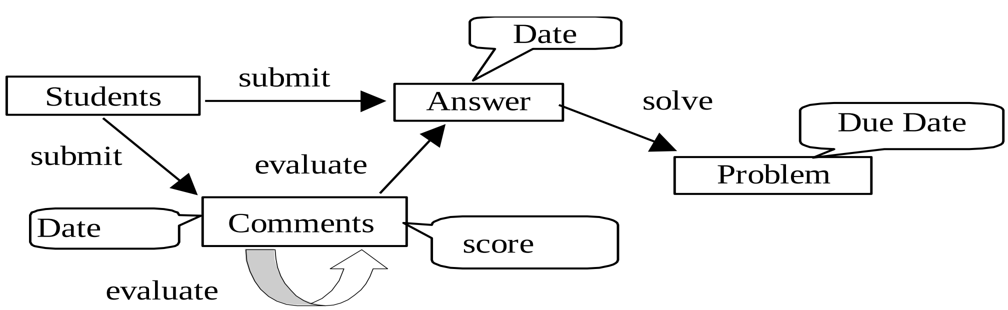


Figure 27: Flowchart of system. This diagram shows the students submission of answer and comments each date stamped. The comment also assigns a score to the answer.

effective. The increased controls in the groupware had a beneficial effect.

The idea of a competitive game inside a classroom is consistent with the idea of an *open market*. In the classroom game situation the open market competition aspects of a classroom are explicit. Students are aware of the impact of their behavior on the behavior and reward of other students. The amount of work required to achieve a top grade is not fixed. The problem with this situation is that a student ought to be able to get higher and higher reward depending on how much achievement they manifest. Instead of there being a closed economy in which a fixed distribution of grades is imposed, why not allow students to compete in some way that the reward is proportional to the effort without limit.

3.6.4 Natural Language Processing

As students interact with one another, the virtual classroom of the future will be able to play a role with them as a partner in the dialogue and as a guide. To do this the computer will need to include natural language processing capabilities. To gain the advantages of a virtual collaborative learning environment, students must not only have the cognitive skills necessary to learn the domain information, but they must also have social skills for working together. The computer can support the *social skills* of the group and increase the likelihood that successful collaborative learning occurs.

As we do not yet know how to program computers that are adept at open-ended *natural language processing*, the virtual classroom that supports the natural language interactions introduces constraints in the dialogue. To participate in the group conversation, a student chooses a speech act and a sentence opener. Speech act theory is fundamental in linguistics as a way to ascribe pragmatic roles to individuals in their discourse with other individuals.

In one system (Soller, et al, 1997), students see the group conversation as it progresses in a large window that displays the students' names, the utterance type, and the details of the utterance. This interface, structures the group's conversation, making the students aware of the dialog focus and discourse intent. By dynamically analyzing the ongoing *conversation*, the computer can determine which students are participating and in what ways. This enables the computer to guide the collaborative aspects of the interaction.

Consider a simplistic example. Assume that Mary and John are two of the participants in the dialog and that Mary is repeatedly choosing to make "seeking information" speech acts. John is repeatedly answering these questions via the "provide information" speech act. The system would recognize this imbalance in speech act types and could subsequently encourage Mary to also take a role in providing information.

3.6.5 Exercises

True or False

1) If students are graded based on the frequency with which others visit their homework submission, then the students feel the grading is fair.
2) If roles in a group can be explicitly defined, then the computer can support the operation of student groups in which group members have distinct roles.
3) Efficiency of a virtual classroom game system is based on the ratio of student-student interactions to student-teacher interactions.

Knowledge Essays

1) How is the notion of peer-peer assessment similar to the monitorial method that was popular in Britain over 100 years ago?
2) Why would the teacher work load be reduced in the classroom game courses when the Virtual Classroom experience at New Jersey Institute of Technology shows teacher work load to increase?
3) Why might effectiveness of the teacher be low in one course but high in another course when the courseware system was the same in each?

Doing Essay

1) Suggest how statistical process control might be applied in a virtual classroom to increase teacher efficiency while maintaining effectiveness?

3.7 Technology Standards

Despite the large number of experiments that have been done in academia in the realm of computerized classrooms, the *standard* way to go about this has not been agreed. If we study the experiences of other people, we find the most dominant practice is to use archived email or discussion groups. Peer-peer assessment is handled by people commenting on one another's work through these online discussions. Part of the reason for the relative lack of tools to further automate the classroom process is the lack of agreement about how to do this.

If a teacher uses a sophisticated tool from one laboratory or company, then the teacher and administrators are going to be concerned about the *transferability* of student assessment information from one system to another. The state of the art in standardizing this classroom management comes from the aviation industry (AICC, 1997). We are essentially taking the student model that is described in the learning or courseware chapter as part of the intelligent tutor and making it a simple but accessible file for purposes of teachers managing students.

In the past, authoring systems made the courseware author and student user a captive of the authoring system vendor. If the customer wanted to manage a set of students in a class, he had two choices:

- Design his own management system with his authoring system tools, or
- Purchase a management system from the same vendor who supplied the authoring system.

In either case, the management system works only for course content from a single vendor. This is fine, until the customer acquires course material prepared with a different authoring system. Standards should promote *interoperatibilty* (AICC, 1997). Interoperability means the ability of a given management system to handle lessons from different origins. It also means the ability for a given lesson to exchange data with different management systems.

There are two ways to enable interoperability of management with lesson delivery:

- Lesson launch: The management should have a standard approach to lesson initiation.
- Communication: The management should have a standard approach to providing information to the lessons and receiving information from the lessons.

Interoperability works as follows:

- The management system creates a file containing the data necessary to start-up a lesson.
- Once the lesson is initiated, it reads the data file created by the management system.
- The lesson system must create a file containing data to be passed back to the management system so that the management system can update its student performance data and make the next assignment.
- When the student leaves the lesson, the lesson system updates and completes the file of information for the management system.
- The management system reads the lesson-to-management file, updates applicable student data, and determines the next student assignment or routing activity.

Management system and lesson system communication is two-way. The *management system* sends information to the lesson when it begins. The lesson sends information to the management system when the lesson ends.

A standard for the virtual classroom concerns the management of the students in the classroom. The standard describes how a *student's performance* should be tracked. This tracking information must be possible to extract from the virtual classroom system that collects it. The models of intelligent tutoring include a student model, a pedagogy model, and a domain model. The student performance information could be seen as part of the student model but now collected by the teacher to manage a classroom of students.

Should the student performance information be the frequency of activity of the student, the number of correct answers to questions, or something else? The state of the art in management of virtual classrooms is not advanced enough to permit agreement as to what information should be stored. Likely candidates for storage in the *management records* are the responses a student made and when the responses were made.

3.8 Conclusion

The relationship between technology and the education environment is a reciprocal one. Therefore, a new technology does not exert a singular force on the people who adopt it, nor is its meaning shared equally by all. *Pre-existing social patterns* alter responses to the use of such technologies. New computer tools are affecting the ways in which teaching is accomplished, and in turn, existing patterns of education are shaping the evolution of these highly malleable tools.

The *richest communication* occurs when people are physically face-to-face, and the most sophisticated technology for connecting people with audio and video has not been able to substitute for face-to-face communication. One must understand the principles of education, groups, and of technology to develop good educational groupware.

One might wonder why earlier technologies, such as the *phone*, have not been used more extensively in the classroom. Limited evidence suggests such a tool can enhance learning in the classroom. However, the phone evidently does not fit the culture of the classroom. The school intercom is more commonly used than the phone because the intercom supports the hierarchical relationships between the classroom and the school.

Groupware can support synchronous and asynchronous communication across arbitrary geographic distances. The communication tools can handle text, audio, and video. However, even with the most expensive equipment the value to people of a virtual meeting may not match the value of a face-to-face meeting.

The conclusions about *cost-effectiveness* of groupware and virtual classrooms is not straightforward. For instance, the creators of the New Jersey Institute of Technology Virtual Classroom claim that it costs more to teach that way than otherwise, but that it is better for students. The Rensselaer Polytechnic Institute Physics Studio people claim that the physics studio reduces costs and improves the quality of education. The studio courses popularized by Jack Wilson seem to have found a good niche in which decent courseware exists for a topic and in which small gains can be made by combining limited groupware with conventional means of student-teacher and student-student interaction.

Numerous classroom environments have been developed over the past decades. However, they typically were special to a particular operating system and network and wide-spread usage was limited. Since the popularity of the web, each virtual classroom on the web can become immediately accessible to a large number of people. The challenge now is partly to standardize. This means in part making clear the design of the systems but more importantly coming to agreement about what this design should be and how components will communicate. Such *standardization* has not occurred but should.

The typical analysis made by academics of cost focuses on the costs to the educational organization as represented by the teachers. It does not pay attention to the *costs to the students*. If we consider that for some students that getting an education by going to where the teacher is physically located may preclude that student getting the education, then the costs are not reasonably measured only in terms of the costs to the teacher to teach the students currently being taught.

When we assess the impact of virtual classrooms, one dimension is the subsequent impact of the classroom on the *students' social behavior*. One charming anecdote in this regard is chronicled here. It relates to the virtual classroom of the *ZDNet University* that is described elsewhere in this book (Black, 1997c):

> By day, Michael Blezien is a maintenance manager at Santafill/U.S.A. Waste Services, where he oversees a fleet of about 100 garbage trucks that serve southeastern Wisconsin, just as he has for the last 15 years. By night, Bleizen presides over the "Keepers of the Page," a group of 15 HTML authors dedicated to "the betterment and advancement of HTML and Web page skills." After meeting in an introductory Web course at ZDNet University, the self-described "tribe" decided to continue their learning among themselves through online interaction, continuing education, and live conferencing.
>
> "There were four or five of us who got fairly tight," said Bleizen, who is looking for a change after 26 years in the sanitation business. "So after the class, we formed a Web group for people that wanted to stay abreast of Web design issues, people who were really serious about pursuing a career."

Companies pay well for employees with a mastery of programming and web design. A recent study showed that average *high-tech worker* earned twice as much per year as the average worker. These kind of motivational factors may plan an important role in the extent to which a student is comfortable or not in a virtual classroom. Extensive studies of how people respond to hypermedia or groupware tools have shown that the situation of the user is more important than the engineering variations among the tools.

The motivational factors of the students are linked to the motivational factors of the teacher. What are these motivations? In the *socialist* view of surplus distribution, the state decides how surplus is evenly distributed to all. Each student is expected to contribute a fixed amount of labor to satisfying the course requirements and deserves an equal reward. The teacher desires to disseminate a certain knowledge to all students.

In the *capitalist* view, the students in a classroom are operating in an open market in which they compete with one another to demonstrate competency. The teacher is the guide on the side whose task is to make educational resources available and to be an arbiter of disputes in the assessments of which students have best mastered the educational resources.

To what extent is the virtual classroom an extension of the traditional lecture hall in which students are presented material and later take exams? Are there circumstances under which the virtual classroom allows a new kind of *microeconomy* to develop in the classroom which is not possible in the traditional classroom? The slavish machines can track the flows of information and reward in the microeconomy of a classroom in a way that teachers would seldom be able.

Having studied courseware in another chapter, we learnt that producing intelligent courseware that more or less contains the teacher inside it is doable but very difficult given the current state of the art. The classroom emphasis thus tends to be on the support for communication among people rather than an *intelligent classroom*. One can nevertheless see already on the horizon forms of virtual classroom that correspond more closely to the intelligent tutor courseware in the sense that the dynamics of running a course are captured with knowledge and procedures in the computer that allows it to support human-human interaction in intelligent ways. This same kind of thing is being attempted in companies where it is called workflow management.

3.8.1 Exercises

True or False Exercises

1) Piaget felt that only teacher-student interactions would support natural learning processes.
2) Virtual Classrooms are a kind of groupware applied to the classroom.
3) The Studio Course emphasizes distance learning.
4) Mechanistic groupware implements rules of group interaction.

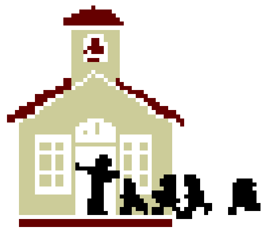
Knowledge Exercises

1) What is the most common virtual classroom mode from a) asynchronous, same space, b) asynchronous, different space, c) synchronous, same space, and d) synchronous, different space.
2) What advantages and disadvantages accrue to using telephones and broadcast video versus using internet communication in classroom education?
3) Why does the New Jersey Institute of Technology Virtual Classroom require greater teacher costs per student, while the Rensselaer Studio Physics Course reduces teacher costs per student?

Do exercises

1) Describe a course topic and a group of students such that detailed roles could be defined, the computer could manage the roles, and the students would learn by working together as a group with each a distinct role.
2) What evidence can you find for implementations consistent with the standards of the aviation industry for virtual classrooms?

Part II: Administer and Author



Part II: ADMINISTER AND AUTHOR

This part of the book has two chapters. One focuses on the general principles of virtual organizations and the models that pertain to administering a virtual educational organization. The information infrastructure that might underline a global virtual educational organization is advanced and the importance of quality control methods emphasized. The second chapter in this Part II looks at authoring of educational content or courseware from the organizational perspective and asks “how can an organization be efficient in content production”?

Learning Objectives

4. Administering Schools

- Understand the definition, theory, and history of virtual organizations
- Model higher education in terms of accounting and responsibility centered management.
- Appreciate features of existing school information systems.
- Understand how a common architecture for a school information system might be specified that could be applied to any school.

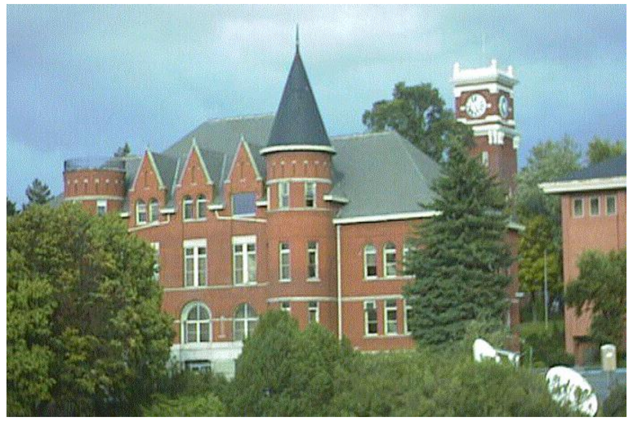


Figure 28: School. The campus of a state university where thousands of students come to live and study is a complex organization.

- Explore a generic method of quality control based on an international standard for quality processes.

4.1 Introduction

We've looked at how students learn and how courseware can support learning. Then we moved to the classroom as the first step in institutionalizing learning. Given that teaching and learning occur, one of the next concerns is the *administering* of the virtual school. How shall this administration be done? Under what conditions can the computer do some of the administering?

The school is a type of *organization*. What lessons have administrators learnt from innovation in organizations in general. Under what conditions is information technology useful to an organization? What are the trends?

To the extent that *models* of organizations are critical to successful automation, must one have models of an organization? What models of schools exist? If one looks at the flow of resources, can one associate that flow with the flow of information in a way that leads to better management?

Given that administrators do not want to reinvent the wheel, they must understand what exists in the marketplace of *available tools* to facilitate their work. What are the popular systems for school use? What functions do these systems provide and how much effort must administrators invest in tailoring the functionality to their specific situation?

Is there a *standard information architecture* for a school that was developed to guide the construction of software to support the administration of schools? If such models have not been widely accepted, what lessons might be learned from other disciplines, such as health care, that can apply to education? If we have a standard information architecture for schools, then we might expect more products and services designed to support the administering of schools and more occasions when schools can work together, exchanging information without the barriers of incompatible information structures and functions.

Quality control is one critical aspect of management. In some senses, one might say that all management is ultimately about achieving quality. What do we know about quality control in schools that could be systematically applied in the information systems that are used to help run schools?

4.2 Virtual Organization

Organizations consist of groups which work together to reach the organization's goals. Each group is expected to have for its members stable roles and defined tasks. Organizations have differing atmospheres, ways of doing things, differing levels of energy, of individual freedom, and kinds of personality -- in short, they have different cultures. Cultures are made of interlocking sets of values, norms, and beliefs. Organizations are molded by history and present circumstances, by technology, by the people that work in them, and by their objectives. Following an information processing approach to the study of organizations, organizations can be defined as the social structures constituted to gather and interpret information about the environment. Organizations use this information to convert other resources into outputs such as products and actions (Rice and Shook, 1990).

4.2.1 Definition

A *virtual organization* is an organization that exploits information technology so as to free people from space, time, and organizational constraints. More importantly it increases synergy between people and their tools. A virtual organization can engage in global communications and instant decision making based on rich information -- activities a non-virtual organization is hard-pressed to realize.

In the past twenty years, the concept of a learning organization and business re-engineering have become popular. The notion is that a company empowers its people to bring new and better methods into the company and that the focus is on continually improving and serving the customer. Every individual in a *learning organization* should be performing the job most suited to that individual and should be continually improving her own abilities and performance and be prepared to change quickly in response to changing customers' needs. While a virtual organization wants the characteristics of a learning organization, the virtual organization emphasizes permanent employees less. People may work for different virtual organizations at the same time.

Figure 29: Hierarchy The arrows represent lines of command going from the top to bottom in a single direction.

In the 1960s, it was argued that computerized information systems would transform organizations by decentralizing them and substantially reducing the numbers of middle managers (Bennis, 1964). What are the relevant *structures* to consider? The web structure is centralized and informal. The hierarchy structure is centralized and formal. Each will accommodate virtual mode in a different way.

Small entrepreneurial organizations tend to exhibit a power culture, and their structure can be pictured as a web. There are few explicit rules and procedures, and a minimum of bureaucracy. It is a political organization in that decisions are taken very largely on the outcome of a balance of influence rather than on procedural or purely logical grounds. The web can break if it seeks to link too many activities. The only way a web organization can grow and remain a web is by spawning other organization. Organizations which have done this continue to grow but are careful to give maximum independence to the individual heads of the linked organizations, usually keeping finance as the one string that binds them to the central web. It is more than coincidence that the term for the web organization includes the term 'web' which is also synonymous with the World Wide Web. The kinds of virtual organizations that are readily created on the World Wide Web may have a *web-like power structure*.

The features of an ideal or pure *hierarchy* are (Parkin 1988):

- The work of individuals and departments is broken down into distinct, routine, and well-defined tasks.
- Formal rules and procedures are followed to standardize and control the actions of the organization's members.
- A multi-level pyramid of authority clearly defines how each level supervises the other (see Figure 29 "Hierarchy").

Conventional wisdom is that the hierarchy will succeed where the market is stable or predictable or controllable, or where the product-life is a long one. However, as virtual organizations are able to benefit from the automation of procedures that are well-defined in the organization, the formally precise operational procedures of a hierarchy are attractive. For an organization that had such a codification of practices, the computer could perform roles otherwise delegated to people. Such a virtual organization would do more than transcend space, time, and organizational boundaries but would manifest some of the efficiencies that can be achieved when the information technology performs more of the roles within its reach.

4.2.2 Early Computerizations

To consider how traditional educational organizations might become more virtual we should review first how *non-educational organizations* have become more virtual. The following two cases illustrate methods of developing organizational information systems that allows an organization to be more virtual. They concern the SABRE airline reservation system and the Lockheed decision support system. Careful attention to users and usability mark the successful virtual organization.

4.2.2.1 Online Reservations

The American Airlines *SABRE* system was built in 1963 and remains a prime example of how to work with users to create a component of a virtual organization (Ligon, 1978). It involved the maintenance of a massive international database of reservations and other airline information with access under real-time constraints. SABRE's main initial purpose was to support customer reservations. In addition, information was provided about flight crews, the maintenance operations, and financial information.

When system requirements were analyzed, American Airlines was very careful to involve the *user*. The company had users detail the functional specifications of a reservation system. These users were told not to be biased by programming considerations nor by how the information could be stored. System inputs, outputs, and data flow were prepared also with the help of users.

Each program was flow charted in advance with standard programming rules. Among the rules were:

- the programs were to be coded in segments of 250 or less words,
- each segment was to be self contained, and
- tests were to be utilized for each program segment before the program as a whole was tested.

The final program included about one million instructions and was enormously successful for American Airlines. The method of *modularization* of programs is now popular under the banner of object-oriented programming. For anyone building the software for a virtual organization the advice would remain sound to decompose the program into small chunks.

Another important lesson from this example is that organizations operating across computer networks to share information independently of space, time, and organizational boundaries is not new. American Airlines had strong virtual organization characteristics over *35 years ago*. Educational organizations had, however, been relatively little influenced by such developments until the advent of the web.

4.2.2.2 Decision Support

The development of the SABRE airline reservation system illustrates how a large, networked information system is successfully built by carefully involving the users from the beginning and developing the software in a modular fashion. Another example of a corporate information system that was developed with user involvement has a rather different flavor as the key users were senior executives. The *Management Information and Decision Support* (MIDS) system provides information for executives so that they can make timely decisions with the correct and latest information (Houdeshel, 1987).

Lockheed Georgia was a subsidiary of the Lockheed Corporation and manufactured aircraft. The *President* of the corporation requested an information service that was tailored to the needs of executive decision makers and in 1978 development of MIDS began. No feasibility study was performed. The justification was informal - the President wanted it.

A team of four professionals was assigned to the project and reported directly to the vice-president for finance. This group began by studying the information requirements of the President and his senior staff. *Standardization and simplicity* were deemed critical. For instance, color was used in a standard way:

- Under budget or ahead of schedule is in green.
- On budget or on schedule is in yellow.
- Over budget or behind schedule is in red.

The information available on a display was designed to be clear and to emphasise only a few points. The person responsible for the information content of a display was listed with each display. Executives were taught to use MIDS in a 15-minute tutorial. No written instructions were provided, and the system was easy enough to use that no written instructions were needed.

The initial version of MIDS took 6 months to develop and gave the President 31 displays. Eight years later the system had evolved to include 700 displays and was in use by 70 top personnel at Lockheed-Georgia. The stimulus of the President combined with rapid prototyping and an emphasis on usability led to a *successful product*.

The MIDS system did not have the wide impact of the SABRE system but illustrates the same theme. By carefully working with users and by building an easily understood system, information technologists can help an organization be more virtual. The goals of virtual educational organizations are similar to those of American Airlines or Lockheed Georgia in terms of wanting information to be more widely available independently of normal constraints of time and space and to have the information help people understand their world. The Lockheed Georgia example used graphical interfaces and knowledge-based systems twenty years ago, and such systems remain unavailable in most classrooms. The technology has existed but educational organizations have been slow to use it.

4.2.3 Workflow

A fundamental principle behind successfully introducing technology into organizations is to *fit into the workflow* of those who are intended to use the technology. Despite huge financial investments, information system implementations sometimes result in failure (Roberts, 1989). Two apparently contradictory assertions have been made:

- Some claim that in order for organizations to realize the benefits of information technology, they have to restructure around the capabilities of the technology.
- Others say that the failure of some information systems implementations has been due to their being developed from a partial understanding of the realities of organizational life.

The import of this situation is that organizations need to be very clear about what they are trying to achieve with information technology, and systems designers need to understand how the organization works.

We will look at examples where a product, in this case Lotus Notes, was well suited to a particular audience and a case where it was not. *Lotus Notes* is a document system. There are four main application types for which Lotus Notes is particularly suited:

- tracking applications allow users to track activities, such as project progress, and typically have many users and are continually updated.
- broadcast applications are made available to a large audience where information is time-critical but remains static thereafter. Newsletters and meeting agendas are example of items which might be appropriately broadcast.
- reference applications provide document libraries.
- discussion applications function like electronic bulletin boards where users address new topics and respond to others.

Notes handles compound documents, integrating graphics, text, images, sound, video, and other multimedia formats. Because electronic mail is integrated with the database features, database documents can be mailed between Lotus Notes users.

4.2.3.1 Success

The *Information Resources Group* (IRG) at Lotus Corporation has provided library-like services and information to other staff at Lotus Corporation since the companies beginning in the 1980s. In 1986 Lotus's director of marketing suggested that library information be distributed on the new product Lotus Notes. The IRG tried Notes but not enough employees at Lotus were using Notes to make this a practical delivery vehicle. IRG continued to provide an increasingly wider ranger of services to Lotus staff that involved unfortunately an increasingly diverse range of incompatible interfaces (Liberman, 1993).

In 1990 Lotus Corporation decided to *standardize* its email and database delivery corporate-wide on Lotus Notes. The number of staff in the company had by 1990 grown to 4,000. IRG began to evaluate all its services in light of their suitability for Notes delivery.

The IRG was able to *integrate its services* with Notes and to provide to users a consistent interface and wide availability. For instance, IRG receives daily news stories from more than a hundred newswire sources. Special software monitors the news sources to find topics of relevance to Lotus Corporation. The stories are then reformatted into documents in a Lotus Notes database and made available daily to Lotus Corporation staff. A manager may specify his profile of interests to the system. On a daily basis this profile may be matched against the latest news, and stories that match the profile will be routed to the manager.

The IRG originally maintained a library of thousands of physical holdings such as books and videos. The catalogue for this library was moved into Lotus Notes and items are now lent with *no recall date*. When a searcher wants an item that someone else has already borrowed, then the searcher contacts the borrower and requests the copy.

IRG's electronic library includes various maps and help systems. Further, the user can request assistance from the IRG staff by completing a form online. When the form is saved, Lotus Notes automatically routes it to the library staff with the help of the Notes integrated electronic mail facility. The electronic library at Lotus has proven highly *successful*.

4.2.3.2 Failure

In the late eighties a few senior staff at a large, international management consulting firm (hereafter to be called Alpha Company) realized that the company was underutilizing information technology. A new position of *Chief Information Officer* (CIO) was created with responsibility to create firm-wide standards for personal computing environments. It was while reviewing communication software that the CIO was introduced to Lotus Notes. He decided that this was revolutionary technology and within a matter of days bought a site license to install Notes throughout the firm (Orlikowski, 1992).

The CIO began a vigorous international campaign within the company to promote the use of Notes. The physical deployment of the technology proceeded rapidly throughout the firm. The system was widely used for electronic mail, but was not widely used for its other intended functions. Interviews with staff in one office before installation of the software revealed that they had little idea of what the new software was intended to do and felt that it was being forced upon them. The CIO felt that *rapid deployment and critical mass* was the key to success and that training or pilot studies would be too costly.

Within Alpha there is an expectation that all or most employee hours are billable, that is charged to clients. Employees carefully avoid non-billable hours. Unfortunately, for the deployment of Notes, its use was viewed as non-billable. The most senior people at Alpha are paid based on company profit rather than on billable hours. While they were persuaded to use Notes, they did not appreciate that the other consultants were afraid to use Notes because the time required to learn it was not *billable*.

The technological push to install Notes had not addressed the issues of ownership and confidentiality of information put into Notes. Consultants were hesitant to put information into the system without a clear understanding of who would control the information. Alpha shares with many other consulting firms a competitive culture at levels below the principals. The hierarchical `up or out' career path promoted intense competition among consultants. This lack of a precedent for sharing information and cooperating with colleagues was another disincentive to use Notes. Thus at all but the principal level (where this competition does not exist) the use of Notes in Alpha tends to be limited to an individual productivity tool rather than a networking tool. If the culture, policy, and rewards of an organization do not encourage sharing of information, then technology such as Notes may have *difficulty being widely used*.

4.2.4 Contemporary Scene

We have covered the definition of virtual organizations, historical examples, and the principle of fitting into the workflow. Where does that leave us as regards the contemporary scene? Are there many virtual organizations in existence now or not? The question is ill-posed because the property of transcending boundaries and exploiting information technology is one with many dimensions and along each dimension the values fall into a wide range. More and more organizations are becoming more and more virtual.

Consider by analogy transportation, such as with automobiles and planes. We might ask to what extent a region is free of space and time constraints due to its transportation activities. Some regions are very advanced in this regard and some less so, but many regions have a continual history of increasing their transportation connections and the trend shows no signs of abating.

As the information superhighway has become more developed, both the opportunity and need for organizations to acquire virtual properties has increased. Based on the principle of fitting into the workflow, we can predict that the most virtual organizations are likely to be those with a high degree of information technology infrastructure. For instance, computer network companies like CISCO or 3COM sell to other companies computer networking devices and support. Of course, the employees of such companies are naturally enough comfortable with computer network devices. That the company would have its inventory, its personnel records, its plans, and essentially every document of its operation online is not unusual. That the employees could be expected to have access to the network wherever they might be working in the world and whatever hour of the night or day is also not unusual.

Transcending space and time boundaries through computer networking is not something that people do because it's fun. They do it of necessity. Take again the case of computer network companies like CISCO and 3COM and consider the competition and the importance of fast, well-informed decision making. If one company has an effective virtual operation and a sudden opportunity to bid on a contract with a global company. The virtual company can respond overnight with its global resources coordinated in a way that a non-virtual company can not. In the evolutionary situation, the virtual company has an advantage over the non-virtual one.

So the trend continues. Again with consideration of the transportation analogy, people are not by their biological inheritance comfortable to sit in a car or plane for hours – they would more naturally walk or run. However, transportation by car or plane has such a competitive advantage over walking or running for many practical tasks that many people will actually now say that they prefer driving or flying over walking or running. The same phenomenon is happening with the information superhighway. People are not biologically comfortable with sitting before a computer for hours and typing on a screen when they could be face-to-face with someone and engaged in more physical activities. However, what can in many situations get accomplished with a few hours at the keyboard of a networked computer is so much greater than what would get accomplished by restricting the activity to face-to-face that people may actually say that they prefer to work across the information superhighway than face-to-face. We see no end to this trend.

4.2.5 Exercises

True of False

1) A virtual educational organization transcends space and time but not organizational boundaries.
2) The hierarchical control structure has better defined procedures than the web control structure.
3) The SABRE online reservation system both exemplifies a superior way to develop an information system and also helped an organization achieve further virtual qualities.
4) The Chief Information Office can judge by the responses of other senior staff whether or not a new information product is likely to fit into the work flow of junior staff.

Knowledge Essays

1) What are characteristics of a hierarchical organization as contrasted with a web-like power organization?
2) What have you learned from the successes of the SABRE Online Reservations project and the MIDS Decision Support project?

Doing Essays

1) If you were developing a virtual educational system, what would you see as the pros and cons of hierarchical administrative structures versus web-like power structures?
2) In what parts of an educational enterprise would you use an information sharing tool like Lotus Notes and what parts not?

4.3 Higher Education

The chapter is entitled "schools" and thus far we have focused on organizations in general. Schools have certain basic functions and structures. The function is to educate students. The structures include course material and classrooms. Teachers, students, and administrators work together. Rather than attempt a broad description and analysis of schools, we will focus on *higher education organizations*. What are the activities, structures, and cost accounting procedures of higher education organizations?

Educational institutions may serve many purposes. A virtual educational organization in the sense of this book focuses on education rather than research or service. However, to gain a perspective on the scope of universities, let's consider first a major research university. The modern *research university* is a complex, international conglomerate of highly diverse businesses. The University of Michigan, for example, has an annual budget of more than $2.5 billion. If it was a private company, then the University of Michigan would rank roughly 200th on the Fortune 500 list of largest companies in the U.S.A. (Duderstadt, 1995).

The large, research university operates as a holding company for thousands of faculty entrepreneurs. The faculty have teaching duties, but performance in these teaching duties is only modestly linked to salary. This model of research universities does not apply to community colleges, as we will see in the next subsection.

4.3.1 Accounting Model

The functioning of American public universities is heavily subsidized by government. The *revenue theory of cost* is appropriate for describing universities (Bowen, 1980). Namely, a university gets as much money each year as it can, spends all that money that year, and next year operates in the same way. From one like university to another like university in the United States the amount of money spent to educate a student can differ by a factor of two and still the quality of education tends to be the same. The conclusions of Bowen's landmark study merit direct quotation as follows (page 227):

> If one observed strong central tendencies toward certain levels of cost, or found clear modalities in the way higher education is

> conducted, or could discover definite relationships between costs and educational outcomes, then one might find empirical support for particular recommendations. Unfortunately, the study of institutions did not reveal such clear-cut conclusions. .... Instead, the dispersion of costs proved to be so wide, even for ostensibly similar institutions, that the mode cannot be assumed to represent an ideal or widely accepted standard. This variance is of course consistent with the revenue theory of cost, namely, that the cost of any institution is largely determined by the amount of revenue it can raise.

The revenue theory of cost for universities means (ibid, page 15) that:

> When resources are increased, they find uses for the new funds, and unit costs go up. When resources are decreased, they express keen regret and they protest, but in the end they accept the inevitable and unit costs go down. This set of generalizations might be called the revenue theory of costs.

As one goes from public research universities to teaching community colleges, one sees something closer to an accounting model in which revenue is related to costs. In particular we will look at a community college funding model.

Most states allocate funds to *community colleges* on the basis of enrollment. A funding unit is the smallest unit that corresponds to a unit of student load and is the product of an educational organization (Bibby, 1983). The instructional workforce consists of faculty and can be measured by the number of full-time equivalent faculty. Productivity is equal to the number of funding units divided by the number of full-time equivalent faculty.

Many *time studies* of teachers have been done to indicate weekly hours for classroom function. One such study (Adams, 1976) produced a formula that relates

T = weekly hours for classroom function,

x = weekly hours in the classroom or laboratory, and

y = number of students taught.

The formula says that $T = x + (.7)\,x + (.08)\,y$. The term $.7x$ represents preparation time and $.08y$ represents the time spent evaluating students. For example, a faculty member teaching 15 hours per week with a student load of 150 will spend $15 + .7(15) + .08(150) = 37.5$ weekly hours for classroom functions alone. The difference between the expected activities of a professor in a community or teaching college versus those activities of a professor in a research university are dramatic. At a research university a Professor may typically teach one course a semester, whereas at a community college the professor teaches ten times that much.

4.3.2 Responsibility Centers

The typical approach to public agency budgeting in the past has been to pool most income centrally and to approach expenditure budgeting without regard to which units or activities generated the income. Thus, units and individuals see no relationship between their income generating activities and the budgets available to them. Since infrastructure costs, like electricity and space, are centrally budgeted, units and individuals feel little incentive to economize on infrastructure costs. *Responsibility centered management* attempts to identify the revenues associated with each responsibility center (RC) and return those revenues to that unit while charging each RC, as nearly as possible, with the expenses (including indirect expenses) associated with its activities.

The *pros and cons of responsibility-centered management* suggest a net positive impact. Responsibility-centered management creates management, budgetary, and reward structures that tie resources to performance closely enough so that individuals will see how their own actions influence the security and fiscal well-being of their units and themselves (OPA, 1996). Other desired results include:

- integrating and coordinating academic and fiscal planning,
- flattening the management structure and further decentralizing decision making (expenditure decisions will be made closer to the point of service delivery),
- matching costs more clearly with benefits,
- providing members of the community with a stronger sense of the relationship between performance and rewards, and
- subjecting service units to constant scrutiny for efficiency, effectiveness, and proper incentives.

Possible adverse effects to be avoided include that unit goals may supplant or contradict institutional goals and excessive decentralization may limit the ability to provide selective investment, innovation, and central direction. Support activities may be complex and disentangling those activities which are revenue generating from those which provide support a complex process.

Given the evident advantages of management with RCs, what are the steps an administration must take to *implement RCs*. A successful responsibility centered management effort requires that:

- In assessing proposed changes, estimated marginal (not average) revenues and costs must be used.
- To the extent possible, all revenues and costs should go to the RCs whose activities generated them.
- Resource allocation methods at all levels must be clearly defined, so RCs know how and where resources will be allocated.
- Forums for jurisdictional disputes must be created to address the negative aspects of competition.
- Operating rules should remain relatively constant to allow decision making in a consistent framework.
- To the extent possible, RCs should have the authority to seek outside services. Where outside alternatives do not exist, RCs should have a say about support unit budgets.

A responsibility center should function as a separate entity with unity of command, should produce products or services, should have an identifiable locus of management responsibility, and should be held responsible for fiscal results by carrying forward balances and deficits resulting from its operations.

The arguments suggest that responsibility centered management should be prevalent in educational organizations. However, the opposite is true. State supported educational organizations tend to avoid RCs. Why is this? The rational for RCs is that a unit can increase its performance and earn reward proportional to its achievement. However, the base funding for state-supported schools is often delivered *for political reasons* rather than performance reasons. When the state economy is strong and taxes plentiful, the schools get more funds. Otherwise, independently of their performance, they tend to get less revenue. This political environment of the school reflects itself in the internal operations. Schools have a political way of working. A unit of the school that has developed over time political power through whatever means but has a low revenue-to-cost ratio will resist the implementation of RCs. For in the RC system that politically powerful unit would lose resource.

The virtual educational enterprise makes more apparent the revenue and cost aspects of a school. The more explicit the formulas for reward relative to performance, the more easily the computer can play a positive supporting role in the running of the school *by semi-automating decisions*. When decisions are to be based on political maneuvering, then the computer is poorly positioned to contribute.

What types of schools will make the greatest *progress* on the virtual education frontier? The politically-driven schools will have the advantage of public financial support but the disadvantage of a less precise method of decision-making. Other things being equal, those schools which operate in accord with responsibility centered management principles should be at a relative advantage in competing in the virtual education marketplace.

4.3.3 Unbundling the Product

Information technology will allow educational providers to separate some key functions traditionally bundled together (Massy and Zemsky, 1995). For example, not all faculty will be architects and instructors once the best lecturers become available across campus boundaries--but perhaps more faculty will be involved in navigating, mentoring, and certifying. The investments in knowledge codification, delivery systems, and assessment techniques will decouple the provision of learning from the certification of mastery, thus opening new modes of educational delivery and paving the way for new entrants to the higher education marketplace.

These separations will allow colleges, universities, and other educational providers to *unbundle their offerings* and prices. Students will be able to pay for instruction with little mentoring or, alternatively, much mentoring, as they choose. They will be able to get learning with certification or contract for learning and certification separately. Both innovations will improve higher education's overall productivity, and they also will undermine the monopoly now enjoyed by traditional providers.

Real labor costs tend to rise with economy-wide productivity gains, whereas technology-based costs tend to decline due to learning-curve effects, scale economies in production, and continued innovation. Increasing technology's share of cost may reduce overall cost growth until the rate differential reduces technology's share to the point where labor again dominates. By this time, however, total cost will be lower than it would have been without the injection of technology. Given the differential growth rates of labor and technology, one can expect *positive long-term returns* on investment even when returns are negligible during the first few years.

4.3.4 Exercises

True or False

1) The revenue theory of cost says that universities spend all the money that they can get and that performance of the university is not related to the cost.
2) Responsibility centered management means that the central administration of the university takes all responsibility for management.
3) Technology is likely to support responsibility centered management and politics to destroy such management in a university.

Knowledge Essays

1) What are the differences in teaching loads in community colleges versus research universities and why?
2) Note some activities of a typical university that are least important to a virtual university.
3) What is responsibility centered management and what forces work against its success?

Doing Essays

1) Why is responsibility centered management well suited to a virtual educational organization?
2) Construct an example that illustrates how information technology applications in education support the unbundling of the product.

4.4 Systems

While we would argue that schools should acquire their information systems from *external vendors* rather than attempt to build them in house, the school is the natural source of requirements. We examine next the activities of some schools in specifying requirements and managing their information systems. Then we examine some commercial software that is available for schools.

4.4.1 Schools

Different schools have different *requirements*. The Education Network of Maine does distance learning with no residential students and needs support for such distant students. The Maricopa Community Colleges have a commuter base with diverse needs. The University of Texas at Austin has a large, residential student population. These different schools have different information technology needs.

There are eight academic units in the University of Maine System, seven traditional campuses and the *Education Network of Maine* (ENM). ENM supports the

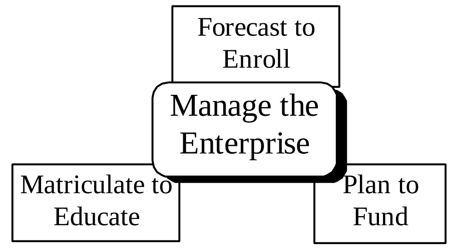


Figure 30: Education Business Practices. To manage the enterprise, SCT includes focuses on the three functions depicted in the plain rectangles.

distance learning programs of the University System. To understand the needs of a distant student, the University developed scenarios for a student enrolling in courses from separate University of Maine System campuses. Several scenarios for that fictional student followed her progress through a maze of campus procedures. The conclusion was that unless enrollment and administrative services are reconfigured for ENM students the process will remain discouraging. Telecommunications and technology have done more than link people together at a distance; they have also revealed that traditional processes for serving them are not particularly suited to an integrated, virtual mode of operation.

The *Maricopa County Community College District* (MCCCD) in Arizona is the United States' second-largest system of its kind, exceeded only by the Los Angeles system. It offers 6,000 courses to a population of commuter students. MCCCD has problems not unrelated to those identified by ENM – namely, MCCCD needs to facilitate the movement of students to and from its various operations. To develop the information technology infrastructure to support its educational mission, MCCCD contracted with a major software company to develop a Learner Centered System. This Learner Centered System replaced, integrated, and expanded the functionality of MCCCD's previous systems that impacted learners, such as the Student Information System, the Monitoring Academic Progress System, the Course Program Register, the Course Inventory Audit, the tutor management system, and the on-line grading system.

The *University of Texas at Austin* has evolved its computing system over several decades, adding technological innovations as appropriate. The university licenses software from established companies that service the education sector. However, the university's systems are generally programmed in-house. The university employs about 400 full-time computer programmers.

The computational needs and costs are radically different depending on the type and size of a school. The University of Texas at Austin has 50,000 students and its information systems are not applicable to a smaller school. For a small school, such as the *University of Texas at Permian Basin* with 1,000 students, the school's accounting needs can be adequately handled with a spreadsheet package on a personal computer. The *University of Vermont* with its 10,000 students is intermediate in size between the University of Texas at Austin and the University of Texas at Permian Basin. The University of Vermont employs 50 full-time information technology staff and licenses its main information system from a commercial vendor.

The *Tennessee Board of Regents* serves approximately 200,000 students and is committed to connecting students and services so that every student is assured online, immediate access to admissions, registration, and grading information. The Tennessee Board of Regents has contracted with one software house for all its software needs and that software house is described next (SCT, 1997b).

4.4.2 Commercial General

A school that wants an integrated information technology system faces a large challenge when it wants to implement this system from scratch in-house. Why not purchase a system from a company with expertise in providing such solutions for schools? In the preceding description of higher education school systems, we mentioned repeatedly that schools had acquired software from a commercial vendor. In many cases this vendor is *Systems & Computer Technology Corporation* (SCT).

The University of Texas at Austin uses SCT software. The University of Vermont paid SCT one million dollars for a license to its major university information system and assigns five full-time staff in-house to maintain the operation of that SCT system. The multi-year contract that the Tennessee Board of Regents has signed with a commercial vendor is a contract with SCT for installation of SCT software throughout the state of Tennessee.

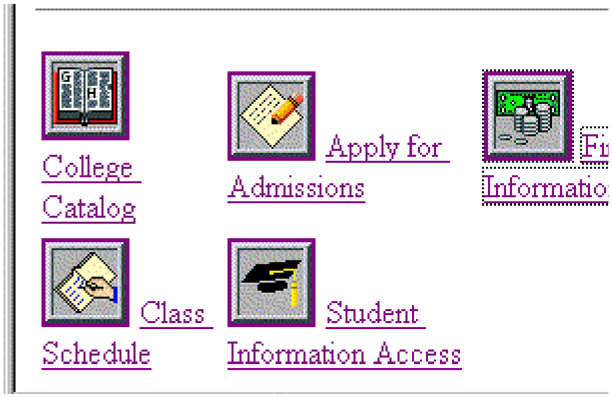


Figure 31: SCT Student View: Part of the screen as seen by a student using the SCT system.

One of SCT's major products for higher education is called Banner and the latest version of that is *Banner2000*. Banner2000 enables (SCT, 1997a) an educational enterprise to operate based on a common set of business practices: Manage the Enterprise, Forecast to Enroll, Matriculate to Educate, and Plan to Fund (see Figure 30 "Education Business Practices"). University users manage revenue and costs with processing designed specifically for the higher education environment. Managing the workforce goes beyond payroll, employment, compensation, and benefits. Position control, tenure, deferred pay, work study, and regulatory requirements further define the information needs. Banner2000's enterprise model supports core financial and human resources business processes with built-in workflow, centralized or distributed information processing, decision support, and employee self-service. Potential students access the institution's information, apply, and research financial aid by themselves across the Internet. With Banner2000, faculty and students can advise, register, grade, and locate financial aid sources by themselves.

We will look at some screen images from the Banner2000 system as viewed by students, faculty, and staff. The student can enter his/her personal id and retrieve personal information or can view the university catalog of courses, the timetable, and so on (see Figure 31 "SCT Student View"). The logon screen for employees is basically the same as the logon screen for students (see Figure 32 "Employee Logon"). The faculty screen includes a menu for grades, schedules, and class lists. On selecting the "Grades" option the faculty member is taken to the grade book for his class and enters the grades and attendance data dynamically.

4.4.3 Commercial Focused

SCT provides a system-wide, general purpose information system for traditional higher education institutions. For virtual educational organizations, the administrator's needs may be more focused and various *specialist products* may be important to consider. We look next at two such products: one that supports largely online forums and the other which is a higher end learner-objects environment.

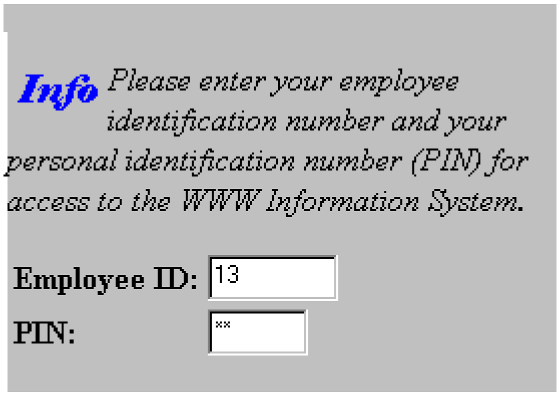


Figure 32: Employee Logon. This is the portion of the interface in which the employee logs-on by entering identification information.

Connectic Incorporated provides an electronic mail and bulletin board system for schools. With *Connectic On-Line*, the educational organization can:

- Send mail to groups using address lists.
- Look up users by name or id and see when they last logged onto the system.
- Send and receive files.
- Add and edit bulletin board information.
- Search information by key words, phrases, or dates from the bulletin board.
- Set per-document download and hourly premium charges.
- Control access rights by user and by document.
- Add, edit, and remove user accounts.

All the above functions fit between the web browser and a database as applications (see Figure 33 "Architecture of Connectic Online"). 5,000 schools use the Connectic On-Line system to communicate electronically (Connectic, 1997).

Connectic Incorporated does not develop its own relational database management system. Rather it uses a database management system from Oracle Corporation. Likewise, SCT does not develop its own database management system but purchases licenses for *Oracle database management systems* and then resells those to its education customers as part of the Banner system. In this way, Oracle Corporation has a dominant but indirect position in the education marketplace.

Oracle Corporation is also competing in the virtual education marketplace with an end-user product called *Oracle Learning Architecture* (OLA). OLA supports teachers in authoring content on the web and students in accessing the courses across the web. The functionality of OLA includes administration, reporting, and teaching. The system administration features include

- User profile management and tracking,
- Access security at user or course level, and
- User self-registration.

Reporting supports

- Usage statistics,
- User comments,
- Broad administrative reporting, and
- Automated royalty calculation.

Teaching functions include:

- Customized course paths based on user competency
- Online access to instructors, and
- Competency feedback via skills testing.

OLA manages content in two areas:

- Physical storage of courses and course elements in a file system organized by source of content (primarily by vendor).
- Tracking and control through Learning Objects stored in an Oracle database. This allows OLA to control access and relationships of courses and users.

Course structure and control utilities enable adding and removing courses and editing course profiles.

Oracle has a dominant position in the horizontal market of database management systems. We will also see elsewhere in this book how Oracle has a powerful virtual school of its own for teaching students about database management systems. Not surprisingly, Oracle sees an opportunity for itself to extend its markets vertically by offering software products directly into the virtual education market. OLA is focused on virtual schools and not schools in general.

All schools whether operating in virtual mode or traditional mode have certain common functions. Students register for courses, teachers guide the learning of students, and students graduate with certain certificates. Administrators have the challenge to guide their institutions to the selection of the appropriate information technology tools. Some schools opt to build their own systems from scratch, but most purchase systems from commercial sources and then tailor the product to their particular school's needs.

4.4.4 Exercises

True of False

1) A large university typically employs a few dozen programmers whose job is to develop or tailor software for the school.

2) One of the largest commercial providers of university information systems has a product for connecting students, teachers, and administrators across the web.

Knowledge Essay

1) What are the similarities and differences between the SCT Banner2000 system and the Oracle Learning Architecture system?

Doing Essay

1) Imagine yourself in charge of a virtual school and describe the kind of software that you would expect to use and how you would acquire and maintain it?

4.5 A Common Architecture

The higher education model and the examples of commercial and school systems to support education have suggested educational information system architectures. *Educational information systems architectures* are not discussed as much as they might usefully be. Financial information system architectures, by way of contrast, are frequently well-defined. The relationships between education and finance are rather tenuous. However, between health care information systems and educational information systems there is substantial overlap. As the health care sector is ahead of the education sector in its use of information systems, we will borrow from progress in the health care area (CEN, 1997).

The *Committee for European Normalization* (CEN) has created standards for health care information system architectures. To modify these standards to address education, one can in some cases simply:

- replace `patient' with `student'
- replace terms for health care personnel or facilities with terms for related concepts about schools, teachers, libraries, and other education related personnel or facilities

Many interesting relationships exist between health care and education that might be further extended as the technological infrastructures for each are extended.

4.5.1 Engineering

A basic *Conceptual Architectural Framework* is structured in three layers (see Figure 34"Layers"):

- Bitways layer providing the basic technological infrastructure, capable also of supporting network and distribution requirements when appropriate;
- Middleware layer supporting the cooperation of the different applications;
- Application layer supporting the highest level of specialization of education requirements.

Common components are responsible for supporting the individual applications and the management of information and activities identified as relevant to the organization as a whole. Two main classes of common components can be identified:

- *Education-related Common Components (ECC)* support aspects and needs which are related to the peculiar requirements and activities of the users in the education domain.
- Generic Common Components (GCC) support generic aspects and are common to any information system.

The specification of the Generic Common Components will not be pursued here but only the Education-specific Common Components (ECC).

4.5.2 Components

To further specify the Education Common Components, we refine our notion of *Activities and Resources*. In any education organization, different types of actors perform Activities, using Resources and generating results. Activities may be either, directly or indirectly, related to the needs of Subjects of Education (including students) or to the general, managerial and organizational requirements of the organization. Depending on the type of activity which is being executed, the results of one activity may represent Education data of the students or, simply, other data to be communicated through the education organization. When executing one activity, a certain quantity of several Resources is also used, such as staff members, computers, content, or libraries. The utilization of each resource has its specific cost, depending on the specific resource involved and on the type of activity performed. Different types of users are authorized to work with the education information system, and are allowed to perform various activities or access the different types of information.

On the basis of such an Activities and Resources view, five main education-specific common components are identified:

- Subject of Education ECC;
- Education datum ECC;

- Activity ECC;
- Resource ECC;
- Authorization ECC; and
- Concept ECC

Student information represents the central issue in the whole education information system. From the organizational and educational points of view, the *Subject of Education ECC* is able to support the proper management, tracking and follow-up of the contacts had by the student with the education organization, either as resident, commuter, or distance student.

The *Resource ECC* represents the fundamental elements which are necessary for enabling the enterprise to work. Various types of resources may be identified, such as personnel (education, technical, administrative), materials including books, computers and even the individual locations where the work is performed. To support the needs of the various types of users properly, all applications need to take into account the characteristics and availability of the resources which are supposed to be used in each individual case.

The definition and control of the authorization of individual users in the execution of various activities and in the access to different information represents a major concern in the education environment. Two fundamental and complementary needs can be identified for the information system:

the security of the managed data;

the control and monitoring of the actual authorization for individual users executing certain activities on the system.

Security relates to the criteria and mechanisms according to which data must be managed, e.g. stored, transmitted and manipulated, by the overall system to ensure an adequate level of reliability and protection. Such aspects may also imply, amongst others, the enciphering of the information and the utilization of specific devices to ensure the correct identification of individuals. As a consequence, security represents a characteristic of the system closely dependent on and related to the technological features and is outside the scope of our concern.

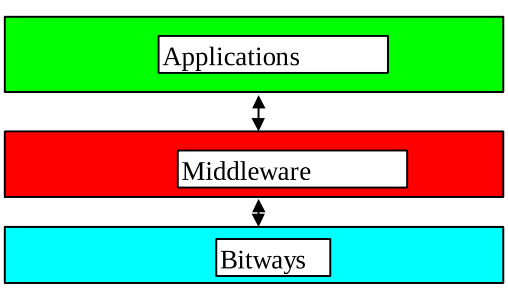


Figure 34: Architectural Layers. Each layer is indicated in a rectangle and communicates directly with the layer above and/or below it.

Apart from the need for ensuring the intrinsic security of the data, another major requirement can be identified in the need of the individual education center to define criteria and rules according to which the individual users may be authorized to access the system and perform the various activities, according to their specific role and responsibility in the organization. The *Authorization ECC* supports this specific need by providing:

- a comprehensive and consistent repository where those responsible in the organization may define the rules according to which the different users may execute the functions provided by the system;
- a standard mechanism in terms of services available and information managed, according to which the other components of the system may check whether one user is allowed to perform the activities they are requesting.

Each agent can be characterized by a name, a unique public identifier, e.g. a code, and some mechanisms for ensuring its correct identification. To access a component, the agent must be a member of one authorization profile of that component. Such membership is granted by another individual agent, and is valid in a specific time period only, i.e. between a starting and an expiration date.

In order to facilitate the complete semantic integrity of the information system, the *Concept ECC* represents:

- the semantic types and classifications defined in the various concepts of the information system;
- the common vocabulary covering the set of terms that an application needs and employs to describe the application domain; and
- the dependencies and rules which may exist between different concepts mutually related, as well as between different individual instances on the basis of specific values of their attributes.

Should a Concept ECC be present in the information system, the other ECCs conformant to it will refer to its service for retrieving a controlled and integrated set of classification criteria and rules, useful for improving the level of support that they are able to provide autonomously to the users (see Figure 35 “Concept Component”).

4.5.3 Dependency and Conformance

Each ECC must be able to operate correctly, according to its scope and objectives, in the framework of any generic education information system, even if no other ECC is present in that installation. This implies that each ECC has to be *self-consistent*, both from the information and the functional points of view, being able to manage the whole set of information which is necessary for its scope, as well as to provide the rest of the system with a complete and consistent set of services to retrieve and manipulate such information.

The following criteria guide the specification of the individual ECCs so that *dependencies* are minimized:

- No 'supervisor component' may exist, having the responsibility of coordinating or integrating the behavior of the other ECCs, since it would create a monopolistic situation stopping each ECC from operating in the absence of the supervisor.
- The conceptual schema of the information managed by one ECC has the sole purpose of describing the external behavior of that component with respect to the data which are exchanged with the rest of the system. It is not intended to represent the fragment of an integrated database schema, implicitly supposed to underlie the whole information system.

For example, the Subject of Education ECC has responsibility for providing services for the identification and management of subjects of education, which include students. The scope of the Resource ECC is to manage resources, which also includes the staff of the university. Should the physical system be implemented through a unique, integrated database aiming at supporting the whole education system, a design decision could be to aggregate both concepts Subject of Education and Resource as subsets of one unique entity, called 'person'. Although the specification of the Education Information Systems Architecture (EISA) makes this implementation approach possible, it is not forced, making different solutions possible, e.g. based on the interworking of different systems, each of them with its own heterogeneous database.

Conformance criteria facilitate both the gradual development of software products conformant to the EISA, as well as the incremental evolution of current systems. The criteria specifying the conformance of a software artifact define

- how much the software artifact is able to provide the rest of the system with the services foreseen by the EISA for that Common Component;
- how far the software artifact is able to be integrated with the other components of the middleware layer, by using the services provided by the other ECCs.

According to this approach, stating that one component represents an Activity ECC conformant to the Resource ECC and not to the Student ECC automatically defines that

- the component offers all services and allows the management of all information foreseen by the EISA for a standard Activity ECC;
- the component uses the services defined by the EISA for the Resource ECC any time it has, either for internal reasons or to satisfy external requests, to deal with information or tasks which are in the scope of the Resource ECC;
- the component manages the information and the tasks related to the scope defined by the EISA for the Student ECC through some internal

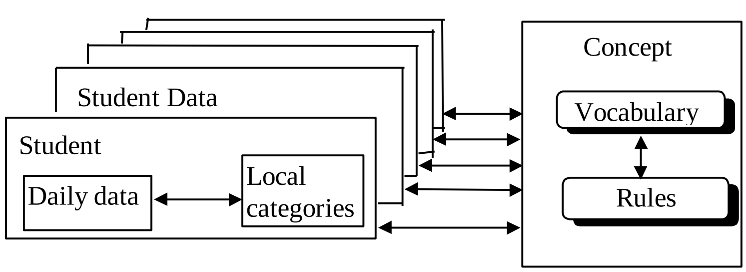


Figure 35: Concept Component. The concept component gives a vocabulary and rules for the other components.

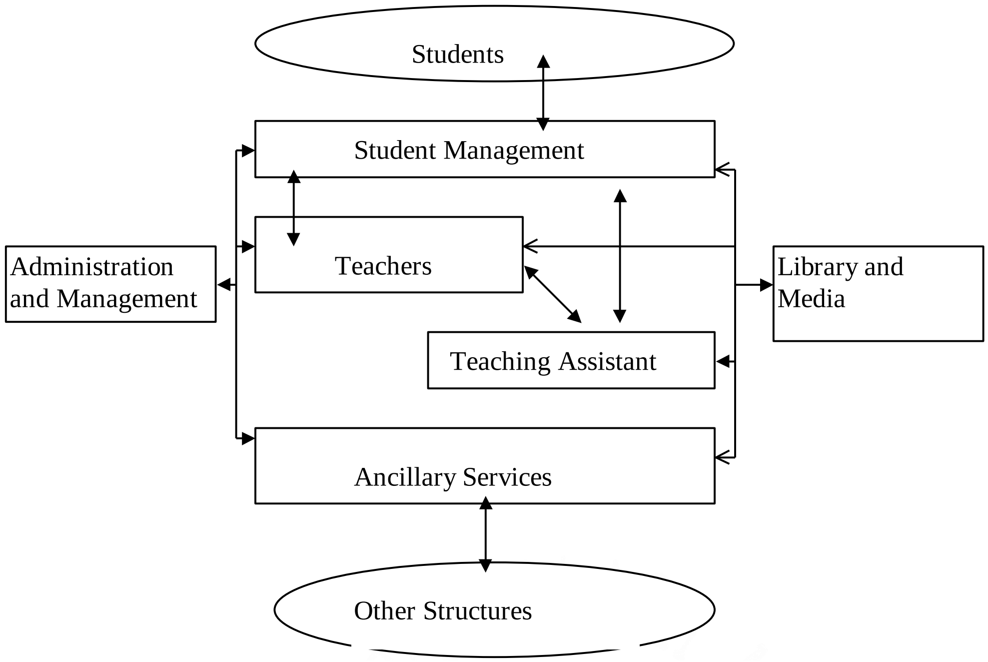


Figure 36: Modular environment. This flow chart of a school information system is based on student information and focused on professional activities.

mechanisms, without referring to the standard Student ECC.

The conformance criteria do not dictate any physical interfacing mechanism concerning the interaction between the components, but simply state that such mechanisms must be explicitly described in a non-ambiguous way in the documentation of the software artifacts conforming to the EISA.

The architecture does not state how the components must be *implemented* . One component can be any type of self-consistent and clearly identifiable element of the information system capable of autonomously interacting with other components in a documented and non-ambiguous way. With the sole purpose of providing some possible examples, it can be mentioned that a component could be:

- a batch program, capable of reading certain input data from a file and writing its output on another file, e.g. a program receiving a file with the student teacher satisfaction survey and creating several output files, individually addressed to the various units related to the classes;
- a program running in a distributed environment, capable of interacting according to client-server mechanisms, e.g. a remote program interworking in real-time with a client, to retrieve student data from a database.

In order to contribute further to the development and utilization of physically integratable artifact products, further standardization exercises can be envisaged. One might extend the conceptual provisions to the formalization of one or more sets of physical Application Programming Interfaces services provided by the individual components of the architecture.

4.5.4 Structure/Function

We have viewed the Education Information Systems Architecture in terms of three layers and also in terms of Education Component Compents. We mentioned only briefly the structure/function view as the user would see the overall system. Now we return to that view in closing this architecture section. In Figure 36 "Modular Environment" a *structural/functional view of an education information system* is presented. Students go through a student management module to teachers, administration, library, and other services. Teachers manage teaching assistants who in turn interact with students through the student management module and have access to library and ancillary services. The model does not address some important concerns, such as marketing, finance, or course production.

The simple model addresses principally *the teaching function*:

- The course material is stored in the library as lessons. Lessons are grouped into courses which are in turn linked into certificate and degree programs. These are one of the resource modules in the common architecture suggested earlier in this chapter.
- The student has a record that identifies the student and points to lesson accomplishments that are recorded separately for each student and each lesson.
- Teachers each have identification records too. Additionally, a record of transactions by the teacher with the student management and teaching assistants is maintained.
- Administration collects student evaluations of teacher performance and manages the assignment of teachers to courses and curricular management.

With such extensive recording of teaching-related activities, quality control of teaching is facilitated.

An indication of the breadth of possible *support services* in a virtual school notes these four categories of such support (Lawrence and Service, 1977):

- Academic Support
- Student Service
- Institutional Support
- Student Access

Academic support is further decomposed into Computing, Course Development, and Academic Personnel Development. Student Service is basically counseling and depending on the student body may involve support for students to advance in their job.

Criterion	Change
quantity of customers	↑
quality to customer	↑
cost per customer	↓

Figure 37: Mission of Organization. The column on the left gives attributes of performance. The column on the right shows the desired direction of change in those attribute values; an upward-pointing arrow means `increase' and a downward-pointing arrow means `decrease'.

Institutional Support includes logistics, administrative computing, faculty services, and public relations. Student Access includes student recruitment and financial aid administration.

Extending our information system model for a virtual school, we further address the *roles* of student, teacher, librarian, administrator, marketer, budgeter, personnel manager, and course developer. The librarians acquire course material from third parties. The marketer develops relationships with organizations representing students and sells the course. The budgeter distributes revenue from student tuition fees to cost centers. Each role can be implemented in different ways but should have a well specified interface that allows other roles to communicate with it.

4.5.5 Exercises

True of False

1) The bitways layer is the part of the system with which the user most directly interacts
2) Authorization is an important function for determining who has permission to do what on the system and is a significantly different issue from security.
3) One should be able to certify whether or not a given component conforms with a particular education information system architecture.

Knowledge Essays

1) What advantages could accrue to the world, if an education information system architecture were standardized?
2) Briefly describe the high-level structure, function model of an education information system.

Doing Essays

1) Suggest aspects of a marketing module that might be added to the structure/function model of an education information system.

4.6 Quality Control

Sam Walton ran an empire of *Wal-Mart* stores with a flat organizational structure that exploited information technology networks that collected extensive information about customer transactions at Wal-Mart stores. With a vision of reducing costs and making accessible to more customers more retail products, Walton created a quality management organization. Some virtual educational organizations have the same high-level objectives of Wal-Mart and are equally dependent for success on quality management.

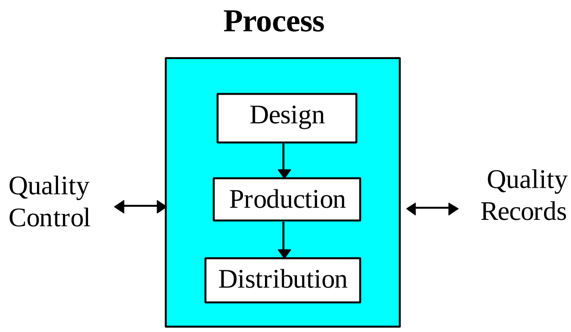


Figure 38: Quality Control. The rectangle in the middle shows the basic process of the company. The quality records that are indicated in the right must reflect each step of the basic process. The quality control is indicated on the left and applies to the quality records relative to the ongoing company process.

Many universities are under pressure to change in the same kind of way that the department stores of the mid-20th century were under pressure to change. They face a *triple challenge*: to improve quality of educational outcomes for students, to increase access to education for students, and to operate under conditions of financial austerity. Technology can help the university manage quality and provide wider access for students. Universities want to improve quality, increase the customer base, and reduce costs (see Figure 37 "Mission of Organization"). One approach to these goals is quality management. Such management depends on standards within the organization.

4.6.1 International Standard

Standards are often about a product but can be about quality management. The pre-eminent standard in the area of quality management is produced by the International Standards Organization and is called ISO 9000. The standard provides a general framework for quality management and is targeted towards manufacturing organizations. The challenge to the organization is to invest in the additional workload of the maintenance of records for monitoring quality in such a way that the profitability of the company is improved. New *standards for quality management* are needed which target other sectors than manufacturing. Universities are now striving to improve their competitive position by exploiting information systems but are in need of better quality management. Might ISO 9000 be tailored to guide the quality management of education?

4.6.1.1 ISO 9000

ISO 9000 began in 1979 when the British Standards Institute began the creation of a standard for generic quality principles for manufacturing. This led to the *ISO 9000* standard that is now the most widely known, most widely adopted, and best selling standard.

The term `ISO 9000' is usually used to refer to a set of intimately related standards. One standard is a roadmap for the others. These standards cover quality design, quality management, and quality assurance for different kinds of companies depending on the extent to which they design as well as manufacture products. Another one of the standards covers risks, costs and benefits, management responsibility, quality system principles, and other building blocks that help users customize quality standards to conform to real-life situations. The term ISO 9000 will be used to refer to this *set of standards*.

One way to model the coverage of ISO 9000 is to think of the organization's operating process, its quality records, and its quality control. The operating process creates the final product or service (see Figure 38 "Quality Control"). The quality records are maintained relative to this process, and the control system corrects for divergences from quality. Quality control is supported by a procedure manual that provides guidance for the implementation of the quality system on a day-to-day basis. The control system must include a means for identifying, collecting, indexing, storing, retrieving, and maintaining quality records. The *quality system* must help people work to quality (Huyink and Westover, 1994). This requires both that the documentation is relevant to the standard and that the behavior of people is relevant to the standard.

4.6.1.2 Why Important?

ISO 9000 is important in the first instance because it gives organizations some guidance on how to manage for quality. Secondly, mechanisms exist by which an organization can be certified for conforming to ISO 9000 specifications. With this *certification* in hand, an organization can better sell its product or service to its customer. It can say that the product or service is the result of a process that continually tested for quality.

The government of the European Union has mandated that some products will not be imported into Europe unless the exporting organization can demonstrate compliance to ISO 9000. Organizations, such as the military, which have traditionally implemented costly reviews of quality in their suppliers can instead require that their suppliers demonstrate conformance to ISO 9000. Employers could require the schools that serve their employees be ISO 9000 compliant. In a market sense, the *buyer* pressures the seller to demonstrate ISO 9000 compliance.

ISO does not itself test for conformance to ISO 9000. Conformance to ISO 9000 may, in general, be checked by

- the organization which claims to follow the standard and wants certification (*1st party certification*),
- the organization which is buying product or service from the company that claims ISO 9000 compliance (*2nd party certification*), or
- an organization which specializes in such certification and is neither the 1st or 2nd party (*3rd party certification*).

Rules exist for how such certification should be done, and organizations exist which certify other organizations as performing reliable ISO 9000 certifications. In the United Kingdom and Australia 3rd party audits of ISO 9000 compliance involves a system audit every three years and five mini-audits within each three year span. To receive certification a company must show that its documentation follows the quality standard and that its people follow the documentation (see Figure 39 "Documents and Behavior").

Mapping Documents and Behavior			
		Documents	
		Good	Bad
Behavior	Good	documents conform to standard and people follow documents	documents do not follow standards but people follow documents
	Bad	documents conform to standard but people do not	documents do not follow the standard or are missing and people do not follow them

Figure 39 **Documents and Behavior**: This 4x4 table has columns which indicate the quality of the documents and rows which indicate the behavior of people relative to the documents.

4.6.1.3 An ISO 9000 University

In 1994 the *University of Wolverhampton* became the first university in the United Kingdom to gain IS0 9000 registration for the entire organization and for the whole of its core business (Storey, 1994). This core business is the design and delivery of learning experiences with provision for research and consultancy services. Achieving this registered quality status represented the culmination of three years of a corporate effort involving a small core team of missionaries, the university's quality assurance unit, and staff at all managerial and functional levels. The main goal was to provide a rational and documented system base for the pursuit of total quality in a large and complex organization.

The Chief Executive of the University of Wolverhampton has said (Harrison, 1997):

> We, the staff of the University of Wolverhampton, are committed to providing high quality services regionally, nationally and internationally - to our wide range of students and other clients regardless of their gender, creed or nationality. This provision is aimed at developing the relevant knowledge, skills and competences to meet the future needs of industry, commerce and society. We will foster a cost effective do-it-right-first-time culture by understanding and conforming to the requirements of the University's Quality system at all times.

The standard of administrative services and academic delivery has risen, since the University began its effort to be ISO 9000 compliant (see Figure 40 "ISO 9000 Compliance").

The University of Wolverhampton quality system mirrors the *structure and function* of the organization. A quality system that works defines not only what the organization controls, but how it deals with what controls it. The rules and regulations, permissions and vetoes coming at the organization from outside the line management structure are described within the quality system as frameworks within which the university must operate.

Figure 40: ISO 9000 Compliance. This is the seal used by the University to show its compliance with ISO 9000.

The process undertaken by the University of Wolverhampton addresses the routine running of an otherwise traditional university. Successfully monitoring behavior is integral to being ISO 9000 compliant but is more generally vital to virtual education activities. Many universities are endeavoring to deliver course material in self-paced, interactive multimedia modules. The faculty at the universities are concerned that they do not have the tools or training to produce or manage such a new curriculum. Accordingly, schools are attempting to define standards for teaching loads that will take into account the technological component of a course. Surveys have been undertaken to analyze and summarize the number of hours and kinds of effort faculty have expended to prepare and teach new technology-enhanced classes. On the basis of this analysis, faculty, unit heads, and staff who have been associated with course delivery in some way define the equivalent *teaching loads* for their particular units. Relevant variables include whether faculty must learn new multimedia teaching techniques; develop their own course materials; or meet face-to-face with classes. As such standards are developed, they become integral parts of the quality management of the university.

4.6.2 Accrediters

A higher education organization that wants accreditation may realize that a *wide-range of organizations* could be approached to accredit its services. For instance, if we visit Indiana University Southeast we see there the statement (IUS, 1996):

> Indiana University Southeast is fully accredited by the North Central Association of Colleges and Secondary Schools, by the American Assembly of Collegiate Schools of Business, by the National League for Nursing, by the Indiana State Board of Education, by the National Council for Accreditation of Teacher Education, and by the Indiana State Board of Nurses' Registration and Nursing Education.

From this list one sees one sample of organizations that have granted accreditation.

Of the many accrediting organizations of interest to readers of this book, the single most pertinent specific accrediter might be the *Distance Education and Training Council*. This Council is unique in American accreditation because it is based upon a method of instruction rather than educational level or subject matter discipline. It covers all programs, courses and distance study endeavors of an institution, including degree, non-degree, vocational and avocational programs. Unlike regional or specialized accrediting agencies, the Accrediting Commission of the Distance Education and Training Council provides distance education institutions with a single source of national recognition.

The process of accreditation begins when a bona-fide distance education institution with two years of operating experience voluntarily sends an *Application for Accreditation* to the Distance Education and Training Council offices. The review requires an in-depth self-evaluation report; review of all courses by subject matter experts; survey of students, graduates, state departments of education, federal agencies, Better Business Bureaus, and other official bodies; and an on-site inspection to verify information. The Accrediting Commission then reviews all reports and surveys in terms of the published standards and determines whether or not to accredit the institution. Only about one in four institutions applying for accreditation become accredited. If an institution is accredited, it must conform to all educational and business standards of the Distance Education and Training Council's Accrediting Commission, submit annual reports, and be re-examined every five years. In addition, any new course developed by an institution must be sent to the Commission for review by subject matter experts.

To give a sense of the wide range of other accrediting organizations we describe briefly next a few other accrediters. The *Commission on Elementary Schools of the Middle States Association of Colleges and Schools* works with public and private schools that serve an elementary-age population in New York, New Jersey, Pennsylvania, Delaware, Maryland, the District of Columbia, Puerto Rico, and the US Virgin Islands. Schools seeking accreditation are processed for candidacy, valuation teams are developed for member schools, and accreditation actions taken by the CES Commissioners are sent out to member schools.

The *Joint Review Committee on Education in Radiologic Technology* (JRCERT) is dedicated to excellence in education and to quality and safety of patient care through the accreditation of educational programs in radiation and imaging sciences. JRCERT:

- functions as an autonomous agency in programmatic accreditation actions for radiologic sciences educational programs;
- conducts the voluntary accreditation review process only upon written request from the chief executive officer of an institution sponsoring a program seeking JRCERT accreditation;
- considers the needs of the profession and the health care delivery system in establishing, maintaining, periodically reassessing and, as necessary, revising policies, procedures and standards for accrediting radiologic sciences educational programs;

- publishes lists of currently accredited programs;
- makes available to the public, reports of its operations and its criteria or standards for accreditation;
- observes principles of due process in the accreditation of educational programs;
- maintains confidentiality of information collected during the accreditation review process; and
- maintains recognition as an accrediting agency by the United States Department of Education.

The *U.S. Department of Education* is required by statute to publish a list of nationally recognized accrediting agencies and associations that the Department determines to be reliable authorities as to the quality of education or training provided by the institutions of higher education and the higher education programs they accredit. Most institutions attain eligibility for Federal funds by holding accredited or preaccredited status with one of the accrediting agencies recognized by the Department of Education, in addition to fulfilling other eligibility requirements.

4.6.3 Exercises

True of False

1) ISO 9000 describes a process by which organizations manage their quality operation.
2) No universities have been ISO 9000 certified.
3) ISO certifies organizations as conforming to ISO 9000.
4) Only a handful of accreditation organizations exist for schools.

Knowledge Essays

1) What is ISO 9000?
2) Describe an organization that accredits virtual educational organizations?

Doing Essays

1) If quality management is basically a challenge of matching objectives to what the documentation of the organization shows was achieved, then how might an extensive electronic information system make it easier for someone to determine whether or not an organization operates in a quality way?
2) How might certification as being ISO 9000 compliant be more relevant to virtual educational organizations than traditional school accreditation?

4.7 Conclusion

The *virtual organization* represents a new combination of people and their technology to address the productivity of the organization. We are particularly concerned with the ways in which organizations can exploit the new information technologies, particularly networked computers. Some high technology organizations had already in the 1960s made major investments in information technology infrastructure that permitted the organization to transcend space, time, and other boundaries. The key to success in every one of these cases is that the technology is adapted to fit into the workflow of the people.

This chapter has explored the specifics of higher education schools, as seen from the administrator's perspective. Schools have students, teachers, and administrators. A traditional school may support ancillary roles, like health care provider and sports coordinator. The virtual school needs the essential roles of a traditional school but not the *ancillary roles*.

Universities that are state supported tend to follow the *revenue theory of cost*. They spend whatever they get and continue to deliver more or less the same service, whether their revenue is doubled or halved. This applies less to community colleges, where the relationship between revenue from student enrollments tends to be more closely linked to resources for the college.

We have covered a wide area that began with virtual organizations and stressed the importance of *working closely with people* in developing any information technology that would be likely to help people. As schools place more information on computer networks, they will have further opportunities to engage in meaningful responsibility centered management and to unbundle the components of the educational enterprise. If a school already has a large information system, then the steps it takes to build on that will depend on the specifics of its current investment.

Companies exist that provide information systems for educational organizations. Contemporary systems should provide web interfaces that facilitate ready access to the organization from all of its constituents. Building and maintaining a powerful and easy to use school information infrastructure is not an easy task, and a school should consider to outsource that responsibility. The school might then focus on its *core competency* of teaching.

An *architecture* for educational information systems has been proposed. The school's information system should be based on this architecture. The architecture includes resources and activities and emphasizes modularity and interchangeability. From this base architecture one can specialize various roles, such as teacher, student, librarian, administrator, and marketer.

Quality control requires that an organization's activities are documented to be in line with its objectives. ISO 9000 is a quality control process standard that was designed for manufacturing companies but has been applied to many other kinds of organizations. A school can be certified as ISO 9000 compliant. Such certification could help a school convince students to enroll. Another approach to quality assurance is through professional societies or associations that set standards for performance and certify a school as conforming to the standard.

Developing the structure and function of a virtual school invokes a high-level *dialectic*. In keeping with one of our earlier espoused themes, we might consider the socialist view of a school and the capitalist view of a school. In the socialist view, the school is owned by the state and selects students to attend. In the capitalist view, the school is part of an open economy that either attracts students or fails.

In the *socialist* view the curriculum is defined in accord with the needs of the state. Certain students follow certain curricula. The state determines standards and certifies schools and students as meeting these standards. In the *capitalist* view, the school is a business. It markets its curriculum and faculty to students. Student tuition fees flow through the school with portions of the fee supporting the units that have contributed to successfully attracting and retaining students. The emphasis in these different views at the enterprise level can be markedly different. Transactions between teachers and students may or may not be the same depending on how one has developed this highest level perspective.

4.7.1 Exercises

True of False

1) Organizations for, at least, decades have been becoming more virtual.
2) A successful information system may or may not fit into the workflow of it users.

Knowledge Essay

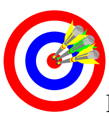
1) When we look at education, we think on the one hand of delivery of education via the information superhighway. However, the use of such technologies to administer the organization itself may be the greatest benefit. Explain what this means.

Doing Essay

1) Describe key components of your virtual educational organization information system.
2) Ideally, students could transfer from school to school throughout their life wherever they are. This would be facilitated by a commonality of functions and structures across all schools. Under what conditions do you imagine such seamless, cradle-to-grave education being possible*?*

Figure 41: Authoring Studio. In this fantasy, authors are collaborating in multimedia, courseware generation.

5. Authoring Courseware

Learning Objectives

- Understand examples and patterns of content production in higher education institutions.
- Appreciate via example the extensive organizational commitment that commercial concerns make to content production.
- Be able to use and extend a model for content production.

5.1 Introduction

We have emphasized the delivery of education in virtual mode, but before this can occur there must be content to be delivered. The development effort required to produce courseware is substantial. In the aerospace training sector, one company spends about 400 hours in developing each hour of training material. The inclusion of high quality sound, animation, or video can mean that developing a course from which students gain 1 hour of training time will require 800 hours. Who can possibly afford such *production costs* and what methods of production are used?

Universities have faculty who are content experts in their disciplines. Are they the appropriate people to develop courseware by themselves? Would a study of what is happening at universities suggest some other approach?

When *companies* make courseware might we expect the same or different practices from those in academia? Would a company have content experts who worked more or less alone to create the courseware or would the company work like a factory with highly specialized roles performed each by a different person? Would schedules be precisely defined and rigorously followed?

Given that we can identify precise practices, can we formalize these practices? Can we build a *model for courseware production* that would lend itself to computer support? When the life cycles and the components of courseware development are well understood might opportunities to improve efficiency, such as through component reuse, increase?

5.2 Universities

University faculty are major authors of textbooks for academia. How are they impacting the development of courseware through their *universities*? What would we find happening in a typical university as regards courseware production? Would this be different in one high-technology discipline that focused on exploiting technology in teaching? What national trends have appeared. Finally might we say about the organizational challenges facing academia as it attempts to become more actively involved in the production of courseware?

5.2.1 A Typical University

Of the thousands of universities in the world, each is unique. However, patterns have emerged as to how courseware is developed at universities. We present next a case study of a *typical university* and its methods of developing courseware – its methods are consonant with the methods at other universities. The university happens to be the University of Liverpool.

Many departments at the *University of Liverpool* are using courseware and some are involved in developing their own courseware. Many more are interested in what courseware can offer their courses and hope to become more involved in using it in the near future. To obtain a more detailed view of current courseware development and courseware use at this university case-studies will be presented which focus on lecturers in different Faculties of the University and concentrate on the reasons why lecturers are turning to courseware. This, in turn, offers an insight into the needs of teachers who are also courseware developers and it is an important prerequisite to any policy making on the nature of a support infrastructure.

The *case studies* were chosen because the individuals or Departments concerned were either developing or strongly considering developing courseware. They reflect work in both large, externally funded projects and smaller, departmentally-based ones. The case studies involve the following departments:

- Geography. The Department has funding as part of a consortium of three Geography Departments to develop courseware for use in all three institutions.
- English Language Unit. The English Language Unit teaches English for academic purposes to students from overseas who are not-native English speakers.
- Veterinary Clinical Science. This Department is strongly considering developing its own courseware in order to maintain teaching quality in the face of increasing student numbers.
- Latin American Studies. This Department has a research project concerned with developing an interactive multimedia package for a specific 3rd Year course.

Of the case-studies undertaken only one is not linked to increasing student usage - that of Latin American Studies, which will be discussed last.

The Geography Program is developing courseware specifically for 1st Year students. High student usage is envisaged. Student numbers in the Geography Department at Liverpool have risen significantly. The largest class sizes are in the 1st Year courses, the year in which there is also the greatest conformity of course content across the different institutions. There are also common courses across the three *consortium* institutions which should lead to the reuse of the materials. Various exercises are being written by lecturers and research students. The exercises are stored on computer in the form of an on-line library and will be incorporated into a tutorial package for use at the three consortium institutions. The fact that this is a consortium-base development means that the groups involved are able to pool resources, i.e. the activities of the courseware developers, the exercises written and the evaluation of the material produced. The nature of the funding for the project means that any material developed will not have a copyright license.

The *English Language Unit* is responsible for teaching English for academic purposes to students from overseas. As the number of overseas students continues to rise there is more need for concurrent classes as there is more pressure on release time from the student's full-time courses. Therefore, the Unit is examining ways of delivering certain aspects of the courses, such as grammar practice and written English, via computer-based self study packages.

Many lecturers in the Department of *Veterinary Science* see courseware as the only effective way to deal with their shortage of staffing and time while maintaining the quality of teaching. In the six Schools of Veterinary Science in the United Kingdom, quality is not an arbitrary measure. It is monitored and assessed by The Royal College of Veterinary Surgeons. If teaching and learning does not meet their rigorous standard graduating students would be refused a license and therefore, would be unable to practice as veterinarians. The Veterinary School faces an added difficulty in that it is located off-campus, about twelve miles away. The Veterinary Clinical Sciences Department has been forced to invest in its own hardware and software as it is impossible for them to use the University's computer lab. Due to their distant location, they have also had problems getting technical support when it has been needed.

The Department of Latin American Studies provides a rationale for the use of courseware quite different from the ones so far discussed. Work here does not involve high student usage. In this situation the teacher wants to do *courseware research*, is aware of the needs of the students and then notices a call for proposals from a funding agency for the development of experimental hypermedia courseware. The proposal was written by one person who subsequently hired another to work on the project.

The design of this *Latin American Studies* interactive video was done in the opposite way from which an industrial training module might be normally developed. Forty hours of documentary film was collected and then painstakingly distilled into 30 minutes of material for the courseware itself. The two developers of the Latin American Studies courseware put many, unpaid hours into the work. Furthermore, each took on many responsibilities which would nominally be beyond the expertise of the person concerned. It is difficult to cost this development process, and so, there is little mechanism by which the budget to develop a similar piece of courseware could be estimated.

To understand the university-wide situation a *survey* was conducted among academics at the University of Liverpool (McDonough et al, 1994). Responses indicated that teachers see collaboration as being an important aspect of course development. As expected, almost all respondents (over 90%) say that collaboration takes place at department level, with colleagues who are known and communication is not problematic. Other departments are also important when developing strategies (nearly 80% agree) but are less important as sources of specific material. While respondents seem enthusiastic about collaboration, they appear less enthusiastic about taking material developed elsewhere and using it. This may be a contributing factor to the slow uptake of courseware. Lecturers feel that technical support is required when adapting a hypermedia educational package to their requirements, and this may be difficult to obtain, if the material has been developed outside their institution.

Academics often feel that they do not have the technical skills and computer expertise necessary to develop and implement effective educational hypermedia. Some staff think that the traditional methods they employ at the moment, for example lectures, will have to change and they want help in doing this. Most also want hardware provision dedicated to each department and technical support, both department-based and throughout the University. This may again reflect the lack of confidence many feel in using computers in a teaching context. A procedure for quality assurance is also desired by some, indicating a desire to get standards set from the beginning. Linked to this is the idea of a courseware library (over 90% think this is important) which could be used to store examples of good courseware and possibly allow its reuse. Several questionnaire respondents suggested that a *courseware center* should be set-up with the remit to provide support for courseware developers. The Center should provide staff training and workshops to improve confidence in non-technical minded teachers

5.2.2 One Discipline

Within a university, a *discipline* may choose to use the computer extensively in education. Such an effort in a high-technology discipline might have a different future than efforts in other parts of a university. By way of example, we examine next courseware development in the Engineering discipline at Purdue University.

The *Engineering* Specific Career-planning and Problem-solving Environment was created at Purdue University. It was designed for pre-professional engineering courses to inform students of the role of an engineer and offer them advice on career planning. The project's premise was that the computer could provide a more dynamic and stimulating insight into engineering than more conventional forms of presentation.

The project allowed students to design and develop their own materials to suit their own needs. An introduction to HyperCard was given and students were encouraged to create individual *career-planning workbooks* using it. Each student was provided with a modifiable template to act as the basis of their workbook. This was the most learner-oriented aspect of the project. It is also probably most strongly linked to whether or not students were likely to give careful thought to their career choice.

The production and design of the courseware was done by small teams and the method of development was informal. Each time before the course has been offered it has been necessary to make changes to improve it.

Sometimes this has required *much effort* by those responsible.

One of the goals of the Purdue Engineering project was to make education fun. To achieve this, multimedia techniques, including digitized sound, color graphics and video, were employed. However, this was not an overall success as the project suffered *technical difficulties* which resulted in the production of less than was anticipated in this area.

Initially *HyperCard* was thought to have the capability to represent both the engineering structure and content through databases of linked text or graphics and simulations. These functions were useful, but they were found to be too simple and therefore eventually limited the development of the project.

The issue of availability consumed a great deal of the projects time and resources. The project was intended to be used by all First-Year engineering students, but as this would put a strain on existing computing resources, it was decided to switch from the Computing Center's Macintosh computers to the Engineering Schools newly acquired Sun Workstations. The high speed processing capabilities, high resolution graphics and large memory were advantages of moving to workstations, but increased availability was the major reason. The transfer to workstations required a *restructuring* of the entire system.

An emphasis on the role of networks came fairly late in this project. This resulted in the project's educational goals not really being revised to take into account any benefits afforded by student-student interaction across networks. *Networks* were used in a more traditional sense -- to provide access to a central dataset and allow for easy access and maintenance.

As one reviews the history of the Purdue Engineering project, one can see that the ambitions were noble but that the progress was slowed by the lack of adequate planning for the technology infrastructure. The switch from stand-alone MacIntosh computers to networked Unix workstations was not anticipated. The costs of changing courseware are great, and an effort with relatively little resource can not afford to be redeveloping its courseware.

5.2.3 State-wide Effort

We have noted the challenges that teachers face as they try to develop courseware and their need for organizational support. *States* have appreciated this to some extent and have introduced new funding schemes to bring organizational support across the state. This is true in the USA, England, Japan, and elsewhere. In this subsection we further detail one such state-wide project in the United Kingdom.

In 1989 the British University Funding Council set up centers to promote the use of computers in education across all United Kingdom higher education institutions (National, 1996). The brief of these *courseware centers* was and is the promotion of sound technology-based educational practice. Each Center focuses on one discipline area, with a senior academic as director of the center and a full-time center manager with content expertise.

The British Computers in Teaching Center for Biology is based at Liverpool University. The Director of that center believes that although high student usage is a crucial factor it does not necessarily mean that a particular course has to have high student numbers to justify use of courseware. Courseware may be reused on other courses, possibly with some customization. Or high usage may refer to consortia developed courseware, which will be used in similar departments in other institutions. Lecturers in other departments and institutions in Higher Education may be interested in using, customizing and reusing existing courseware, but they have to know that it exists in the first place. The various Centers have offered some help in this area to their own specific disciplines by *collecting, collating and disseminating information* about courseware. The important considerations are that courseware must be easy to obtain, easy to customize and easy to use.

The courseware centers are part of a larger British effort entitled the *Teaching and Learning Technology Program* (TLTP). After the spending of tens of millions of dollars and several years effort an independent review of the TLTP project was undertaken. Some of the conclusions of that study (Coopers et al, 1996) are summarized next.

Institutional support was a criterion for TLTP project selection. Institutions implemented TLTP through five main strategies: staff training, development and support, internal specialist units, awareness raising, strategic coordination, and technological infrastructure development. Such an *institutional focus* is critical to the success of change in higher education. Without a basic level of institutional resourcing, expertise and commitment, the uptake and integration of technologies in support of teaching and learning cannot be guaranteed.

An original TLTP objective was to make teaching and learning more productive and efficient. This objective became less prominent as the program progressed. The emphasis instead switched to *quality improvement*. The academics were more comfortable with the concept of working towards improving quality than improving efficiency.

Although comprehensive dissemination planning was rare, a great deal of effort went into dissemination through surveys, newsletters, roadshows, and piloting. Projects did not, however, conduct cost/benefit analyses of such activities. Systematic dissemination plans were not apparent. A developed dissemination plan should have been a pre-condition for funding.

TLTP followed the principle that its courseware should be *free* to all higher education institutions in the United Kingdom. This approach appears to have dampened the desire of projects to put much effort into dissemination in the United Kingdom because there would be few resource-related returns to the investment. Project members question whether the product can be maintained without being able to charge for it.

The independent review made two major recommendations for future funding. The first was that emphasis should be placed on implementation and take-up. This requires addressing such areas as cultural change within higher education and the role of teachers in education. The report said "We think funding should be available for this, but *to the market not to the suppliers*". The second area for future funding would be a small amount of new courseware. To receive such funding a project would have to demonstrate that large student enrollments were possible across institutions, that efficiency would result from using the courseware, and that no institution alone could support the effort.

5.2.4 Organizational Issues

A delicate balance between *technical and academic* issues must be reached before computers can offer a high-quality, educational experience. As technical environments become more powerful, maintaining this balance becomes more difficult. The organizational issues involved are of paramount importance. As projects move from conceptualization to actual creation, the roles, tasks, and organization change.

There are three key *stages in courseware development* : (Hopper, 1993):

1) defining what the courseware should do and how it will be used.
2) actually designing and developing the courseware or finding an existing piece of courseware that could satisfy the requirements decided upon in Stage 1.
3) using the courseware.

Stage 1 is generally done by faculty members. It appears to be based on the lecturer's own experiences, not on any pedagogical theory, and comes from the desire to improve an existing course or teaching method.

In stage 2 a common method of courseware production is based on a team development approach. The reasons for the existence of a team and of its constituents varies from project to project. For instance, some projects develop both *course content and software* and others only content. Larger teams are typically involved in developing software than in developing content alone because of the need to have the software speak exactly the language of the computer.

While some courseware developers have taken courses related to design and development, most have not. They tend not to know formal models of courseware development. Most follow an *informal process*. Furthermore, the documentation of the plans tends to be informal. Many university courseware developers keep plans and processes in their heads. There are few formal planning activities and the main form of communication is verbal. This is possibly due to the informal nature of academia or perhaps to the high degree of flexibility the computer allows.

It is important to maintain any product to stop it falling into disuse and ultimately unusability. This is an organizational issue. As already stated it is the faculty who conceptualize courseware and often play a large part in its development. They have tended to see courseware projects in the same way as they would a publication, i.e. once it is finished and delivered that is the end of the matter. This is highly detrimental to the longevity of the couresware.

The two most important resources for the initial creation of courseware are human and technical, but its continuation and expansion are mainly dependent on organizational resources. Three different *organizational models* (see Figure 42 "Courseware Organization") have been developed to support courseware development :

1) the creator organizational structure,
2) the integrator organizational structure, and
3) the orchestrator organizational structure.

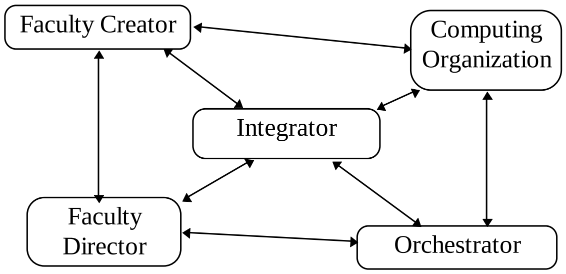


Figure 42: Courseware Organization. The creator, integrator, and orchestrator roles are depicted here.

The *creator organizational structure* is the traditional academic structure for course design and implementation. An individual faculty member takes on the responsibility for both administration and creation. A person who performs this role is typically called an author or a creator. Where faculty create courseware, there is an emphasis on the need for technical resources which would allow a great deal of adaptability and availability. This type of structure does have limitations, as it is dependent on the enthusiasm and talents of an individual who doubtless has other commitments and interests.

The *integrator organizational structure* is characterized by the role of the integrator. This refers to an individual who is engaged in a partnership with the faculty. The integrator had responsibility for development but was neither a faculty member nor part of the main computing organization of the university. Projects which use this model resembled the traditional lab structure. The universities tend to recognize and support them in similar ways. Consequently this model is limited in the same ways and is found to be financially challenging.

The *orchestrator organizational structure* is characterized by the role of a third organization to support the development of courseware. This third organization is neither an academic organization nor the main computing organization at the university. Such an organization is most likely to be used when the project is involved in creating its own software tools. It has a distinct set of goals related to the production of courseware or software. The orchestrator tends to support many courseware products at one time. This is a particularly dynamic model as it allows the various roles within it to change and grow. Within this model the role of integrator still exits and it is at this point that the academic, technical and orchestration organizations meet. A mutually beneficial relationship is created by using the strengths of the departmentally-based projects to provide the content and part of the human resources, while the orchestrator provides support in the form of technical resources and advice.

There is perhaps another organizational model that can be considered which leads from the effect that delivery can have on the courseware development process. It can be called the *learner construction organizational structure*. The issues of limited time and skills which are prominent problems in faculty-based development are often missing from student-based development strategies. Students are greater in number than faculty and may have together more time and skills available. Not only does student-based development have advantages for the project but it also brings benefits to the student. The student gains greater motivation for his or her course as well as improved cognitive skills.

5.2.5 Recommendations

Universities are major users of and developers of courseware. Around the world many educational institutions are looking to courseware as a new way to effectively and efficiently provide education and for their staff to be important contributors to the courseware libraries. These *ambitions* must, however, be matched with an understanding of the difficulty of reaching the goals and with a commitment to providing the vision and resources needed to achieve the goals.

Several *case studies* have been presented of the development of courseware at universities. The first set of case studies come from a typical British university which is only now coming to grips with the importance of courseware. Various Schools in the university are trying, each in their own way, to establish the ways of developing teaching material in this new medium. Particularly interesting in this regard is the perhaps typical case of courseware developed in the Latin American Studies area by two lecturers. They developed the material as part of their research into ways of developing courseware and followed a path for developing courseware that might be typical of the way they would otherwise develop research results directly about Latin America -- namely, they collected extensive ethnographic data and then analyzed and presented it.

The Purdue university effort was devoted towards improving education of first year engineers. The Purdue experience showed the importance of long-term commitment to developing, distributing, and maintaining courseware products. The level of staff expertise and *university commitment* to the project was not enough for the Purdue project to be as successful as intended.

The methodology of collaborative courseware production by academics is not nearly as advanced as the methodologies of software engineering, even though the final product may be considered in many cases to be very similar. This is partly explained by academic courseware designers and authors conceiving the production of course materials as an *artistic endeavor*, as opposed to a manufacturing process (Phillips, 1990). While there may be fewer objective tests as to both the completeness and the quality of courseware versus software, courseware developers should take advantage on the life cycle and teamwork models effectively used by software developers.

It is important that new educational computing initiatives learn from the experiences of previous projects in this area. There are three contexts which exert an influence on educational computing and its success or failure. They are:

- the educational context,
- the technical context, and
- the organizational context.

A well-established link between the courseware developers and a computing organization (internal or external to the institution) enhances the chances of a successful project. It is important to balance the *educational and technical considerations* within the organizational structure.

Courseware authoring is a complex activity that requires various specialist roles and multiple intermediate products. One can not reasonably expect an individual faculty member to be a successful producer of top-quality courseware. Instead an organization, such as a university, must provide extensive support to such efforts, if the university wants to be part of successful courseware production. A high level of organizational commitment is required and this in turn requires a clear, *long-term vision* and leadership that maintains that vision year in and year out.

Goals should include that of working with the target student audience as the course is developed. Active learner participation in the courseware development or improvement processes should be encouraged for multiple reasons. Collaboration between the two interested parties would ensure that the educational goals of the courseware are reached more quickly. This is the fundamental lesson from efforts to introduce information technology to people – namely, the *end user* must have been closely involved from the beginning to the end in the specification and testing of the product. Furthermore, in the courseware case, the end user, namely the student, might contribute directly to the development process.

5.2.6 Exercises

True or False

1) Large numbers of students enrolled in a course at one university are an essential precondition for investing in courseware development.
2) Changes in the technological infrastructure and objectives of the courseware development in the Purdue Engineering case study hindered progress.
3) In the British state-funded courseware efforts, academics focused on efficiency.
4) The creator organizational structure is the most effective in university courseware development projects.
5) Frequent involvement with end users is necessary for quality courseware production.

Knowledge Essays

1) In a survey of university faculty a frequently voiced concern is for further training and resources to develop courseware. Why do they not request further training and resources for book authoring?
2) Academics have traditionally treated content production like a cottage industry but that is changing. One early step is the creation of training facilities for faculty. What other steps might be taken?
3) The independent review of the British Teaching and Learning Technology Program suggested that funding go to the market and not to the supplier. What does this mean, and why would this be the recommendation?

Doing Essay

1) How would you organize a virtual courseware production operation as part of a virtual university?
2) The university support for courseware authoring is often consistent with the web-like control structure that was discussed in the administering chapter. Why would such a web-like organization be difficult to semi-automate in terms of having the computer take roles otherwise performed by people?

5.3 Companies

Companies may be engaged in courseware production. The types of companies and their activities may vary widely, as they may be small or large, they may target a fixed audience or any audience, and so on. Our concern is for how they effectively develop courseware. What lessons can be learned by looking at some examples of *corporate courseware authoring*?

5.3.1 Small, Diverse Company

A small diverse courseware company is one that has a few staff and targets a diverse audience. We will look at one such company, called FutureMedia. FutureMedia produces hypermedia courseware for distribution on CD-ROM. Typical customers are industrial companies that wish to improve the distribution of training materials about their products. Each contract is treated as a separate project, and staff with the necessary skills are deployed to each project under the coordination of the Project Manager, who obtains further resources as necessary. The computer plays little part in the management process, which is undertaken using traditional tools. We will next look more closely at the life cycle in courseware production at this *small company* in the phases of domain analysis, courseware design, and development.

5.3.1.1 Domain Analysis

Each piece of courseware is allocated to a Project Manager at its inception, who is responsible for its design and implementation through to final delivery to the client. The project manager calls on specialists, who compose the implementation team, to perform the various tasks of the project. The *project manager* therefore plays the major driving role in this methodology. In practice, many of the roles are closely related and the distinction between them is sometimes very fuzzy.

Initial analysis revolves around the production of a detailed script, which will later drive the design process. This script is written by the Instructional Designer in conjunction with subject specialists in the client organization. The Instructional Designer attempts to make the most effective use of the available technologies to deliver the training objectives, as identified by the client. In this, there is a regular exchange of views between the Instructional Designer and the subject specialists in the client organization. At the end of this phase a *script* is available which describes:

- the aims of the courseware
- the instructional strategy to be followed
- what will be taught to the students

together with estimates of the length and complexity of the training material which will have been refined from those in the original proposal to the customer.

The project team formally reviews the detailed script with the *client* at this stage to determine whether the proposal fully meets the client's requirements. It is possible that with the increased understanding of potential technologies, the client's aspirations will have been considerably raised, in which case some redesign work will be inevitable. Also, choices must be discussed where various strategies will involve considerable differences in cost. Individual clients may have particular views on these matters, but in practice, they generally follow the guidance given by the Instructional Designer.

Hardware and software platforms are identified in the initial proposal to the company so that the design of the instructional components and methods can relate closely to the resources chosen. A preferable approach to the problem would be, after learning the objectives of the course, and the ultimate users, for the instructional designer to suggest the best mix of media with which to assemble the teaching material. Many *constraints* including time, budget and existing resources, hinder this.

5.3.1.2 Design

Once the objectives of the courseware have been agreed, the next stage is to turn it into a series of *storyboards*, which show in detail what is required in each module. In particular, the media to be used will be decided at this stage. This is so that the most appropriate project team may be assembled to actually write the final courseware.

A team of experts can then be assembled to participate in the detailed design of the courseware. This team will include numerous *roles*, each of which may or may not be performed by one person. Three sample roles are:

- Graphic Designer who will develop graphics and animation.
- Video producer who will take charge of the production of quality video images which will conform exactly to the script description of that part of the course, produced by the script writer/instructional designer.
- Software designer who will control the way the media hangs together, work with different `units' of media to be presented to the user based on the script from the instructional designer, possibly in the form of storyboarding stacks where units represent a particular event.

Further discussions on the nature of the components of the course together with their relationships take place to determine the practicality of alternative solutions. The organization of the individual events is finally determined at this stage.

Generally the team produce and discuss ideas, reacting to those ideas by agreeing or disagreeing with their content, and finally agree to a presentation which will be taken to the client. If the client disagrees with the proposed design, then the designers either defend their case or, more likely, attempt to modify the design to meet the client's needs. The final result is a script for the *final production*, which must be approved by the content expert.

5.3.1.3 Develop

In the design phase, the role of the team members has been to act, more or less, as consultants but in the development phase the collaborative aspect becomes more important. Continual intercommunication is vital. The instructional designer, however, controls the overall process. Each area of expertise looks after its own sections of the design script. This means, for instance, that the graphics experts perform the graphic production and that video production and editing are done by the video experts. *Communication* is required to collate other units with the interactive video events. There is parallel production of the final product in which each of the expert groups contributes.

If there is a need for information which already exists, then a decision must be made as to whether to incorporate this rather than to create the material anew. Reuse decisions are affected by availability, time constraints, budget constraints, feasibility, suitability of previously stored information, and quality. The evaluation of the feasibility of reusing information only takes place at this development stage and not before. During the previous stages the idea of reuse is not considered. *Reuse* may or may not take place and is not explicitly anticipated. Information, such as video scenes are shot for the current project and may be used at a later stage if appropriate. The images are logged and stored in a library to be used again if necessary.

The development phase requires the use of all functionalities of team members, such as team worker, leader, and evaluator, as well as the skill experts, such as video producer and instructional designer. People must work closely together, and peer and customer review helps to evaluate the work under the guidance of the project manager or instructional designer. The development of the courseware in this way is seen to be more or less content independent. The *methodology* of the interactions among the members of the team have become well established. Projects generally last six months to a year.

There is a feeling that a *house style* may add to the success of the company. This would support reuse, as well as ensure good practices are followed. As yet this has not been implemented but may become important as the number of completed sets of courseware grows. In general, the company is so small and fragile within its rapidly changing environment that opportunities to stabilize are few. Instead the company scrambles to adapt to the next customer whose needs may be rather different from the previous customer. As the clientele grows and specialization occurs within the company, the ways of work may become further specialized.

5.3.2 Large, Specialist Company

We noted how the small, diverse company had little opportunity to formalize its activities. Might a *large, specialist company* have formalized methods of working? We will look next at such a company called AMTECH.

AMTECH is a subsidiary of Gruppo Agusta. Gruppo Agusta is an organization of about 10,000 employees that designs and manufacturers helicopters. In order to better approach the application of new technologies to education and training, Gruppo Agusta established AMTECH solely to make courseware and particularly for the aerospace manufacturing sector. AMTECH employs 100 full-time courseware specialists that follow well-defined courseware life cycles.

5.3.2.1 Course Architecture

A course developed by Augusta AMTECH has a *standard structure*. Each course is split into modules which identify one or more subject areas. A module is split into one or more lessons. Each of them will describe one topic. The topic will be provided to the trainee during a teaching session. A teaching session should be 45 minutes in duration, between two teaching sessions a break has to be allowed.

Recurrent parts are present in each *lesson* which have the aim to describe contents and give general information about a lesson. These parts are: lesson title, lesson description, and lesson conclusion. The lesson title is a standard format frame containing the title of the lesson. The lesson description is a standard format frame, or a series of frames, stating:

- lesson objective;
- what the trainee will be able to achieve at the end of the lesson;
- pre-requisite background necessary to reach the lesson;

- lesson length.

The lesson conclusion is a standard format frame which reports general information when the trainee has completed the lesson and the next lesson to perform.

A lesson may be decomposed into one to five sections. Each *section* is split into four distinct and consecutive teaching phases:

1. introduction,
2. presentation,
3. review, and
4. test.

The introduction phase is made by one or more standard format frames including:

- section objective and length;
- what the trainee will be able to achieve at the end of the section; and
- other teaching resources, such as text books and maps

The aim of this introduction phase is to allow the trainee to evaluate whether he already knows the section content and whether he wants to jump to the review or test phase.

5.3.2.2 Courseware Life Cycle

In the following paragraphs the procedures for the implementation of a *courseware project* are listed, and the different phases in which the project will be articulated are identified. All the different working groups involved in the project are identified together with the tasks, activities, and documentation they have to produce.

The *courseware life-cycle* at AMTECH has eight phases (see Figure 43 "The AMTECH Courseware Life-Cycle"). In each phases, there are strictly interconnected intermediate phases. All the phases are subject to quality control in order to establish conformity to the relevant specifications. The quality control is performed on both the result and the methodology used to generate it. Active customer involvement in the process is a must for the project success. This is similar to a software life cycle but with additional courseware-specific steps, such as "storyboard production".

Courseware product development originates from a *customer training request*. The customer training request, which is rendered official with the issue of a system document, is the basis for generating a development contract. Starting from the customer training request, the project group performs the following activities:

- it identifies the training goals of the courseware and the target population;
- it defines how the training goals will be met;
- it plans the activities needed to develop the courseware.

In the *Requirements and Planning phase* the project group issues the Courseware Requirement Specification document, which includes hardware and software architecture; applicable teaching strategy; and interconnection between the different components of the courseware. At the same time, the Courseware Development Plan document is issued containing the planning of activities, the employed resources, and the time schedule. In addition, the Courseware Test Plan document is produced which describes the testing methodology. At the same time the Quality Assurance group issues the Courseware Quality Assurance Plan document.

The *Review of Requirements* is held to verify the completeness of the requirements and to approve the testing criteria. The following staff take part in the Requirements Review:

PHASE	DOCUMENTS
Requirements and Planning	Requirements Specification; Development Plan; Quality Assurance Plan
Preliminary Design	Design Specification
Storyboard Production	Storyboard Collection; Storyboard Test Report; Audiovideo Specification
Implementation	Frame Listing; Lesson Test Report
Integration	Trainee Manual; Instruction Manual
Delivery	Configuration List Item Data; Acceptance Test Report

Figure 43: **AMTECH Courseware Life-Cycle**. The documents which result from a phase are listed in the right-hand side of the box describing the phase. The final two phases not listed here are "guarantee" and "maintenance".

- The Didactic Systems Office Manager (President);
- The Software Project Quality Representative (Secretary);
- One or More Customer Representatives;
- The Configuration Management Representative;
- The Training Systems Technical Manager;
- The Quality Assurance Manager;
- The project Technical Manager; and
- Current Documentation Authors.

At the end of the meeting, a report is issued describing the discussed topics, the problems encountered, the corrective actions to be performed, and the time necessary to complete them.

During the *Design phase*, the customer is allowed to analyze a sample lesson showing the training strategy and the courseware graphic, audio, and video. This phase is completed once the Design Review is held. The staff that take part in the Design Review are basically the same as those who take part in the Requirements Review.

For any single lesson, a *storyboard* will be drafted on paper, containing one or more graphic images (drawing or pictures) to describe a particular item inside a section. These images describe what will be implemented on the computer in terms of:

- objects to be drawn on the screen;
- interaction with the trainee;
- text layout;
- audio sentences; and
- flow-charts to describe the logical links among the blocks of frames constituting a particular topic in the section.

The storyboards allow the simulation of the lesson before its implementation on the computer.

The Courseware Designer, with the possible help of the Subject Matter Expert, issues the storyboards of the current module, on the basis of agreed standards which are contained in the documents issued during the previous activities. The storyboards, together with the relevant flow-charts, are gathered in the *Storyboard Collection document*.

In the *Implementation phase*, the story-boards are implemented on the computer. All the graphics, texts, and logical links of the lesson are developed. At the same time, the visual and audio material is implemented in a preliminary way. Each module is composed of one or more lessons. Each lesson is to verify the correctness of logical structure and adherence of the lesson content to the storyboards.

In the *Integration phase* graphics and text are integrated with the final audio and video. At the same time, the Courseware Usage Manuals are produced. Those manuals will contain an exhaustive summary of the contents in each lesson in the course. In particular the Manual for the Instructor will contain a list of all tests. A Final System Review is held to analyze and approve the issued documentation, and to examine and approve the courseware produced. In this phase, the final version of the course is officially delivered to the Customer.

The hardware and the software are guaranteed by the contract. The *Courseware Guarantee* starts after the Delivery Review, and lasts all the period provided by contract. The guarantee covers the eventual technical problems which have not been found during the testing phase or which have manifested themselves during the effective usage of the courseware.

Errors have to be signaled with a document written by the Customer containing:

- complete courseware identifier;
- description of the frame where the error has occurred;
- error description; and
- description of the conditions in which the error has occurred.

The *error report* will be assessed by the producer in order to guarantee a quick action. Any modifications to the produced courseware involves an update of the whole documentation and configuration. The corrected courseware will be submitted to all the tests provided for the integration phase. The Customer can request modifications involving substantial variations to the delivered courseware, but pursuing such modifications will give rise to a dedicated contract.

5.3.2.3 Delivery Platforms

Training is for people distributed in classrooms. The AMTECH *delivery platform* is controlled by main computers which manage the trainee stations in the classroom. Each classroom is equipped with an instructor station and a large screen system connected to the instructor station. Both the trainee station and the instructor station support multimedia.

The *station* has a high resolution color graphics board. The effectiveness of the training session is enhanced by means of videodisc real images and digitized audio.

Touch screen and mouse allow a natural interaction with the system.

The software elements of the training system fall into four categories:

- Operating System,
- Authoring System,
- Audio Edit System, and
- Management System.

All *software packages are proprietary*. The training system operates under a multiuser operating system. The authoring system can be summarized as having two distinct functions that are courseware creation and courseware delivery. The authoring system provides an integrated graphics editor to develop displays in terms of graphics, text, video, and animation. The authoring system also provides an easy tool to develop the lesson branching logic. The audio edit system supports digitizing audio sentences and storing them on the main computer hard disk. A Management System provides the instructor with numerous facilities, including selection of the most suitable instruction for a student at a particular time and automatic testing of students both before and after instruction. The Management System creates a data base to store information on the trainee learning process for each course and lesson.

5.3.3 Exercises

True of False

1) A courseware company will focus on obtaining a contract from a user that defines what is wanted of the courseware before beginning to make the courseware.
2) The customer plays an integral role in giving feedback at various steps of the courseware life cycle.
3) In the small courseware company presented in this chapter, namely FutureMedia, the models for the courseware life cycle were highly formalized and computers were extensively used in guiding the project management.
4) A large, specialist courseware company, such as AMTECH, may well operate in a manufacturing mode.
5) AMTECH leaves the definition of the overall structure of a lesson to the individual author.
6) The AMTECH courseware life cycle includes exactly one testing step and that is at the end of development.

Knowledge Essays

1) The courseware structure specified as mandatory in the courseware authoring at AMTECH has the advantage of a consistent style for students and teachers to understand. Might such a regimented structure be inappropriate for any types of courses? If yes, give an example. If no, explain why not.
2) In what ways is the courseware life cycle like the software life cycle and in which ways not.

Doing Essay

1) Imagine yourself organizing a small team to develop educational material and to operate in virtual mode. In what ways would your methods be the same or different from those of FutureMedia and why?

5.4 Content Production Models

We have seen that a large courseware company may have a highly formalized courseware life cycle and team member job description. To the extent that this formalization may be useful to other courseware development companies or groups, how might we standardize the description of the model? If we can standardize the work model, then tools to support the work are more likely to appear and be usable across organizations.

The objectives of this upcoming section are partly to explore the courseware production life cycle. To that end a modeling language for describing coordination in the workplace is presented. However, this much formalism and detail would not be warranted did we not think that the same formalism and method would be applicable to other aspects of the virtual education initiative. The administration of a school or a classroom might also benefit from this formalization. Hopefully, the reader will develop enough familiarity with the method to want to apply it to other problems in the virtual education arena.

The learning objectives for this section are to:

- understand the theory of coordination.
- appreciate how the Activity Model Environment language allows us to encode the coordination activities of a team.
- apply this modeling language in detail to parts of the courseware life cycle in order both to understand the life cycle better but also to understand better the method of modeling.

With such an understanding we should be better able to support courseware authoring.

5.4.1 Modeling Language

To describe rigorously courseware authoring activities we need a language for modeling such activities. We have used examples and various free form English descriptions, but we want next to become more *precise*. First we'll use coordination theory to show the need for communication and decision-making. Then eight-component object-oriented activity modeling language or environment is defined in which the courseware authoring will be represented in detail.

Coordination may be described in terms of successively deeper levels of underlying processes. For instance, many coordination processes require that some decision has been made and accepted by a group. Group decisions, in turn, require members of the group to communicate in some form. This communication requires that some messages be transported in a language that is understandable to both. Finally, the establishment of this language depends on the ability of actors to perceive common objects. The strongest dependencies are downward through these layers (see Figure 44 "Processes Underlying Coordination").

The *Activity Model Environment* (AME) is an object-oriented system for representing coordination models of organizations (Smith et al, 1989). The AME includes a database and an associated rule-based formalism for representing activities and organizational states. Users interact with the model by creating and playing roles. Activity-related communication proceeds via the exchange of messages between roles.

Eight components of the *AME framework* can be identified:

1. Activities are sets of tasks for achieving a goal.
2. People are placeholders for actual individuals.
3. Roles specify the responsibilities and duties of people.
4. Workspaces contain resources associated with roles.
5. Messages are objects that flow between the role instances associated with an activity.
6. Information Units are used in building messages.
7. Rules constrain the behavior of components.
8. Functions are performed by roles and messages as part of an activity.

Roles, people, workspaces, information units, and messages are represented as objects.

All objects are stored in the *Organizational Manual*. The Organizational Manual is a database acting as a reference both for users of the AME and for the AME itself.

People have object entries in the Organizational Manual associated with them. Each entry specifies the roles that each person is authorized to play. A person interacts with AME through specified role instances. Each person may hold several role instances at any one time. *Roles* define responsibilities that are taken by one or more people. A role instance consists of the person instance undertaking the role, the set of role rules, and a role agent. The role agent is executed by the system and might undertake some of the person's responsibilities. The role agent uses the role rules in the performance of the role.

Messages collect and transfer information associated with activities between roles. They exist for the lifetime of an activity. There are different types of messages (e.g. memos, notices, and forms). Information units (iunits) are atomic information objects. Messages are composed of groups of iunits. An iunit has a name,

Process Level	Components	Examples
Coordination	goals, activities, actors	identify goals, assign activities to actors
Decision-making	alternatives, evaluations	making choices
Communication	senders, messages	establishing common language, transporting message
Perception of common object	actors, objects	seeing same physical objects

Figure 44: Processes Underlying Coordination. Levels of Coordination and correspondent representations are identified, particularly in terms of generic processes.

fields, and a set of completion rules associated with it. Rules define and constrain the behavior of roles, messages, and iunits under specified conditions. Functions are atomic operations performed within group communication (e.g. instantiate-message, fill-field).

Next we will apply this rather formidable modeling language to the description of the courseware production process that we witnessed at the AMTECH courseware factory. Recall that the AMTECH courseware life cycle was similar to a software life cycle but with additional courseware-specific steps, such as “storyboard production” after “design”. Also for every step there are precise rules. So the coordination modeling language should help us describe rigorously the courseware development process.

5.4.2 Learning Needs Analysis

One of the first phases of the courseware life cycle is to determine the learner’s needs. To get ourselves familiar with the language for formally defining the life cycle we will first describe one subphase of the learner’s needs analysis phase. We will not be comprehensive in our coverage of the courseware life cycle but rather intend to the give the reader a flavor for how the *modeling* proceeds. The learning objective is that the reader might take the methods presented here and apply them.

The objective of the *Learning Needs Analysis* subphase of the `Analysis' phase is to analyze the actual learning needs in order to define the general educational aims (knowledge, skills, and behaviors to be acquired by the learners) and the prerequisites to enter the course. In particular, the analysis of learning needs can be divided into the following tasks:

1. to gather information about the target environment and the target population using different modalities, such as interviews and questionnaires);
2. to structure and aggregate the gathered information by statistical methods;
3. to define the general educational aims and the content areas; and
4. to define prerequisites to enter the course.

The *Customer/Sponsor Information message* is created by an Instructional Designer in his workspace using a template from the organizational manual (see Figure 45 “Learner Needs Analysis”). The message will contain information about the person who created it, the role the creator was playing (Instructional Designer), and the time it was created. The message is then routed again to an Instructional Designer workspace. Typically, a person performs the role and fills-in the details in the current unit of the message. However, some of the fields within the unit may be filled-in automatically by the computer. After the person or the computer fills-in the fields in the unit, the workspace unlocks the message and informs the current unit that it is complete. At this stage, the unit triggers its rules which check the validity of the field values and determine which will be the new `current' unit and which role will process it. The *message* then routes itself to the appropriate workspace.

This circuit is repeated until all the units are completed. At this point the message is considered complete and the next message is activated and routed to the appropriate workspace. The process is repeated until the final Learner Needs Analysis is produced. Once the analysis of learning has been completed, the courseware outline may be developed.

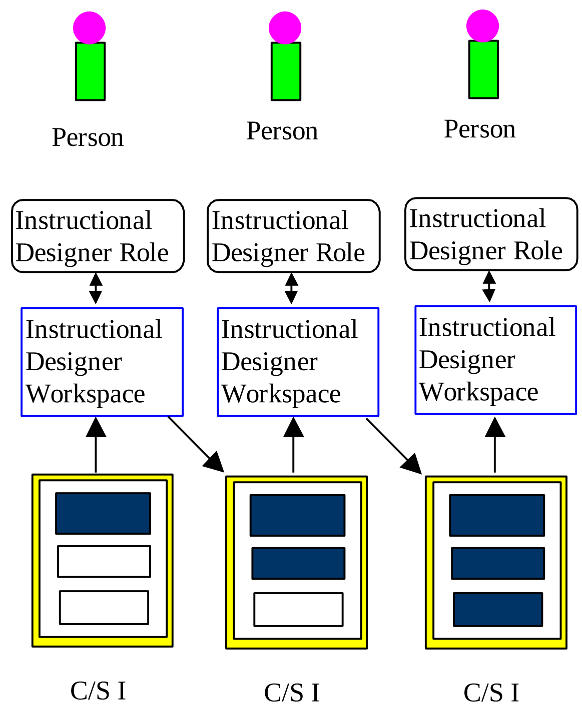


Figure 45: Learner Needs Analysis: The Customer/Sponsor Information (C/S I) message is completed in a step-by-step process in which it goes to the instructional designer workspace, the instructional designer completes one information unit of the message, and sends the message to the next workspace, which happens again in this case to be that of the instructional designer again.

5.4.3 Courseware Outline

The objective of the *Courseware Outline subphase* of the `Analysis' phase is to define the overall courseware architecture as a framework for the design phase. At the same time it provides the information needed to estimate and plan the development effort (see Figure 46 “Courseware Outline”).

The messages required to generate the courseware outline include those used in the `Learner Needs Analysis' subphase and additionally Module Description Card 1, Module Description Card 2, and Architecture messages. Three different roles collaborate to produce the courseware outline, namely the Instructional Designer, the Subject Matter Expert and the Media Expert in a two-stage process:

1. Messages completed in the `learning needs analysis' subphase are manipulated to complete Module Description Cards 1 and 2.
2. Finally, the *Module Description Cards* lead to the completion of the Architecture.

The next and final phase of the analysis consists of planning the project using information obtained during the definition of the courseware outline.

5.4.4 Other Phases

Following the Analysis phase, which clarifies requirements and produces the project plan, is the *Design phase*. This phase is concerned with specifying and defining the requirements so that they may be further developed. We will not describe here

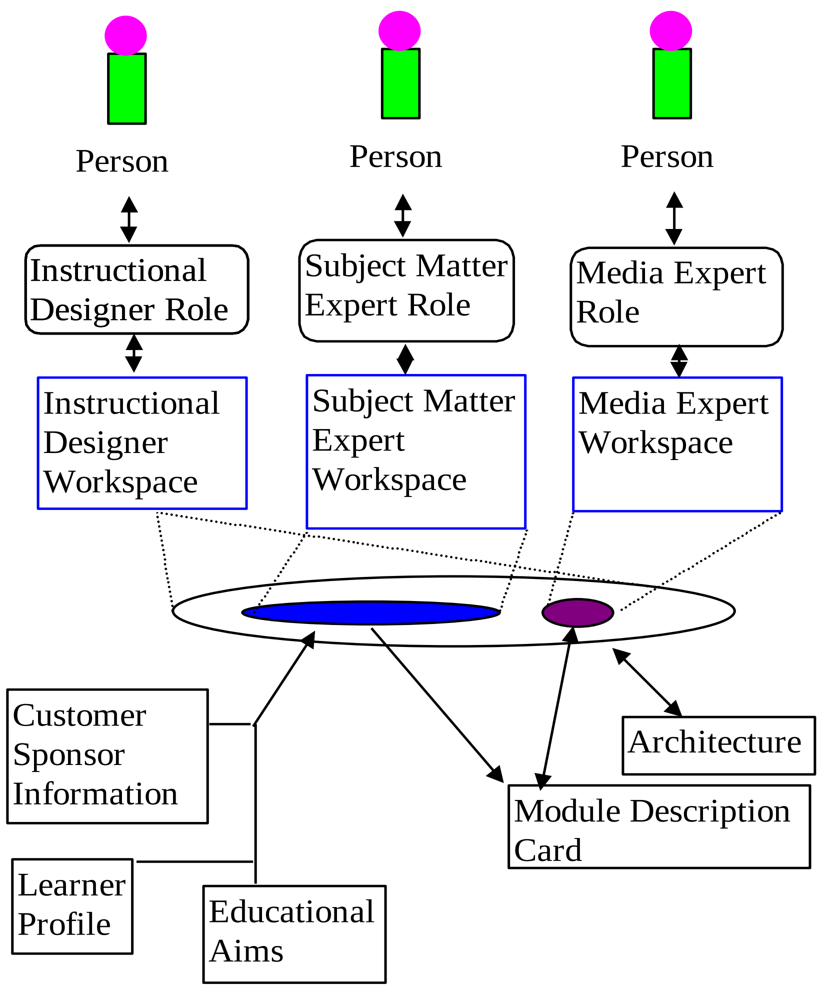


Figure 46: Courseware Outline. Messages shared by the Instructional Designer, Subject Matter Expert and Media Expert in the definition of courseware modules and the overall architecture.

the multiple subphases of the design phase but rather refer the interested reader to Rada (1995a). Rather our point in this subsection will be to give further the flavor of the formalized courseware production model by highlighting features not already covered.

The aim of the *Contents Domain Representation* subphase is to represent the course content. The content's representation will match the educational objectives and will have a grain size that supports a modular architecture of the courseware. The aim of the *Instructional Strategies Definition* subphase is the analysis of the courseware matter in order to define and organize the presentation of the courseware contents to the learner, taking into account the possible didactic strategies related to its model. Once the Instructional Strategies have been defined, the Assessment Methods may be specified. Notice how these aspects of the production are distinct. The content expert figures most prominently in the contents domain subphase whereas the pedagogical expert takes the lead role in the instructional strategies definition.

In the Courseware Development phase, guidelines for the implementation are established. The aim of the `Standards' subphase is to define a set of guidelines that guarantee quality and uniformity of the development phase products. The objectives of the `Script and Storyboard' subphase are to define and to describe the actual material involved in the courseware (textual, graphical, sound, and video) and to make available the global pattern of the screen lay-out and the flow of control through the program (see Figure 47 "Script").

Like the Script phase, the Script and Storyboarding phase involves numerous roles and messages. Messages involved in the Script and Storyboarding subphase are:

- Contents List,
- Architecture,
- Selected Educational Strategies,
- Contents Domain Representation,
- Specific Educational Objectives,
- Writing Standards,
- Script of Contents,
- General Standards,
- Storyboarding Draft Forms, and
- Storyboarding Production Forms.

Six roles are required in the `Script and Storyboard' subphase: Graphics Designer, Media Expert, Subject Matter Expert, Communication Expert, Instructional Designer, and Writer. On completion of this phase, all

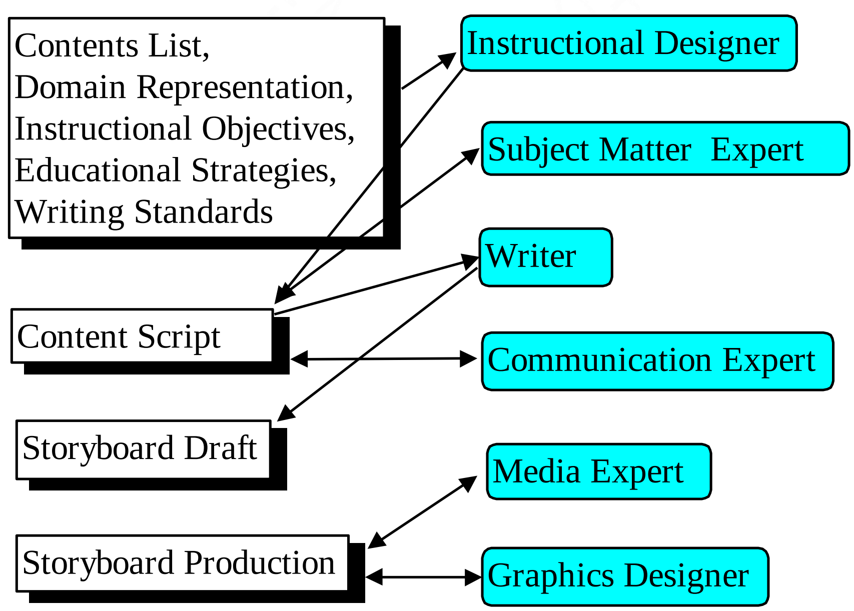


Figure 47: Script. This figure shows the interaction of roles and messages involved in producing the script. Notice that we do not give the detail of the workspace, role, and person but assume the reader could provide those details.

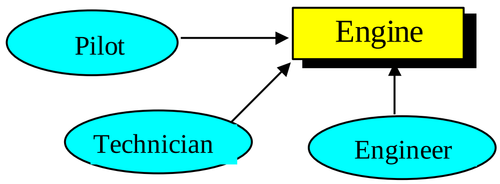


Figure 48 Airplane Engine. The description of the engine is useful to different types of students.

the components of the technical plan have been assembled and implementation can proceed.

In the *Implementation phase* courseware will be implemented in accordance with the specifications defined in the storyboarding process. This entails prototyping and implementing the multimedia courseware and checking its congruence with the specifications. At least seven different roles are required to work together to complete the implementation.

5.4.5 Reuse

We have finished the description of the formal model of coordination as it involves the roles and messages in an ongoing production. However, we have given little attention to the *reuse* of existing courseware components and what those might mean for the courseware author. From a library of properly classified components, a courseware author could find and tailor components in making new courses.

Take a simple illustration of reuse. Say that the courseware production company develops many training modules for the aerospace industry (as AMTECH does). One overview photograph of an *airplane engine* is frequently used in the course. A course for a pilot will be different from a course for an engineer or a technician, although each might be able to use the same overview photograph of an engine for one part of the course (see Figure 48 "Airplane Engine"). The details of the engine may need to be seen differently depending on the needs of the student. The author of the course should, however, be able to reuse the overview picture in one course that was acquired by perhaps a different author for a different course.

For many years courseware authors have tried to determine the factors which influence the efficiency of courseware development. Reusable, instructional templates were identified as contributing to *efficient courseware authoring* over fifteen years ago (Avner 1979). As the availability of courseware components has increased, the attractiveness of building and exploiting libraries of these components has grown.

Reusable information can take many forms, such as a library of software routines included in a computer program, or a standard letter used by a company to offer the same services to a number of customers. Approaches to courseware reuse center on multiple access points into libraries of teaching material and the ability to reassemble components (Rada, 1990).

For libraries of textual material good methods of indexing and retrieving information are relatively well known. For other media, the story is less simple. For instance, the University of Bristol has produced a videodisc with 36,000 biomedical images. Copyright of the images remains with the donors of the images. The images can, however, be freely reused for non-profit making purposes. A text catalogue of the material is available and can be searched with a free text retrieval system (Williams and Hammond, 1994).

The production of a single frame of film often costs over $300. Amazingly this ultra-expensive footage is only used once. The million dollar scene has its place in the movie, and that is the only place it will be seen. Several efforts have been made to build *video libraries* which could be reused. The MIT Media Laboratory experimented with repurposing footage from the soap opera Dallas for interactive replay. The experiment failed because this apparently multithreaded soap opera was too tightly structured to be repurposed (Pentland et al, 1993).

As we might have expected, the more complex media types are more difficult to effectively reuse. However, on further study we would find that the real bottleneck to reuse is not something peculiar to the content to be reused so much as the ethos of the teams doing the authoring. Reuse is not typically much encouraged. People author to get the immediate task successfully finished, and contributing to a reuse library is not part of this task typically. Reuse must be part of an *organization-wide commitment* for it to succeed. Libraries must be built or acquired and authors must be rewarded for contributing to or taking from the reuse library. One advantage to formalizing the model of courseware authoring, as done in the preceding subsections, is that the modelers now have further opportunities to try to institutionalize reuse by entering it into the model.

5.4.6 Exercises

True or False

1) Coordination requires decision-making and communication.
2) The Activity Model Environment is used to represent images in an animation.

3) The information units in a message are completed in the workspace by the role assigned to the workspace.
4) Finding a relevant video clip to reuse and tailoring it to the needs of a courseware package is easier than the same task for a paragraph of text.

Knowing Essay

1) Describe the function of four of the most high level components of the Activity Model Environment.

Doing Essays

1) The instantiation of the courseware life cycle in the modeling language makes it easier for us to develop computer programs to assume some of the functions otherwise performed by people. Provide at least one example of such a function.
3) Consider the "Courseware Outline" figure. Pick any of the messages indicated in the "Courseware Outline" figure and suggest some information units that might be included in that message.

5.5 Conclusion

Some organizations produce courseware about a product that they sell. In this case the knowledge that the courseware producers want to capture for later transmission is knowledge close to the organization's heart and the organization can *invest* great effort in the production of this courseware. Schools from kindergarten through university are a different story. A school operates in a way as a franchiser of its teachers. The teacher may or may not produce courseware. The school itself has no vested interest in the content of a particular teacher's courseware. Thus the school is less prepared to make large investments in the production of courseware.

Numerous companies exist to develop training material for the commercial sector. Sometimes these companies are small and independent and serve many different customers. Such a *small company* is FutureMedia. FutureMedia's guidelines for the execution of a project are not rigorously defined, and a project leader is largely free to adopt whatever method of courseware development seems most suited to the case at hand.

Some *large courseware authoring companies* are intimately connected to a yet larger corporation whose needs for training material the courseware company exclusively provides. Such a company is AMTECH. The procedures at AMTECH are uniformly rigorous and reflect a manufacturing approach to the development of courseware. Every step of the process has a pre-defined before and after step. Every function to be performed is assigned to a specialist role.

Before the computer can play an active role in supporting an otherwise human activity, the activity must be very precisely represented. This precise representation should be in some *formal language*. The Activity Model Environment provides one such language for representing organizational activities and is well suited to the representing courseware authoring activities. Based on the courseware authoring process described for AMTECH and using the Activity Model Environment, the courseware life cycle has been formalized. In addition to the five basic phases of Analysis, Design, Development, Implementation, and Evaluation, numerous subphases are described.

If multiple companies follow the same formalizations of the courseware development process, then the opportunities for exchange of components among companies is increased. What determines whether a company is prepared to commit to a *standardized work model*? Perhaps AMTECH's regimented approach to courseware development is a reflection of the close connection of AMTECH to its massive, parent firm Agusta, and the well-established policies of Agusta. Perhaps the organization-wide policies of AMTECH, which apply consistently to all courseware products developed at AMTECH, are partially a reflection of the relatively homogeneous customer needs.

The major conclusion to be drawn from the contrast between the academic and the commercial case studies is that the characters of both the product and the people affect the mode of work. This is not a surprising conclusion in itself, but the degree to which the work styles and phases vary is most remarkable. The professional training company with manufacturing customers followed the classic life cycle and had specialized people in all of the critical roles of hypermedia courseware authoring. The academics developed material in a less structured way, as they were often learning which material they wanted to convey through the experience of trying to create material. The academics did not have as clearly defined roles for the team members nor as well developed a script, as the commercial people. In this book's *dialectic approach*, this contrast between the commercial and academic approaches serves as one of the major tensions.

Large investments in courseware production with a team approach are not restricted to commercial operations. For instance, the Open University in England follows a manufacturing approach to courseware production. The number of likely buyers of the courseware are identified and when that number merits investing about one million dollars in course production, then a new course is generated with a large team of specialists working to a highly structured courseware life cycle. So the difference is not necessarily something intrinsic to academia versus industry rather the question is one of *organization mission*.

We are back again in part to the basic questions of economics. If the courseware production comes from a cottage industry, then there is not enough capital to afford a Hollywood-style product. If substantial resource, including capital, is available to invest in the production of courseware intended for a large audience, then the model illustrated by AMTECH seems the appropriate one. A professor in a university is unlikely to have enough students in a particular course to merit large investments in the production of courseware. Perhaps the key to Hollywood-style productions in academia will come from alliances among schools or from investments from publishers. The *socialist model* would accord with the alliances among schools and the *capitalist model* would accord with the investment from publishers. Which shall it be?

5.5.1 Exercises

True or False

1) Teachers do not each write their own textbooks for everything that they teach, we would not expect them to each produce their own courseware.
2) Specialized roles in courseware production are more common in academia than in industry.
3) The courseware life cycle is similar to that of software but includes additional components for storyboarding and media.

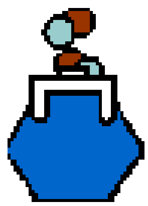
Knowledge Essays

1) Compare and contrast the courseware authoring methods of academia to those of industry.
2) To what extent and why is the AME modeling environment better suited to the industry mode of courseware authoring than the academic mode?

Doing Essays

1) Consider two different markets for courseware, such as elementary school children learning mathematics and airplane pilots learning how to fly a plane, and suggest what courseware authoring organizations are likely to dominate that market and what methods and tools they would use.
2) Examine the Globewide Network Academy web site at http:www.gnacademy.org. People come to the site and contribute listings of online courses. What features of this system would lend themselves to be extended so that people also co-authored courseware for some of the courses online and what features speak against such extension.

Part III: Market



Part III: MARKET

We have developed a model of students learning in classrooms as part of an organization that exists in cyberspace. The student role can be filled by people anywhere anytime and likewise for the teacher and administrator roles. In order for virtual education to occur somehow the teachers and students need to be connected. This is the job of marketing.

Virtual education is being offered today by colleges, major corporations, small businesses, government agencies, the armed services, trade associations, religious institutions, political entities, private entrepreneurs, and charitable organizations. As the information superhighway empowers these organizations to do more, the demographics of education will widen. While since 1890, more than 100 million Americans have studied by distance education (DETC, 1996), that number is small compared to what could be. With technology changing rapidly, the need for employee training and retraining grows commensurately. The amount of money to be spent on corporate job-training alone is conservatively estimated at hundreds of billions of dollars annually. What are organizations doing to compete in this developing *marketplace*?

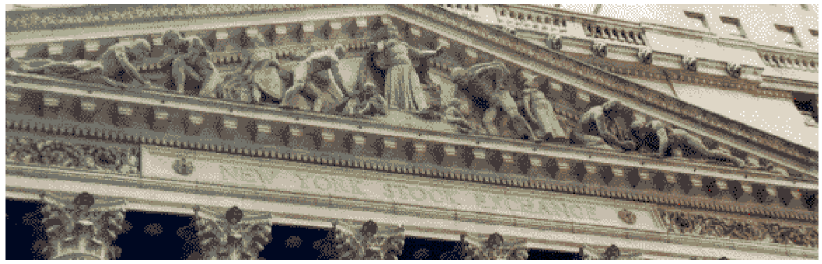


Figure 49: Corporate Icon. This facade of the Wall Street Stock Exchange is a symbol of corporate activity.

6. Corporate Marketing

Learning Objectives

- Appreciate the importance of employee and customer education.
- Understand some examples of virtual education by companies to their own employees.
- Understand why information technology companies are most active in customer education in virtual mode.

6.1 Introduction

Employees of a company constitute a captive audience for education from the company. Companies invest massive amounts of money into employee training. Also, the organization that wants to teach about its product or service has a certain kind of *captive audience*. If the buyer needs to learn about the product or service, then the seller is uniquely positioned to provide this education.

6.2 Educating Employees

Companies have long had education programs but with the rapidly changing business environment, the need for *employee education* has grown. Sometimes the employer wants the employee to have access to degree-based training and at other times to company-specific education. In the following, we see for instance that Office Depot wants specific salesperson skills passed to its new trainees, while the Boeing Company wants to provide degree programs for its engineers.

The learning objectives for this section on educating employees are:

- Be able to model the training cycle in a company as it reflects the assessment of competencies and the delivering of education or training that demonstrably improves job-needed competency.
- To sense the importance of virtual education for large companies, like Xerox, GTE, and Boeing.
- To appreciate the details of the running of a virtual seminar in a global company and how employees reacted to it.
- To know an example of the introduction of a new virtual classroom tool into industry that made a measurable, positive difference.

- To examine the method and results of an analysis of market trends as evidenced on the web.

Through the accomplishment of these learning objectives, the reader should be able to recommend to others the importance of employee virtual education. The focus should be on identifying critical educational needs that are costly to satisfy in traditional ways.

6.2.1 Training Principles

The *quality objectives* of an organization and its personnel are affected by a number of internal and external factors. These might include organizational changes brought about by technology or the requirements of customers and other stakeholders. Such change may require an organization to review its human resources requirements in terms of competencies. Education could be one effective means of addressing those changes (see Figure 50 "Improving quality by training"). When education is used in this kind of focused way to address a company's needs, it is often called training rather than education.

A planned and systematic training process can help an organization meet its quality objectives. For selecting and implementing training to close the gap between required and available competence, management should monitor the following stages of the *training cycle* (see Figure 51 "Training Cycle"):

1) identify and analyze training needs
2) design and plan training
3) provide and deliver training
4) evaluate training outcomes and improve training process

In the ideal situation, the output of one stage will provide the input for the succeeding stage.

Stage 1. *identify and analyze training needs* is the starting point. Organizations should identify the competencies for each job, assess the competencies of the employees to perform the job, and develop plans to close any gaps. Such needs assessment is peculiar to the working environment and not the same as identifying general knowledge gaps in students at school because the workplace analysis is specifically related to performance on the job.

The *design and plan* training phase provides the specifications for the training which are consistent with the organizations quality policy and quality system. This phase includes :

- the design and plan of actions to address the needs identified in the earlier process; and
- the design of the criteria for evaluating the training outcomes and monitoring the training process

The relevant methods of training that can meet the training needs should be identified.

A training supplier is then selected to deliver specific training contents. Forms of *delivery* might include seminars, on-the-job coaching, and distance learning. Specifics of the implementation further include :

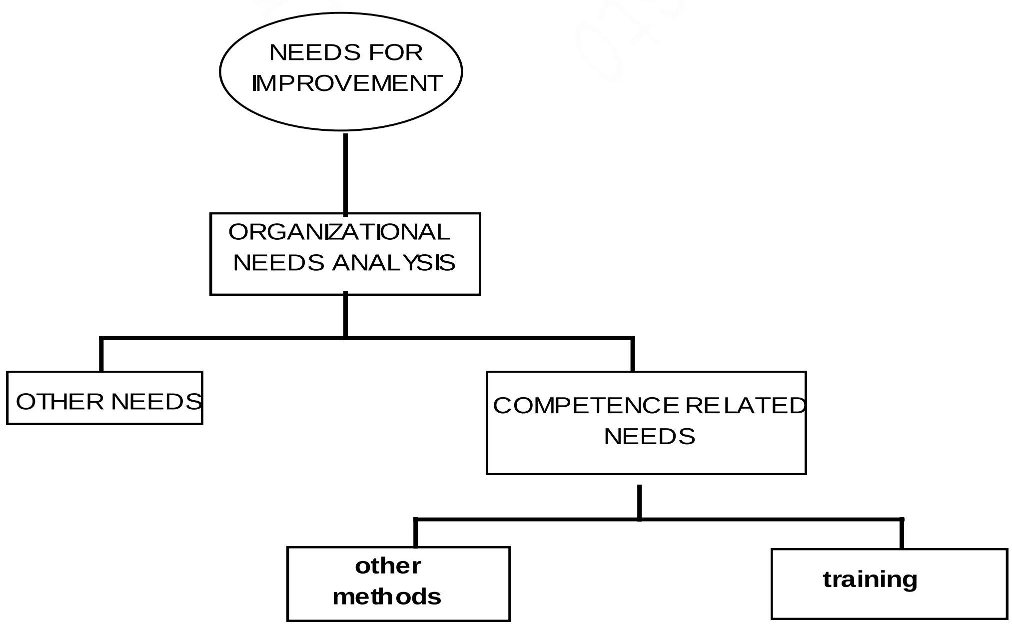


Figure 50: Improving quality by training. The organizational need for improvement may depend on improved competence which in turn may require training.

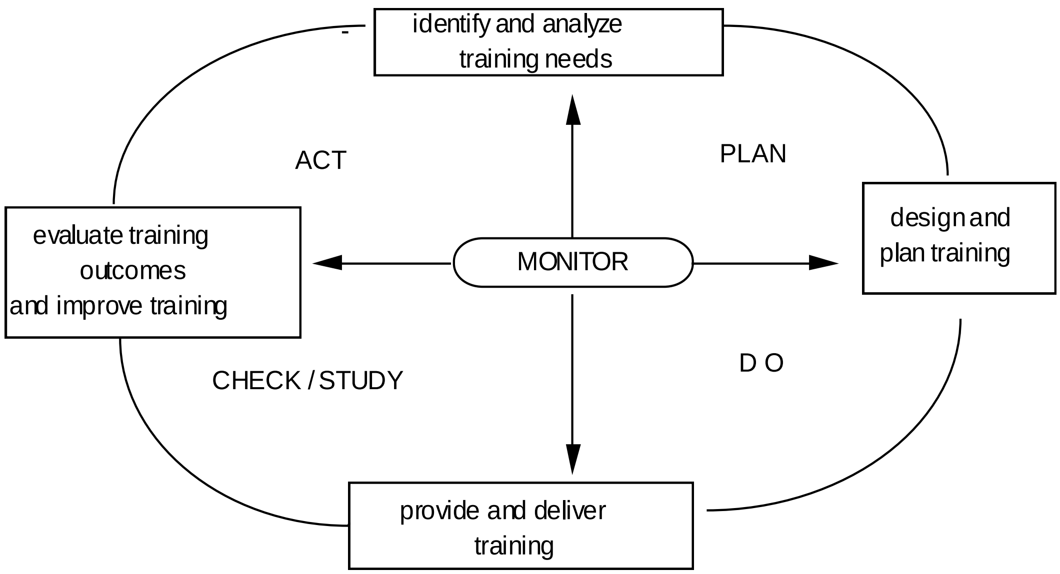


Figure 51: Training Cycle. Training should begin with an identified need. The training is then planned, delivered, and finally the impact is evaluated.

- date, place, and location,
- cost,
- sequence of implementation, and
- forms of assessment, evaluation and certification.

The results of training often cannot be fully analyzed and validated until the personnel who were trained can be observed, measured, or tested on the job. Within two weeks after the employee has completed the training, internal quality auditors should perform a *compliance audit* to determine if the practice conforms to the level of competence required for relevant procedures and work orders. It is quite likely that nonconformances will occur that will require corrective action.

In summary, competent employees are needed to achieve quality objectives. The training cycle includes identifying needs, planning delivery, delivering, and assessing impact on competency. Identifying training need requires a careful understanding of the workplace needs and the staff competencies. The training is then planned and implemented. The ability of employees to perform as expected must then be assessed on the job. This cycle has in common with quality control processes the statement of objectives and the documentation of progress towards the objectives.

6.2.2 Global Giants

Large, globally-distributed companies need to *institutionalize education* to successfully perpetuate their internal culture. For a small company the web of personalities may be enough to sustain the internal culture but for large companies more is needed. We will see next how the Xerox Corporation makes a top priority of education and how all employees participate. The telecommunications giant GTE provides an illustration of using the Intranet in education offered by GTE training staff to other members of GTE. Finally the aerospace manufacturing giant Boeing is used to illustrate how companies may look for contracts with public higher education institutions to help the company get continuing education for its employees.

Xerox started the office copier business in 1959 and is now one of the world's largest corporations. The Education and Learning Division of Xerox is responsible for the policies and programs designed to educate Xerox employees. Xerox spends hundreds of millions of dollars each year on training employees. This includes training on specific products, as well as broader learning opportunities for skills needed in today's knowledge economy. All Xerox employees go through an intensive course in Total Quality Management early in their careers. To quote from the Xerox Vice-President for Education and Learning (Xerox, 1997):

> Worldwide Xerox Education and Learning is leading the way as Xerox moves toward the virtual university. It is helping Xerox organizations around the world combine advanced learning techniques with new technologies to deliver training to the student, when and where it is needed.

Xerox wants to be a learning organization and believes that the most effective and productive employees are

PROFESSIONAL DEVELOPMENT:

COURSES ON THE INTRANET

GTE's Organizational Learning and Competency Development group is utilizing the intranet to offer new courses to all employees. Four separate education programs currently are being developed for delivery to employees through the intranet home page. The first program, the Balance Sheet, now is available … these programs are engaging, interactive, involve no cost to employees and personally are efficient because they're available at employees' desktops. They are designed to help you become more knowledgeable on the financial aspects of our business, yet not require you to attend a formal classroom. Additionally, course descriptions, program schedules and on-line registration also can be accessed through the intranet home page.

Figure 52: GTE Course Announcement. This intranet announcement from GTE is for a virtual educational offering.

those who approach work itself as an opportunity for continuous learning.

GTE is a global telecommunications company with an interest in exploiting telecommunications in its own internal education. Part of its internal training unit offers education via the corporate Intranet (see Figure 52 "GTE Intranet Education"). The extract from a GTE employee email bulletin illustrates the intention of reaching people at their desktop with just-in-time, anytime education (GTE, 1997).

Boeing has 15,000 engineers. Under 2% are involved in graduate level engineering education programs. United Technologies is a company similar to The Boeing Company but sends 6% of its engineering population into continuing education, and the United Technologies company goal is to increase that to 18%. Boeing intends to be more like United Technologies in its participation rate for engineers in graduate education. That means increasing its annual *enrollment* from a few hundred to a few thousand. At that point, The Boeing Company enrollment is comparable to that of a substantial higher education institution.

Boeing does not want to duplicate the efforts that universities already invest in creating and delivering educational programs. Accordingly, Boeing has put forward its requirements to the higher education community and is looking for partners to provide the education. Boeing wants its engineers to be able to earn a degree from a *university* but to be able to stay at the Boeing workplace. The student and teacher should be able to easily communicate across space and time. In one model, Boeing gets videotapes recorded earlier, and a mentor on site works with students as they progress through the videotapes. Boeing pays a normal university tuition fee for its students. Boeing would like to use the Internet and other technologies to further support its education.

In summary, large corporations institutionalize employee educational programs. Xerox puts every employee through educational programs. GTE has placed employee training programs on the Intranet. The Boeing Company intends to have thousands of its engineers each year being educated on the job by universities using the information superhighway. This snapshot of some corporate activities would readily be extended to many other companies.

6.2.3 A Virtual Seminar

The Gallup Organization is a recognized leader in the measurement and analysis of people's opinions and behavior. While best known for The Gallup Poll (founded in 1935), Gallup's current activities consist largely of providing marketing and management research to the world's largest corporations. Gallup has operations across the globe and thousands of research professionals. To keep its workforce current with the latest methods, Gallup has institutionalized an extensive educational program. While face-to-face seminars are an important part of this educational program, Gallup is experimenting with seminars online.

A typical, *traditional seminar* attracts about twenty people. Gallup seminar attendees earn certain credits which ultimately also contribute to the employees financial reward. The seminars are typically held in Lincoln, Nebraska where the company's operational headquarters are located. Traditional seminars are videotaped, and the videotapes are circulated on request.

Two seminars were placed on the Internet in 1996. Gallup hypothesized that a *virtual seminar* would:

- have more participants than a traditional seminar,
- allow people to participate anywhere, anytime, and
- would gain more participants through a combination of email, fax, and WWW than by any mode alone.

Participants would hopefully

- want to take another virtual seminar, and
- see applications of this offering to their clients.

The moderator would

- provide a cost-effective service and

- refine a model for other virtual seminars.

The goal generally was to improve education.

The first seminar occurred June 27 through July 8, 1996 and attracted 23 participants. Communication mode in this first seminar was largely by *email*. A few people used the web to submit some or all of their exercises, and one participant depended on faxes. The remainder relied on email. If the seminar mode of communication had been restricted to just one mode, participation would have been less.

The seminar succeeded in attracting participants from distant *cities* (see Figure 53 "Seminar Participants"). While the moderator of the seminar was in Lincoln and communication flowed through Lincoln, the number of participants in non-Lincoln offices approximately equaled the number in Lincoln offices. People participated from Caracas, London, and throughout the United States.

Often one anticipates that new technology or new ways of doing things will be particularly attractive to younger people and not older people. But the age of participants was distributed evenly across a wide range of *ages* in the virtual seminar. In part this may be due to the example set by the inspirational leadership of Don Clifton, the Chairman of the Board of The Gallup Organization (see Figure 54 "Clifton"), who also participated in the seminar.

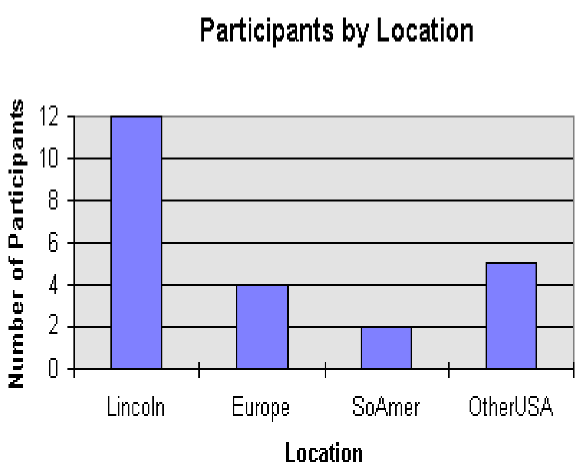


Figure 53: Seminar participants. Participants were in Lincoln, Europe, South America, and Other USA cities. "Number of Participants" is the number of people who completed the Virtual Patient Satisfaction Surveys Seminar.

The seminar participants were surveyed as to their *satisfaction* with the seminar. The participants said that they had learned from the experience and would take another virtual seminar—the response was unanimously positive in this regard. . The enthusiasm in the survey question answers was often evident, as in statements such as "benefits would be great for any technologically-oriented organization". The replies about whether or not people would try to sell a virtual seminar to a client were less clear. The largest response was a "probable" in which people said something to the effect of "partly" or "after getting more experience with the virtual seminar".

Most people liked the seminar best for its new method. The most disliked aspect of the seminar was that the email was cumbersome. Many of the comments about what was most or least liked about the seminar did address the *mode of delivery* or organization of the content rather than the actual content - as one might expect for a seminar that is delivered in a new mode.

The *second virtual seminar* relied on the web. Participants were expected to answer questions through forms on the web. The topic of the seminar was now a more popular topic than that of the first seminar, but most Gallup employees were not prepared in the summer of 1996 to use the web. The geographic distribution was again worldwide. Again most participants said that they benefited from the seminar and would take another virtual seminar. The teacher was particularly thrilled to observe how students in the USA submitted answers during the day in the USA and participants in Asia contributed exercise answers while those in the USA slept. Overall, we see another virtual mode seminar that attracted people from various parts of Gallup and that had positive reviews

After these first experimental efforts in the summer of 1996, The Gallup Organization introduced a further sequence of virtual seminars on various topics for employees. Seminar participants said that a virtual seminar would reduce costs and that a virtual seminar would increase access of people to the information and service that Gallup provides. Additionally, some of the educational offerings to customers have since the summer of 1996 been augmented with a web component. However, the company is not yet prepared to make a major investment in virtual education. Its first order of business is to exploit information technology further in its core business activities. Such an approach makes sense for any organization. Namely, if the organization operates globally with information, it should have its basic functions take advantage of computer networks. Until the company has that part of the operation well under control – its *core business* in

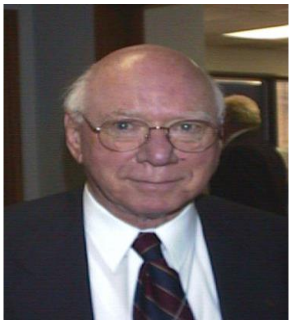


Figure 54: Don Clifton, Chairman of the Board of The Gallup Organization and strong proponent of corporate virtual education

virtual mode -- using computer networks in education should take a backseat.

In summary, the Gallup Organization is committed to continually educating its employees. Employees gain financial credits for participating in seminars. Virtual seminars were introduced to increase access. Satisfaction with the seminars was very high. Gallup is continuing its efforts in virtual education but slowly because its first priority is to get its core businesses to take further advantage of computer networks.

6.2.4 A New Tool

Office Depot is the largest office supply company in North America. About thirty thousand associates are trained on a regular basis at Office Depot. Training topics include store openings, order entry, personal computer skills, and sales management. Traditional training has been conducted in instructor-led classrooms or directly in the stores. This approach has not been able to satisfy the enormous demand. To support the internal training program, Office Depot has adopted a new virtual classroom tool.

In 1996, Office Depot began converting some of its major training courses to courseware. At the same time, the company initiated a method of leading students through this courseware over a distance. Office Depot chose to standardize its training format and delivery through a commercial product called *LearnLinc*. LearnLinc is a framework for courseware, and LearnLinc supports synchronous and asynchronous management of a class across a distance. The manager of training said:

> LearnLinc allows us to have a consistent message, because we use an authoring program to send the same message every time. In addition, LearnLinc sessions give us better quality output by using a top notch instructor to reach many more people than we could with traditional training techniques.

Office Depot LearnLinc sites are located at the corporate headquarters in Florida and at one store in Texas and one in California. There are 10 distance learning seats at each location.

Prior to using LearnLinc, the instructor would be in a classroom in the Florida headquarters with 10 students. Then the instructor would go to Texas and then to California to teach 10 students in each of those locations. Using LearnLinc, the instructor can teach 30 students at the same time *without travel*.

A survey asked participants to rate the course content and instructor in the LearnLinc environment. When the results were compared with traditional instruction of the same courses, the LearnLinc courses scored higher. More employees have access to better training using the same resources. Office Depot expects to triple its installation of LearnLinc sites so that all associates will be within commuting distance of one of these LearnLinc facilities. For Office Dept this immediate investment in virtual mode education is *cost-effective*.

In summary, Office Depot is a retailer with thousands of employees in need of training. The company is moving from its traditional face-to-face instructional mode in favor of a courseware-based and distance-education based mode that uses the tool LearnLinc. Students and teacher now travel less and the students get a uniform education through the use of LearnLinc. Office Depot finds this virtual education to be cost effective. Such a role for virtual education at Office Depot would apply similarly to other large, geographically distributed retail companies.

6.2.5 Industry Patterns

To improve one's understanding of the attributes of organizations that widely use the web for educational purposes, one might study the content of the web. *Content analysis* is a well-established method in social research that has been typically applied to paper document sources (e.g., Todd et al, 1995). The web offers a new and rich source of information for content analysis.

What kinds of companies are using the web for internal training? We have approached this question by studying web activity. The list of 1000 top USA companies has been divided into categories based on the type of business (Fortune, 1995). Three very different *industry categories* were chosen:

- computer and data services
- airline and
- pipeline.

Within each category there were about 10 companies (see Figure 55 "Three Largest Companies"), and we studied the web sites of those companies.

At each corporate web site a search was performed for evidence of educational offerings by the company to its own employees. Internet usage was measured as follows:

- a 0 was assigned, if no evidence of educational offering was present.
- a 1 was assigned, when education was available but the Internet was not used.
- a 2 was assigned, when education took advantage of the Internet.

The *airline companies* provide more extensive evidence on the web of a commitment to training their own staff, then do the computer companies (see Figure 56 "Web Educational Activity"). This training was most commonly of the form of training for pilots or flight attendants. Three of the airlines also offered pilot training to other than their own employees. In general, we note that companies that have a large workforce, wide geographical distribution, and a need for training have the greatest evidence of web educational activity.

Content analysis of the web can help us understand the developing marketplace for web education. Three major industries, data, airline, and pipeline, were chosen for study. The airline companies showed the most evidence of using the web for educating employees. These results should generalize to similar industry types.

6.2.6 Recommendations

Companies spend substantial sums on continuing *employee education*. This can be done in a targeted way so that employees have improved competence for the jobs that they do. By moving more of their education onto the information superhighway some companies would for some employees be able to offer a better educational service. The major impediment to progress currently is the relative unfamiliarity of most companies with the options.

The experience at The Gallup Organization showed that simple technology could be used, primarily email in one case, and that employees could benefit from such virtual education. Whether or not the offering was *educationally effective* would depend on the content of the education, the tools for delivery, and the particular circumstances of the employee. Obviously the education has to be relevant to the students needs and the tools must fit into the work flow.

When we stand back and ask ourselves about the future of such education at The Gallup Organization, we are forced however to take another kind of look. The Gallup Organization realized the benefits of a systematic approach to managing and motivating internal education, but the company had to deal with higher priorities. If one explores the extent to which computer networks can be used to improve education, one must first in a typical company ask whether the computer networks are adequately serving the company's *core functions*. If the answer to that is "no", as it will be in many companies today because of the incredibly rapid rate of change in technology, then the investment in education is deemed lower priority than the investment in the base functions of the company. This makes good sense in several ways and would only be counterintuitive, if one needed the education before one could proceed with the core business improvements. So if one wants to look to extending virtual education within a company, the first lesson to learn is that the company should already be reasonably sophisticated in its use of information technology in making itself virtual. Otherwise, the step to education in this mode is likely to be too dissonant to have more than curiosity impact.

Computer and Data Services	Airline	Pipeline
Dunn & Bradstreet	AMR	Enron
Microsoft	United Airlines	Panhandle Eastern
Computer Sciences Associates	Delta Airlines	Transco Energy

Figure 55: Three largest companies (as defined in Fortune 1995) within each category are listed.

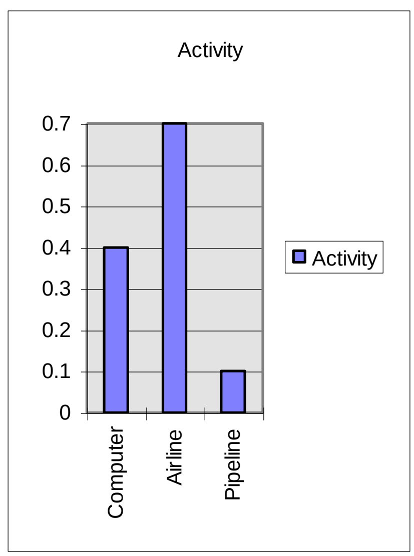


Figure 56: Web Educational Activity. Three company types along the x-axis and degree of employee educational activity on web along the y-axis.

Office Depot provides a different kind of example where the need is for frequent training at the low ranks in widely dispersed office locations. The cost of the training was clear as was its importance to proper job functioning. The technological support that was offered by computer networked tools measurably reduced educational costs, while maintaining the quality of the education. To advance virtual education, one should look for such circumstances where the education is measurably related to work performance and where the educational costs are also *well defined*.

The Boeing Company is different again from either of the two companies Gallup and Office Depot, both in the size of their workforce and the character of their work. Boeing provides an example of a company that seeks *university-originated education* for a large number of employees that can be delivered into the workplace. This creates an opportunity for arrangements with traditional educational organizations that will be a topic for future sections of this book.

By reviewing what we could find on the World Wide Web of corporate efforts to use the web in educating employees, we obtained *counter-intuitive results*. We had expected that the computer industries would appear most frequently in this analysis but they did not. Workflow issues would have suggested that data processing companies would most readily fit to education on the information superhighway. However, the airline industry provided more evidence of online education for employees than did the data processing companies. We speculate that this is because such education is more critical for pilots, flight attendants, and maintenance engineers than it is for employees of data processing companies.

In summary, companies engage in education in order to increase the competence of their employees to perform. The Gallup Organization virtual seminars demonstrate that such virtual education can be highly appreciated by the students, and the story is similar at other companies. The future of such education at Gallup and other companies may depend in part on the extent to which the particular company has already its core functions adequately in virtual mode. Another factor determining the suitability of virtual education for employees is the need and the measurable cost benefit. While data processing companies would seem to be the most likely to use virtual education for employees, our content analysis suggests that airline companies surpass data processing companies in this regard, and we posit that the reason for this is the greater need for documented, formal, continual employee education in airline companies.

6.2.7 Exercises

True/False:

1) The pipeline industry is most active in virtual education to employees.
2) Proper corporate training is guided by competency assessments of employees.
3) United Technologies has less than 5% of its engineers in continuing education programs.
4) Virtual seminars in the Gallup Organization were attended by employees on several continents.
5) Office Depot uses LearnLinc to teach employees at their home

Knowledge Exercises:

1) What are the four phases of the corporate training cycle and how does the output of the fourth phase become the input for the first phase?
2) What are the employee education objectives of The Boeing Company.
3) How were the virtual seminars taught at The Gallup Organization and what were the results?
4) What is a web content analysis and how was it applied to measuring virtual education in companies?

Do exercises

1) If the GTE Financial Policy documents are online and financial policy is being taught on the intranet, what connections might you usefully make between the manuals and the training?
2) To what employees of what companies would you offer virtual seminars on what topics and what tools would you choose to deliver these virtual seminars?
3) If you company had 500 stores distributed throughout the USA and you wanted to have computer stations for training, would you put classrooms with 10 computers in 50 stores or would you put one computer in each of the 500 stores and why?

6.3 Customers are Students

Novell Corporation develops computer network software. Some employers say that a new employee with a certificate from Novell earns more than a new employee with a Masters degree in Business Administration. These *Novell certificates* are part of a broader mission of Novell to increase its market share (Novell, 1995):

> Novell Education's mission is to drive global pervasive computing through quality education programs and products; its purpose is to increase literacy on Novell products and technologies and thereby foster Novell's success worldwide. Novell Education plays a critical role in providing true pervasive computing by building the infrastructure of support and literacy that is necessary to drive and sustain that vision.

In other words, Novell is educating its customers so as to better sell its networking products. What is happening industry-wide as regards such education in virtual mode?

The learning objectives are to:

- appreciate via some salient corporate examples how educating customers can be fundamental to sound business.
- understand the pattern of web educational activity for customers by industry type.
- appreciate the Master's Degree and other offerings of Oracle to customers.
- appreciate the wide range of activities of Microsoft in furthering its educational mission.
- see the relationships that exist among certified software developers, certified teachers, and certified training programs.

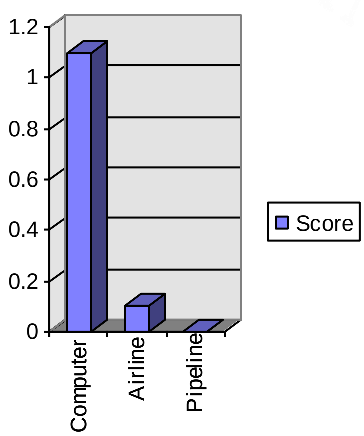


Figure 57: Corporate Web Activity. The vertical axis is the average Internet usage, which could go from 0 for least to 2 for most. The horizontal axis is for "Computer and Data Services", "Airlines", and "Pipelines" groups.

- understand how other than information technology companies can also be intimately involved in customer-oriented virtual education, the student will learn the plans of a market research company to develop certificate-based educational programs for its clients.

We believe one of the greatest markets for the growth of virtual education involves companies and their customers.

6.3.1 Content Analysis

In the earlier presentation of the *content analysis* of employee education on the web, a method of data collection and analysis was explained. When we look at which type of company is most using the web to deliver education about its product to its customers, what do we find? Of the three industries analyzed, namely, data, airline, and pipeline companies, which is the most active in offering education in virtual mode to its customers?

Again the scale of activity per industry type ranges from 0 to 2, where 2 indicates the use of the Internet in customer education and 0 indicates no customer-oriented educational activity. The data show clearly that the *Computer and Data Services* companies are the most educationally active (see Figure 57 "Corporate Web Activity"). The "Pipeline" companies showed 0 educational activity for customers.

Three *quotations* from the web sites of three of the "Computer and Data Services" companies illustrate some of the direction these companies are taking.

- From Oracle Systems (Oracle, 1996): "This will not only make it easier to overcome common barriers to training, such as distance, budget or schedule conflicts, but allow you to address a wide range of experience levels and learning styles in the process."
- From Equifax (Chapman, 1995): "Consumer education is very important to Equifax and the credit reporting industry. The Equifax Forum on Microsoft Network gives us another way to be in touch with consumers about credit information topics and to be responsive to consumers who use their personal computers rather than the telephone to conduct personal business."
- From Lotus Development (Rothstein, 1996): "While I'm here to represent the commitment of Lotus Institute, … to this partnership …, I'm really here because we seek to serve the same people - individuals seeking access to education."

Any global company with an information service or product has a special opportunity to extend its relationship with its customer into a virtual education relationship. In summary:

- Content analysis of the web was applied earlier to employee education and is now applied to customer education.
- Computer and data services companies prove far and away the most active in educating customers over the Internet.
- Quotes from individual computer companies indicate the breadth and depth of commitment to education.

As information technology companies are more likely to have customers that are comfortable with information technology than any other kind of company, it is not surprising that those companies lead the way in customer education on the web.

6.3.2 Specialist Software Companies

A specialist software company produces a software product for a specialist market. For instance, a company that only makes large-scale commercial database management systems is a *specialist software company*. Likewise, a company that only makes commercial-grade statistical analysis software is a specialist software company. All such companies have in common that their customers need education in how to use the product. Given that to use the product is to be in front of a computer, it makes sense that these companies would be leaders in the area of virtual education for customers.

SAS Institute is a leading company in the area of high-performance statistical analysis software. The SAS Institute offers a large range of online training options to its customers (SAS, 1997). These include video-based coursed, courseware, Internet courses, and face-to-face courses. Sybase Incorporated is a major producer of large-scale database software. The company provides virtual education in multiple forms and specializes in web-based education. The introduction to the Sybase's marketing information about its web-based educational package says (Sybase, 1997): "Lots .. rich interactions that transport you to a world where learning is fun and pain free. … learner control, efficiency, self pacing. … far beyond what's been available on the Web till now." Rather than continue a two sentence *survey* of other specialist software companies, we'll next look in rather more depth into one such company.

Oracle Corporation is the world's largest database management system company. Synergy exists between on-line education and Oracle's technology and education expertise. The Internet increases market potential for *Oracle products*. To quote from the Oracle web site (Oracle, 1997):

> By leveraging its core competencies—relational database management systems, media and web servers, open systems, scalability, any data, and the integration of products and services—Oracle can be the innovator in Internet-based training by providing complete, role-based training solutions for corporate users, developers, and administrators of information technology.

The Oracle Corporation has a separate division to deal with education. Oracle has education centers in almost every country and hundreds of online educational offerings. In addition, Oracle hopes to establish a global standard for developing and receiving online education.

By way of example, we describe a few of the details of one of the certification programs. A certification test for Oracle Database Administrators is available internationally. The *Oracle Database Administrator Examination* measures one's mastery of the knowledge, skills and abilities needed to proficiently perform the responsibilities of an Oracle Database Administrator. The two-hour test is comprised of approximately one hundred computer-delivered multiple choice questions.

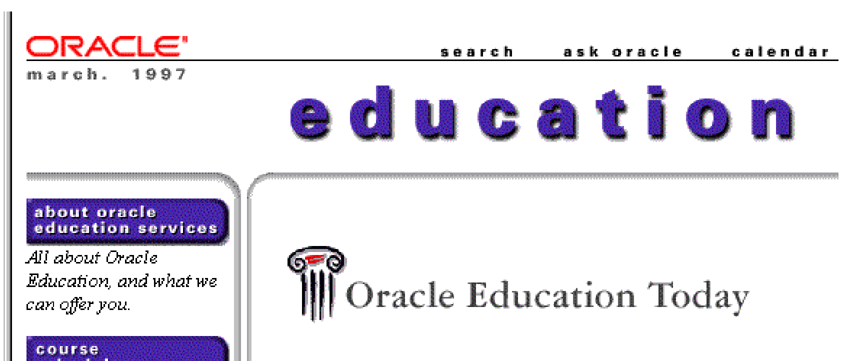


Figure 58: Oracle Education Home Page. This screen introduces the services and courses of Oracle web-based education.

Oracle Education offers curricula focused on job roles via various *Oracle Masters Programs*. People can earn a Masters by completing all of the required courses in an Oracle Masters Program. One can earn further recognition with Oracle Masters Upgrades.

Oracle Education offers a variety of *training methods*:

- instructor-led training,
- Oracle Channel and television broadcasts,
- self-paced computer-based training and videocasettes for the desktop, and
- Internet service.

The Oracle Channel regularly broadcasts interactive Oracle technical training via satellite. Each broadcast operates in real-time and allows participants to communicate with the instructor as well as with other participants via two-way voice and data keypads. Computer-based training delivers structured, hands-on training to any desktop. Oracle Education offers an Internet Service that provides course content addressing information technology developers and managers, on the one hand, and general skills on the other hand (see Figure 58 "Oracle Education Home Page"). The Internet Service has about one hundred courses online, including the most popular Oracle training titles (see Figure 59 "OLA Course Catalog").

Specialist software companies make a product that solves specialist needs of other companies. If we look, for instance, at companies that make expensive statistical analysis software or database software that is intended for large-scale commercial use, then we find that these companies offer virtual education about their product. Oracle Corporation is a database management system company that secondary to its primary mission of selling database products and services needs to provide education to its customers. Oracle has established certificate programs and a Masters Program. The training tools include two-way broadcast video, CD-ROM courses, and Internet catalogs and interactions. What a specialist company like Oracle is doing with virtual education is not radically different from what many other comparable companies are also doing.

6.3.3 Mass Software Companies

Mass market software is software that is used on the average desktop. For instance, word processing software from Microsoft or Apple is targeted to be purchased and used by the public. The company expects

Figure 59: OLA Course Catalog. This screen image from the Oracle web site (Oracle, 1997b) shows a list of courses generated by a search criterion. The price, the content, and other information about each course can be obtained from this site.

to sell millions of copies and to make a small profit per copy. In contrast the specialist software company products, such as those from Oracle, may sell for millions of dollars to one customer. How does a company like Microsoft or Apple address the educational needs of its customers?

For products that are to be used by everyone, such as word processors, the company policy has been to make usage so intuitively obvious that formal training was not a prerequisite to successful use. For other more complex but still public-type products, like programming language environments, the software company may provide far reaching educational programs, in addition to engaging in donations to public schools so that the schools can teach students how to use the products. To effectively reach the large audience, the software company needs to leverage its influence. We will look next at how Microsoft uses various techniques to multiply its educational impact.

The *Microsoft Corporation* appreciates the importance to its long term mission of educating people. Microsoft certifies teaching organizations to offer courses on Microsoft products. Students pay a fee for classes and the proceeds are shared between Microsoft and the teaching organizations. In this and other ways, Microsoft leverages its influence so as to educate millions of students.

6.3.3.1 Microsoft Online Institute

Microsoft has created the Microsoft Online Institute. The *Microsoft Online Institute* provides training via the web about Microsoft products and technologies (MOLI, 1997a). Through the web site students can learn about classes available online, enroll in the classes, and take the classes (see Figure 60 "MOLI Home Page"). Students can also learn about careers facilitated by Microsoft training, and faculty members can interact with other faculty members online.

The Class Catalog provides an extensive listing of classes available (see Figure 61 "MOLI Catalogue"). For every *class*, the interactive database provides information about the cost of the class, the contents, and the teachers. The classes can be completed online but may involve the acquisition of other material, such as a CD-ROM. Most of the interaction between students and teachers is done via email or newsgroups. The teaching organizations to which Microsoft contracts not atypically guarantee response to an email question within 24 hours. Some classes may have various fringe benefits, such as counting toward credit toward a traditional university degree, but the main objective is to help people get certified by Microsoft as a Microsoft Certified Professional.

The Microsoft Certified Professional Program was founded in 1992 and by the end of 1996 had already

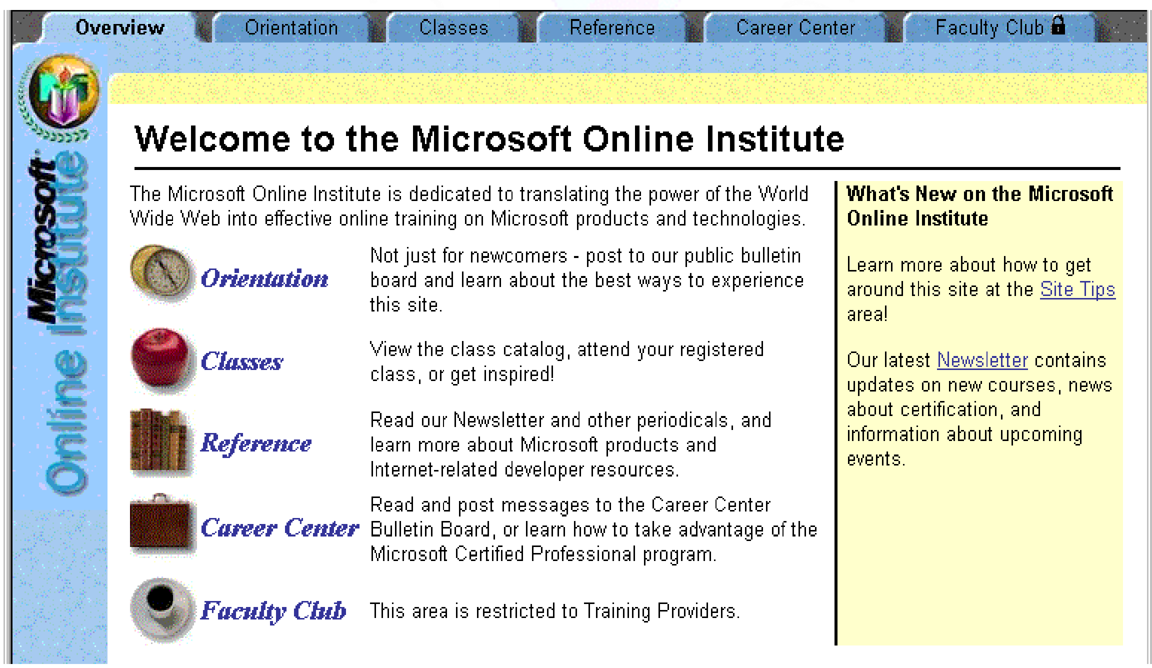


Figure 60: Microsoft Online Institute Home Page. This web page introduces the student to the range of offerings and benefits of studying in virtual mode through Microsoft.

certified over 100,000 people. The Microsoft *Certified Professional Program* was designed to provide computer professionals with validation of their ability to design, develop, implement and support solutions using Microsoft tools and technologies. Certification is achieved by passing one or more performance-based exams.

In summary, the Microsoft Online Institute supports education about Microsoft products via the web. Microsoft operates as a broker that links together other teaching organizations with students. Students who want to become Microsoft Certified Professionals need to pass an exam administered through Microsoft. Microsoft's method of operation has proven enormously successful.

6.3.3.2 An Authorized Trainer

Many different educational organizations offer classes through the Microsoft Online Institute—these are called Authorized Microsoft Online Training Providers. We give a snapshot here of one such organization, called *Atlas Online University*. Atlas Online University was established for the sole purpose of providing online training for Microsoft products (Atlas, 1997). Atlas course offerings include, for instance, "Windows NT Training" which one can take over a 16-week period online for $800 (MOLI, 1997b).

Atlas Online University operates in *virtual mode*. Two key administrators run the organization. Ethan Wilansky and Christine Caswell have jointly owned Atlas since it began in 1995 and are the only so-to-speak permanent staff. From his home in Maryland, Ethan operates as lead trainer and is responsible for interacting with the online Atlas Learning Advisors. Christine lives in North Carolina and manages marketing by interacting both with corporate clients that want training for a number of employees and directly with individual students.

Atlas draws on a network of Microsoft Certified Trainers for its course *instructors*. Regular business meetings are held online and an advisor mentoring program allows experienced online instructors to share information with newer ones. Ethan remains a central contact point for all instructors and students, and works with them to introduce new technologies into classrooms. Atlas instructors currently use private newsgroups to keep track of students' progress.

In summary, the Authorized Trainers are organizations with which Microsoft makes contracts for the delivery

Figure 61: Microsoft Online Institute Catalog. This entry from the catalog describes the details of one of the many courses offered via the Microsoft Online Institute.

of Microsoft-linked education. Atlas Online University is one example of an authorized online training provider. Atlas Online University operates entirely in virtual mode with teachers drawn from a pool of Microsoft Certified Trainers. Numerous other virtual educational organizations thrive based in large part on business as Microsoft authorized online educators.

6.3.3.3 Addressing the Skills Gap

One way that Microsoft tries to increase its market penetration is to license information technology implementers. One of these programs creates the *Microsoft Solution Provider* (MSP). To become an MSP Member a company must:

- Have at least two Microsoft Certified Professionals,
- Derive at least 15 percent of its revenues from technical services provided to third parties,
- Submit semi-annual sales and service reporting to Microsoft, and
- Pay an MSP membership fee.

Microsoft in turn provides MSP members with privileged access to Microsoft product information and helps connect them with new business opportunities.

Microsoft reports show that tens of thousands of positions are vacant in MSP due to lack of trained candidates. There are not enough qualified people in the world to fill the jobs which need filling. MSPs rank the *skills gap* as their biggest business challenge. In 1997 Microsoft announced a major initiative to deal with the gap between industry demand for skilled Microsoft information technologists and the supply.

Microsoft's existing worldwide training and certification programs trained more *than one million information technology professionals* in the first half of 1997 and certified an additional one hundred thousand. These educational programs are growing at a rate of almost 100 percent each year (Microsoft, 1997). Saturday training classes have proven to be the most successful way to engage a large segment of the computing industry by avoiding the "lost opportunity" cost of a day away from the office. Microsoft is broadening its Saturday program to handle about one hundred thousand people. Microsoft is also providing academic institutions with information technology training for teachers and professors, as another way to try to leverage existing resources towards providing the necessary skill base to further the use of Microsoft products.

In summary, Microsoft Solution Providers are licensed by Microsoft to help other companies tailor Microsoft products. These solution providers need to hire more staff but can not find skilled people – this is called the skills gap. Microsoft's training programs have involved over one million students, and Microsoft intends to increase this number substantially. The skill's gap that Microsoft is addressing will improve its own business fortunes. Other information technology companies also are suffering from the skill's gap and can take similar steps to those being taken by Microsoft.

6.3.3.4 High Schools and C++

To achieve its vision of a computer on every desk and in every home Microsoft goes into education in more ways than to certify software engineering professionals to develop or tailor software. Another example of virtual education from Microsoft is the Microsoft Visual *C++ Internet Distance Education Training Program* (see Figure 62 "Internet Distance Education"). To expand C++ instruction, Microsoft in partnership with Thomson Publishing and the Center for Electronic Education and Evaluation have created the Visual C++ Internet Distance Education Program (IDE).

The Internet provides an opportunity for students and teachers to learn about C++ and for many this opportunity would otherwise not exist (Thomson, 1997). Some students are taking C++ with IDE support at their local school. Others are taking C++ with help from IDE host schools that may be 1,000 miles away. Students can use the Internet to take tests, transfer code, receive assignments and information, and to communicate with other C++ Internet Distance Education participants. Current participants include Home Schools, Middle Schools, High Schools, Area Technical Centers, and Colleges. *Host schools* help new C++ schools get started correctly.

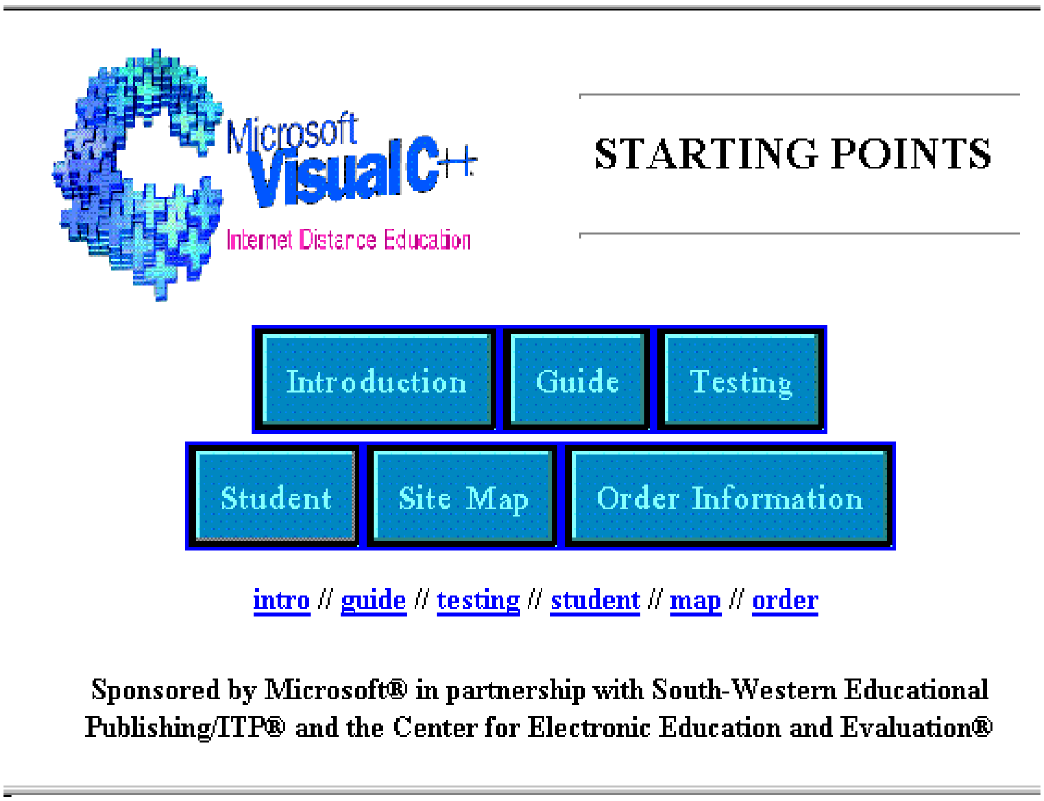


Figure 62: Internet Distance Education for C++. This web site introduces the C++ education that one can get online sponsored by Microsoft.

Schools are using the program and the training to transition from Pascal to C++ in preparation for the new Advanced Placement Computer Science exam. Graduating high school students in the USA may take the Advance Placement Computer Science exam to secure a good position for themselves in college. Teachers in high schools and middle schools were largely trained in Pascal themselves. Now that the *Computer Science Advanced Placement exam* for their students assumes that the students understand C++, there is pressure on teachers to become competent in C++. However, the opportunities for teachers to get such training are limited and IDE thus has a significant market niche to fill.

In summary, Microsoft is supporting the education of high school teachers and students through its C++ Internet Distance Education Program. Students and teachers can participate across arbitrary distances via the Internet. The Computer Science Advanced Placement Exam now uses C++ and high school teachers and students want to be prepared for that exam. By helping students in high schools learn how to use Microsoft products, Microsoft contributes to the growth of its own market share.

6.3.4 Market Research Companies

Market research is the gathering and evaluation of data regarding consumers' preferences for products and services. A market research company sells its data and analysis to its customers. The customer wants to know how to use that analysis to improve its market performance. Just delivering the analysis may not be enough and market research companies are interested in offering education to their customers about the market research.

The *Gartner Group* is an information technology market research firm and has opened an Internet education center to help teach its clients more about the significance of its market research (Garnter, 1997). However, not only information technology companies are in this position to teach about their product or service to their customers. We will look next at an opportunity foreseen by The Gallup Organization.

The *Gallup Organization* was described earlier. Gallup's long-term objectives are to maintain intimate educational relationships with customers of Gallup that allow both the customer and Gallup to develop new insights and results continually. The mid-term objective is to establish in several domains the premiere programs for Gallup customers that allow the customer to earn a certificate in a Gallup-related topic. The first domain will be health care. For the health care sector, Gallup performs patient satisfaction surveys.

One five-year objective in the health care sector might be to maintain a *College of Quality of Health Service* that demonstrated a successful relationship with major health clients. Predicted enrollments in this program include that the many department heads are enrolled annually in continuing education that allows them to obtain or retain their Certificate in Quality of Health Service.

Students will receive a highly tailored education that builds on the patient satisfaction surveys that Gallup does for its health care clients. They will be offered a package that includes some modules in fundamentals of quality of health service and ongoing exercises in developing action plans from the regularly delivered Gallup data. Students will learn how the surveys are done, how one identifies significant data that indicates areas in which improvement can occur, and how to develop action plans for improving patient satisfaction.

A *mix of technologies* and methods will be used to suit the needs of the diverse students. All course reading material and data will be available either through the Internet or on the health care companies intranet. Email and discussion facilities will be linked to the web. Real-time, as well as archived, video and audio will be available. As an option in the enrollment package, a health care divisions (a division is a set of hospitals in one geographic region) may elect to have Gallup experts visit the division headquarters to hold face-to-face seminars for all the students in the division. Hospital staff who have seniority in the Certificate life cycle will serve as mentors for junior members in the life cycle. These mentors will be responsible to give feedback to the junior staff on their assignments for the course.

The educational services for a hospital will be financed by the hospital. Individual hospitals will enroll students in the Certification program. The *College staff* would expect within 5 years to have grown to include a social facilitator, a technical facilitator, a web librarian, a digital graphics artist, a marketing expert, an accountant, a higher education administration expert, a nurse, a hospital administrator, a grant writer, and a deputy. Tuition fees would also support professional educators who delivered critical components of the education, as well as support all staff in the long run.

The benefits that might accrue to Gallup as a result of its educational activities could be measured in ways other than strictly financial. As one developed educational programs for Gallup customers, one would hope to develop insights into that company's needs and also to enlighten that company about future possibilities with Gallup. Nevertheless, the educational program can operate on a solely self-financing basis and could be a *profit center* for the company by itself.

In summary, market research companies sell an information product to customers that want education about what that product means. The Gallup Organization is one example of a market research company that wants to offer education about its market research to its clients. For instance, a Gallup College of Quality Health Services could certify health care managers as being knowledgeable about patient satisfaction. Students will learn both the theory and practice behind the market research which their company buys from Gallup. The educational operation can be a profit center directly but also provides various benefits for the marketing of other services of the company.

6.3.5 Exercises

True or False

1) Content analysis on the web reveals that pipeline companies are the most active in offering online education to customers.
2) Some specialist software companies, like Oracle, offer customer education about their software products.
3) Microsoft certifies students but pays no particular attention to the qualifications of trainers that are not directly employed by Microsoft.
4) The various educational activities that Microsoft helps support in the area of customer education about Microsoft products reach less than ten thousand students per year.
5) The number one barrier to continued growth of Microsoft Solution Providers is the shortage of computer circuits.
6) By reaching into high schools and offering education across the internet, Microsoft hopes to improve its long-term market share.
7) Market research companies are another example of companies whose product is information-based and whose customers want education about the product.

Knowledge essays:

1) Why do companies want to educate their customers?
2) What industries are most involved in virtual education to customers?
3) What are some of the activities of Microsoft in the educational arena for customers?

Doing essays:

1) Select a company outside the data services, airline, and pipeline category and discover whether that company offers virtual mode education for its customers through its web site.

2) If you were to develop a virtual education program for customers would you use the certified professional and certified trainer approach or not and why?

6.4 Conclusion

To be successful a corporation must have revenue. To have revenue it must have satisfied customers, and to have satisfied customers it should have satisfied employees. *Employees* need to be trained in the ways of the company and then to get new education as and when their competencies are inadequate to the challenges of their job.

Large, *global companies* have enormous educational training programs which are naturally supported for some cases across computer networks. These companies may have cost factors which clearly demonstrate the value of virtual education, as was the case for Office Depot. Or the company may have more abstract goals of raising the educational level of its staff, as in the case of The Boeing Company, and want state-supported universities to contribute to the workplace education.

In order to better prepare their customers and thus have more *loyal customers*, some companies engage in education about the company products or services. Numerous information technology companies have educational programs that target this external audience. However, the company's primary mission is to provide the product or service rather than the education about it. Thus these educators have an external audience, and for the company this activity is secondary. Novell, Motorola, CISCO, and others have educational programs that their staff teach about their products. In each case, the student is particularly attracted to the education blessed by the company because the student is better able to advance in her career with such education. Oracle has an internet based educational offering. This is part of Oracle's larger educational program that includes a Master's education that focuses on database management systems from Oracle.

A company that wants people to be educated about its offerings does not need to necessarily do the education directly itself but can control the education. Microsoft offers certification in various skills and knowledge sets that are germane to Microsoft products. One can gain enough of this training online so as to earn certification. Microsoft does not provide teachers itself but focuses on licensing other educational organizations to provide the teachers and the classrooms. Microsoft *monitors the quality* and earns some of the revenue.

We have looked at virtual education markets in which the student is captive. An organization has *captive students* when they either employ the students or they offer education about a product that they make. We have examined selected case studies about the technology, course offerings, tools, and market size of such virtual educational organizations.

From an enterprise perspective we should address other questions, such as:

- Is the technological infrastructure sophisticated and able to evolve quickly.
- Is the education profitable. What do students pay and what are costs?
- What are predicted figures for market size in number of people?
- Who are the competitors now and in the future?

Where we to look at the answers to these questions we might learn new things about the *marketplace* of virtual education.

Some of the marketing and technological information about corporate virtual education is readily available. However, the information about profit is not. Microsoft Certification costs students thousands of dollars in tuition fees for relatively little face-to-face instruction. What *profits* do Microsoft and its certified teachers make for this?

On the financial side, another distinction that might be made is that between organizations who are supported by the state and those who are not. Typically, a state university offers *subsidized education* to a bounded geographic region—namely, the state. This would contrast with a non-subsidized organization, such as a private university, which charges the same tuition to students wherever they might live. We will look in the next chapter at the efforts being made by state universities to reach students in the workplace.

In summary, good companies support the continuing education of their employees. One can readily imagine a situation in which large, global companies will have more students than a typical university. While competent employees are vital to success, so are satisfied customers, and virtual education has a special niche to fill as regards education of customers. State-funded educational organizations are not well prepared to compete with a global company that offers education specifically related to the company products. The developing marketplace is fast changing, and companies must look for opportunities to both differentiate themselves from their competitors and to insure long-term success – virtual education is one such attractive opportunity.

6.4.1 Exercises

True or False exercises

1) Competent employees are not a key ingredient in the success of a company.
2) Information technology companies are particularly active in offering virtual education to customers.
3) Microsoft's drive to have a computer on every person's desk is not perceived by Microsoft to be related to education.

Knowledge exercises:

1) Why might airline companies be more active in web-based educational activity for employees than data services companies but less active in customer education?
2) What are some of the differences in contemporary approaches between employee virtual education and customer virtual education.

Doing Exercises:

1) Describe a strategy for virtual education/training for employees in some corporation of your choice such that the information superhighway is used as much as possible.
2) Design a virtual education program for customers of your own consulting company.
3) In designing virtual education for a company, might your design usefully serve the employees of the company and the customers of the company simultaneously? What would be the pros and cons to a joint strategy for employees and customers.

Figure 63: Flags. This photo of flags from countries around the world is related to the government theme of this section.

7. State School Marketing

Learning Objectives

- To understand the role of state schools in virtual education.
- To appreciate the market significance of compulsory, public education as regards mass publications and wide information access.
- To know the major successes of some state universities in providing education at a distance.
- To imagine the plans that state universities might make to become more virtual.
- To know the patterns of activity on the web of state universities.

7.1 Introduction

State schools are funded by tax payer money to provide education that the state deems important. What are the special opportunities for developing markets as seen by state schools. We will look briefly at K-12 education but then focus on state universities.

Virtual education can be studied in terms of its objectives of increasing student access, improving the quality of learning, and constraining per student costs. Different parts of the public school system can take these objectives to heart in different ways. The K-12 school system is certainly vital to the future of society, but its *student access* opportunities are peculiar, as we will explain shortly.

7.2 K-12

Children are enrolled in school in massive numbers. They constitute an enormous market for virtual education. Furthermore, the teachers of children are themselves are sizeable audience. To what extent might virtual education reach children at home and offer continuing education to their teachers?

7.2.1 Home Schooling

Based on inflation adjusted dollars, America's total *expenditure per student* for one year of public elementary and secondary school went from less than one thousand dollars in 1930 to over six thousand dollars now. Public expenditure per student in colleges and universities is significantly less than that in elementary and secondary public education. Full-time public school staff rose from 5 per 100 students in 1950 to more than double that now. Yet, educational results for American children have not improved. Other developed countries typically produce results in education that are superior to those of the United States at less cost. Japan and Germany spend only one-third per pupil what America spends but educate higher scoring students. Perhaps the problem is the extent to which schooling is encouraged in the homes of the different countries. Might more happen in the home to improve education and might technology play a role (PHS, 1995)?

In the United States the kindergarten through 12th grade school system is *free, compulsory, and public* (Ellis, 1997). Free means that the taxes paid by the people of the state fund the school and no individual student pays a specific tuition. Compulsory education simply refers to a system which requires attendance. According to various American state laws, education is mandatory for all individuals between five and eighteen years of age. The term public connotes schools that are accessible to all citizens.

Based on the straightforward description of free, compulsory, and public, we can analyze some of the opportunities for virtual education in a logical way. Do the state K-12 schools want to increase *access*? How can they when attendance is already compulsory for all students and physical schools exist to provide this access. However, access can be measured in ways other than the number of students enrolled but also in the amount of time that each student spends in educational activities. Students can work from home.

While we have said that public schooling is compulsory, the interpretation of schooling is broad and most states allow students to be educated at home. Each state in the United States has its own rules for education. The Idaho law says: "The parent or guardian of any child resident in this state who has attained the age of seven years at the time of the commencement of school in his district, but not the age of sixteen years, shall cause the child to be instructed in subjects commonly and usually taught in the public schools of the state of Idaho....Unless the child is otherwise comparably instructed the parent or guardian shall cause the child to attend a public, private or parochial school..." *Otherwise comparably instructed* includes home-schooling. (Foorey, 1997). In Texas, parents who choose to educate their children at home are simply required to provide a letter to the school district stating that their children are regularly involved in appropriate home schooling and the students are then exempt from the other regulations that would require attendance at schools.

About one million U.S. children in grades kindergarten through 12th grade are being home-schooled. However, this represents only about two percent of the children in school. One reason that more children are not in home schooling is that the state provides schooling for free in state schools. If parents elect to teach their own children and not send them to school, the parents still pay taxes. Interestingly, in Alaska home schooling is particularly popular. There the state is now in certain cases *paying the parents* to home teach and providing other benefits to encourage home schooling (Stanton, 1997).

In addition to providing funds to parents for doing home schooling, states can encourage schools to support home schooling. Some school districts have begun distance learning programs focused on home schoolers. With the Internet, fax, and telephone, and the parent providing most of the work, various systems can be implemented. The school receives some money for each home schooled student that the school helps parents educate. One such program is the Interior Distance Education of Alaska program. This program provides the parents and children a computer and modem and free curriculum material of the parent's choice (Diest, 1997). This combination of *home schooling and state schools* takes some advantage of the expertise at each end and could be a model for relationships in which students still go to school but get further education at home.

7.2.2 CDs and the Internet

Tens of millions of American kindergarten through 12th grade students have access to computers at home. The compulsory character of K-12 education means that the market is necessarily massive for educational products to satisfy this audience. If a publisher has a market of a few hundred students, then the publisher is unlikely to

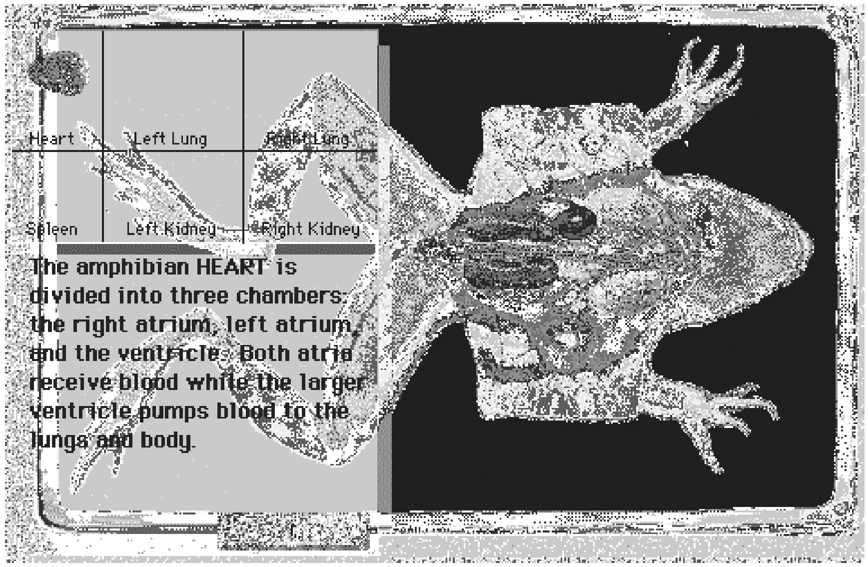


Figure 64: "Frog CD". This screen image from the contents of a CD entitled *BioLab Frog* (Pierian, 1997) presents realistic, color images of a frog. Here the student has been asked to identify the heart and to move it to the appropriately labeled box in the upper left corner.

invest a million dollars in a courseware publication. However, if the market is *millions of students*, then a CD-ROM that costs a million dollars to produce could prove profitable.

Microsoft has mass market objectives and produces CD-ROMs that teach children basic skills. One series of CDs is called the *Magic School Bus* series. Individual CDs address the human body, the solar system, or other such topics. Each CD includes numerous educational games that teach the child basic skills.

Several companies produce CDs for children that target different age groups and different topics. One popular series goes under the rubric of "Jump Start" and includes CDs for toddlers, kindergartners, 1st graders, 2nd graders, 3rd graders, and 4th graders. Each CD is easy to use and full of thematically connected educational games. These games both hold the child's interest and focus on educational lessons that are appropriate to the indicated age or competency group. Another company targets older students and classifies each CD by topic. For instance, the biology CD includes a simulation of a *frog dissection* (see Figure 64 "Frog CD"). These CD products can increase access to education and quality of education, while reducing per student costs under certain conditions.

Videotapes can be an important adjunct to learning. While many purely educational videos are available, still the most commonly used source of videotapes in American public schools are Disney videos. Disney Corporation is increasing its attention to educational products that can be used in the school or at home. The Vice-President for Walt Disney's new Educational Publishing Division believes traditional education has failed to adapt to change. *Disney's Educational Publishing* has devised three basic rules that underpin its multimedia output. Rule One is to emotionally engage the learner. Rule Two is to connect children with their world. Rule Three is to challenge children. These products are intended to be used at home or the school and to complement the normal face-to-face schooling that a child receives. The Disney Vice-President does not feel that the new technology poses a threat to the traditional school and says (Napack, 1995): "Kids need to interact with each other. They need to have teachers and mentors around, so that they can help them when they run into problems. …. Having said that, we are seeing before our eyes the network being built that will allow kids to tap into vast quantities of information at home. … So, some of their play-time will be on the network. And some of the games that they're playing at home will be learning games."

Innumerable K-12 schools now host a web site that describes the school — the place, the teachers, the students, and special features of the school. Experiments are being done in which students from one school interact with students in another school across the Internet. Whether such efforts will lead to wide-spread, practical implementations of *Internet-supported interactions* among students in schools for structured educational purposes is being carefully studied.

One of the popular trends in American education is *outcomes-based education*. This concept was spawned by classical curricula and operationalized through vocational education. Outcomes-based education can lead to the development of national standards, subject by subject, and national testing measures, subject by subject, which would then be used to gauge general scholastic effectiveness and individual levels of learning. Virtual education with its transcending of boundaries could support national curricula standardized to certain outcomes.

7.2.3 Continuing Teacher Education

We have talked about the market for home schooling of children in the K-12 grades. Another audience is the *teachers* themselves. Many states have rules that require teachers of K-12 students to be engaged in continuing education. These teachers are a market for virtual education. As there are millions of K-12 teachers, even one percent of them taking online courses would amount to an audience of tens of thousands of people.

Each state has rules for continuing education for teachers. One typical example of continuing education requirements comes from the state of Ohio. Renewal of a *Ohio Professional Teacher Certificate* requires completion of 12 semester hours of coursework or 36 Ohio Department of Education approved Continuing Education Units (Kent, 1997).

Increasingly organizations are offering continuing education in virtual mode to this audience of K-12 teachers who need to renew certification. The *National Teacher Training Institute* was initiated by Public Broadcasting Corporation to help teachers take advantage of video in educational ways in the classroom (NTTI, 1997). This Institute offers teachers a six-hour distance learning telecourse, an on-line forum including a lesson database and discussion center; a series of training tapes that examine how to integrate video and other technologies strategically into the classroom, and a CD that includes an interactive tutorial.

Heritage OnLine is a on-line teacher continuing education program of The Heritage Institute. The Heritage Institute is affiliated with Antioch University, and all Heritage OnLine courses are available for Antioch University credit. Antioch University credits are acceptable in many states toward educator re-certification and within school districts for salary advancement. Tuition is less than tuition would be for courses at most schools (Heritage, 1997).

The Heritage Online program has twenty *courses about teaching* in a variety of subjects such as art, assessment, classroom management, education, foreign language, literature, math, science, social studies, writing and technology. Teachers explore information resources on the Internet and communicate via email lists. Courses may be started at any time, are self-paced and are taught by expert instructors from various institutions.

One example is presented to help the reader better understand the kind of course offered by Heritage Online. One, typical course is about *writing with the Internet*. K-12 teachers with Internet and World Wide Web access learn to use Internet resources to motivate student writing. Teachers (who are in this context actually students) work collaboratively with other teachers using specific Internet resources to develop lesson plans that enhance student writing. A course listserv links teachers in discussions and cross-classroom projects. The instructor is the Instructional Technology Director for the Cooperative Educational Services Agency in Wisconsin. The instructor has no other connection with Heritage Online than to teach this one virtual course.

7.2.4 Exercises

True or False

1) United States kindergarten through 12th grade education is free, compulsory, and public.
2) Home schooling requires parents to become certified as teachers in the same way that public school teachers need to be certified.
3) Educational multimedia CD-ROMs are not appropriate for the K-12 market.
4) Disney Corporation and Microsoft are two examples of companies that produce multimedia for K-12 education.
5) Continuing teacher education is only available on the Internet on the subject of history.

Know Essays

1) Free, compulsory, public education must market to its constituents in a different way than a corporation would market education that it offered to its customers. What are some of the salient differences in the attributes of the market for these two different kinds of organizations?

Do Essays

1) Describe a strategy for reaching first graders with educational products that argues that CD-ROMs are

more appropriate than the web for this audience and its learning needs.

7.3 Universities

Earlier in the book we emphasized the special opportunities that exist for companies that have work forces to educate or more interestingly have customers who need to know about their product. Such education related to companies has not traditionally been the remit of the state but a fine line sometimes exists between education that is appropriate for the state to offer in support of its companies and education that would be a favored treatment of one company in the state against another company in the state. Some schools have permanent faculty based in some central campus but the students do not attend that campus. A pre-eminent example of such a university is the British Open University. However, many universities are moving in the direction of using the internet to improve their market position and we will discuss how some of these are proceeding too.

The learning objectives for this section are:

- To appreciate the impressive features of the Open University in terms of its history and its size.
- To understand the Open University's method of using broadcast video and its move toward the Internet as part of its market strategy.
- To realize that other universities have smaller scale but comparable successes to those of the Open University and are also extending their markets.

State-supported universities are a major force in higher education and can be expected to play a major role in virtual higher education.

7.3.1 Open University

Harold Wilson, the former Prime Minister of the *United Kingdom*, launched the idea of a 'University of the Air' in 1963. Originally he saw this as a consortium of existing universities using broadcasting and correspondence to bring their teaching to adult students in their own homes (Open, 1997a). His Minister for the Arts, Jennie Lee, took responsibility to implement it. Jennie Lee made it clear that she wanted an autonomous, independent university equal to any other. She overcame the scepticism and even hostility of the educational establishment by 'outsnobbing the snobs', as she put it herself. She brought together a Planning Committee of top higher education leaders and won the support of the legislative branch of government. The Open University became a reality.

The Open University is *Britain's largest educational and training organization*. It leads the world in the large-scale application of technology to learning (Open, 1997b). There are two essential characteristics which make the Open University different from most other universities:

Geography	1994	1995
United Kingdom (UK)	130	133
European Union (non-UK)	5	6
Non-European Union	8	11

Figure 65: Student enrollment at Open University by geographic region in 1,000s of students.

- It is open to any adult living in the European Union, irrespective of previous educational qualifications.
- Teaching materials are delivered to the students in their own homes or places of work—by post, by computer, and via national television broadcasts. Local support is provided by tutors.

The Open University awards BA and BSc degrees, Masters, an MBA, a PhD, and numerous certificates.

Most students are aged between 25 and 45, and the median age for graduation is in the mid-thirties. About three-quarters of students remain in full-time employment throughout their studies.

The Open University also operates in *countries* around the world. Countries outside the European Union where there are students following British Open University courses include Russia, Bulgaria, Romania, Hungary, the Czech Republic, Slovakia, Singapore and Hong Kong (Open, 1997c). When one looks at the student distribution one sees that the growth area is in non United Kingdom students (see Figure 65 "Student Enrollment by Geographic Region").

Degrees have been awarded to over *180,000 students* (see Figure 66 "Degree Types"). The distribution of students by academic subject category shows a very wide and even distribution.

Total cost of study to British students to include tuition fees, residential school fees, travel, postage, books and materials, over the appropriate number of courses and years of study to receive a degree is about $6,000. In a typical American state university, *tuition fees* for a degree alone might be expected to be about $20,000.

Staff numbers for 1996 totalled about 12,000. Fewer than 1,000 staff are actually academics per se. About 8,000 are tutorial staff or teaching assistants. The university has an annual revenue of about $300 million

Qualification	1994	1971-1994
Bachelors	15	172
Masters & PhD	2	8
Certificates	7	19

Figure 66: Degree Types granted in 1000s by Open University**.**

dollars. About 60% of this is from the government and most of the rest from tuition fees. The expenditures include 30% to academic costs, 25% to support for tutoring, and 20% for courseware production. This emphasis on *production costs* would not be seen in typical universities where teachers use existing textbooks. The Open University has such a large enrollment that it can afford to invest heavily in tailored products to serve its students' needs.

Studying a conventional Open University course involves *supported distance learning*. This means that the student is at home in his own time using custom designed paper-based study materials and where appropriate home experiment kits, television broadcasts or video tapes, audio tapes, and other media and equipment appropriate to a particular course. It also means that the student has an individual tutor assigned for the duration of the course. This tutor will provide advice over the telephone, via letters, and at live tutorials at a local study center. In addition, the tutor makes detailed comments on each 'Tutor Marked Assignments' which along with the final examination grade form the student's grade on the course.

7.3.2 Other Universities

The United States does not have *a national distance education university* in the way that the United Kingdom does. Some other countries, such as South Africa, have the equivalent of one enormous open university. In the United States each state provides its own scaled down equivalent of open university operations through its various higher education institutions. The American schools are not in a position to invest as heavily in a given course as the British Open University is because the size of the American state audiences are typically smaller. We will describe in one paragraph a California State Universities initiative and then go into some details about Washington State Universities approach to virtual education.

The state of California has decided to create a virtual university. As one step in that direction in the summer of 1997 the *California State Universities* announced the "Digital Summer School" (Gonick, 1997). The Digital Summer School Session targeted an international audience. Twelve campuses of the system together placed fifty courses into distance mode. Students registered online and earned normal academic credit. Many of the courses were offered entirely over the Internet. The range of courses offered was wide and included such technology based courses as "Multimedia Applications on the Web" and other more traditional courses such "Introduction to Philosophy" and "General Psychology".

Washington State University (WSU) has offices in all counties of the state of Washington and several campuses. The university offers distance education via broadcast video but primarily provides face-to-face lectures. The University has developed a blue print for a virtual component. The term "virtual" at WSU implies the integration of technology into the learning culture. Of special relevance to Virtual WSU is the prediction that the *number of students* needing to be served in higher education in the state within the next decade will double. The potential learner base includes working professionals, as well as a wide spectrum of other place-bound populations. New methods and tools are sought to help deal with this growth of student numbers.

Virtual WSU should

- enhance active learning and retention of knowledge acquired, by delivering course material in self-paced, interactive multimedia modules and
- leverage the new technologies and methods of instruction to deliver courses and programs to populations who have found it difficult or impossible to obtain access to WSU's educational programs and services through traditional means.

Achieving these two goals of *quality and access* should benefit all students.

To reach the access goal, Virtual WSU will expand and enhance educational opportunities throughout the state using modern telecommunications and computer technology. To this end three marketing strategies are advanced:

- Virtual WSU will form alliances with other higher education institutions to reach all potential student audiences with courses, programs, and degree offerings covering a wide spectrum of needs. A clear policy will be developed for acceptance of courses from other universities offered through distance learning. This policy should address maximum transfer credits thus allowed.
- Virtual WSU will make provision for the enrollment of all qualified learners who are willing to pay the full per-credit price and take a course.

Practices consistent with WSU policies may be established to include in the curriculum pre-defined blocks of courses leading to certification or other specialized diplomas not equivalent to an official degree.

- Virtual WSU will strive to ensure that each person enrolled in a WSU class has opportunities for direct interaction with fellow learners, faculty, and others associated with the content area of the class or program. Interactions may be face to face for learners physically resident at a WSU facility. For others, communication will be accessible through the information superhighway. Policies and procedures will be developed for enlisting, credentialing, and reimbursing community-based preceptors, mentors, and adjunct faculty with whom enrollees can interact.

These three strategies support *expanded access* for Virtual WSU.

7.3.3 Distance Education Survey

A survey on distance education courses offered by American higher education institutions was initiated by the U.S. Department of Education in 1995 and the results were reported in 1997 (National, 1997). The *survey* was designed to provide the first nationally representative data about distance education course offerings in higher education institutions. For this study, distance education was defined as education or training courses delivered to remote (off-campus) locations via audio, video, or computer technologies

A third of higher education institutions offered distance education courses, another quarter planned to offer such courses in the next 3 years, and about 40 percent did not offer and did not plan to offer distance education courses in the next 3 years. *Public institutions* offered distance education courses much more frequently than did private institutions. About 60 percent of public institutions offered distance education courses compared with less than 10 percent of private institutions.

In one academic year, US higher education institutions offered an estimated 26,000 *distance education courses* with different catalog numbers. Three-quarters of the institutions that offered distance education courses used courses developed by the institution's subject area departments or schools, and about a quarter used courses developed by commercial or noncommercial vendors.

Distance education courses were delivered by *two-way interactive video* at 60 percent and by one-way prerecorded video at 50 percent of the institutions. About a quarter of the institutions used computer-based technologies, principally the Internet, to deliver their distance education courses. Institutions frequently directed courses to students' homes (50 percent), other branches of their institution (40 percent), and other college campuses (35 percent). About a quarter of the institutions directed distance education courses to K-12 schools, and 20 percent directed courses to work sites.

More higher education institutions offered distance education courses designed primarily for *undergraduate students* (80 percent of institutions) and graduate students (30 percent of institutions) than for any other type of student. Ten percent of institutions offered distance education courses designed primarily for professional continuing education students. Forty percent of institutions that offered distance education courses targeted professionals seeking recertification, and 50 percent targeted other workers seeking skill updating or retraining.

800,000 students were formally enrolled in distance education courses in the United States in 1995. About a quarter of the institutions that offered distance education courses offered degrees that students could complete by taking distance education courses exclusively. There were an estimated 690 degrees and 170 certificates offered that students could receive by taking distance education courses exclusively. 3,500 students received degrees by taking distance education courses exclusively.

Among institutions currently doing distance education, most plan to increase their level of activity in this area. While costs of technological infrastructure and program development were often cited as slowing progress, *no major hindrances* to progress were foreseen. In the next subsection a survey specifically for distance education activity on the web is described?

7.3.4 University Web Trends

What attributes characterize a university that has a dominant educational position on the web? A university’s formal technology policies, provision of hardware and software, faculty development opportunities, and technical and administrative support have been claimed by others to influence a university’s level of educational technology activity (Snyder, 1995). To look more deeply into *patterns of web activity* across universities and to explore more systematically the factors affecting such patterns, the content of the web itself has been analyzed.

Analysts were told to begin at a university home page and to work from there to find courses. Each course was then scored for educational content. The score was itself based on the online presence or absence of five attributes: syllabi, course material, hypermedia links, interaction, and submissions: The university's web educational value was a sum of these scores and is referred to as the Reliable Academically-Directed Activity (RADA) value. Each analyst was also given a copy of the Classification of Instructional Program (CIP) codes (Morgan, et al, 1990) of the USA Department of Education. For each visited file with educational content, the analyst recorded its CIP code,

One would expect to find a correlation between the absolute size of a university and the absolute number of courses it taught with support of the web. To test this hypothesis, data from the *Integrated Postsecondary Education Data System* (NCES, 1992) was obtained. This rich data depository, sometimes called IPEDS, gives many attribute values for each university. The following attributes from IPEDS are some of the many that reflect the size of an institution:

- total enrollment,
- instructional support dollars, and
- academic support dollars.

When the total enrollment data from IPEDS was regressed with the RADA data, no significant relationship was established. Similarly, the data on instructional support dollars and academic support dollars did not correlate with the RADA data.

States are experiencing different growth rates. The USA is experiencing a *baby-boom* "echo" effect over the next 10-15 years such that the enrollment in higher education institutions is expected to grow substantially. In some states, this expected growth is much greater than in others. The expected percentage growth in number of high school graduates per state was entered into the database and compared with the RADA data. No significant correlation was found.

One might expect that *geographically-isolated universities* would focus more on the web. For each home campus of a university in the RADA study, the miles as the crow flies between the home campus and the closest metropolitan area in the state of that university were measured. A regression between these distances and the RADA score did not reveal a positive relationship.

One might expect that a *multi-campus university* would find more benefit from web courses than a single-campus university. A course that was otherwise only taught on one campus might be taught across all campuses when the web is used. But no significant relationship was found between the number of campuses and web activity.

Not having found any predictable pattern among universities as regards their web educational activity, the next place to look was within a university by program. Courses were organized by their CIP codes. Would the programs that contribute most to the university's RADA scores be ones whose code corresponded to a technologically-sophisticated program? Across the 50 universities, the top 6 programs were by RADA score, in descending order:

1) Computer and Information Engineering
2) Engineering
3) Life Sciences
4) Physical Sciences
5) Business Management
6) Agricultural Sciences.

These 6 programs accounted for 60% of the RADA contributions. The top 6 programs include the most *technologically sophisticated programs* of a university.

The only predictable pattern in the data is related to disciplines. Technologically-sophisticated programs, such as computer science and engineering, dominated the high scoring RADA values. One might have guessed that those programs which most use computers would be the most likely to exploit the web in delivering education. This is consistent with the theory that successful innovation must *fit into the workflow*. Those in the technologically-sophisticated disciplines are more likely to be comfortable with the use of the web in education.

Why has it been impossible to find attributes of a university that would predict web educational activity? Other studies of university activity, such as Bowen's (1980) analysis of educational spending activities, have noted the difficulty of predicting patterns across universities. Bowen wanted to predict a university's per student costs based on attributes of the university. He looked at numerous attributes, such as size of the university, the distribution of its expenditures, and its educational outcomes. He analyzed massive amounts of data that had been collected by the federal government over many years. His conclusion was *that no predictable patterns* exist. The results of the web study are complementary to the results of Bowen.

7.3.5 Online Degrees

Most web activity in state-supported public universities occurs in the high technology disciplines, as would be predicted by work flow considerations. Teachers and students of information technology-related subjects are more likely to be comfortable using information technology. Dozens of Masters Degrees in information technology-related disciplines are now available on the internet, primarily from private universities. We look next at *online degrees* from two state universities as illustrative of the kind of market presence that one can find. The universities are the Open University and Southwest Missouri State University.

Studying an *Open University course via the Internet* means that in addition to the support provided for traditional Open University courses, the student can also communicate with his tutor and fellow classmates via e-mail and electronic conferencing, submit assignments via e-mail, and participate in electronic tutorials from home. The notion of a course in the Open University is a comprehensive one that corresponds more to a degree in the American vocabulary. Courses available via the Internet include:

- Fundamentals of Computing
- Computing for Commerce
- Human-Computer Interaction

All students (whether studying conventionally, or via the Internet) must attend the final examination in person at one of the approved examination centers in Europe or arrange an examination at a local university or British consulate.

Courses currently presented via the Internet normally have the paper-based materials, any audio/video tapes and home experiment kits sent via conventional surface mail before the course begins, although some course material may also be available in electronic form. The minimum requirement to participate in a course is that the student must be able to send and receive Internet *email messages* and be able to attach files to these messages using an approved standard encoding method. The student may write his assignments using any major word processor. The marked assignment is returned to the student as a Microsoft Word file attached to an email message.

Figure 67: Glass Hall. Headquarters of virtual degree program in building donated by WalMart chairman.

The Open University offers a *Master's Degree in Distance Education* using electronic media and print. Students

- receive prepared study materials.
- keep an electronic workbook and submit assignments on-line,
- have a tutor who tutors the student personally on-line,
- join electronic conferences with students and other tutors, and
- attend examinations.

A part-time degree, normally completed in three years, it includes taught courses plus a Master's level dissertation or project report. It offers a grounding in the theory and practice of open and distance education, with a strong emphasis on information technology applications.

Southwest Missouri State University

Southwest Missouri State University offers a virtual mode Master's Degree in Computer Information System. The advertisement says (Southwest, 1997):

> The Master of Science in Computer Information Systems program at Southwest Missouri State University is clearly an idea whose time has come. It meets the needs of the non-traditional student by combining minimal on campus instruction time with extensive distance learning via the Internet. This program is designed to work with the schedules and careers of today's busy professionals.

The Computer Information Systems department is located in Glass Hall, named for alumnus David Glass, chairman of *Wal-Mart Stores* (see Figure 67 "Glass Hall"). The world headquarters of WalMart are near Southwest Missouri State University and the relationship between the philosophy of WalMart and distance education is striking.

The degree is available largely online but does involve four week-long meetings. One such meeting occurs every six months during the two-year program. Following the *one-week meeting*, learning continues off campus in virtual mode and communication is largely via email. Accrediting bodies tend to require fairly traditional, face-to-face education. The week-long face-to-face meetings help satisfy accrediting requirements.

Before acceptance into the program, students are required to supply *letters of support* from their employer that assures the school that the employer expects the student to commit substantial time to the two-year degree program. While this approach might be seen to discourage some students from applying, the marketing experience also suggests that such requirements attract students and employers who are committed to the program, and thus build the quality reputation of the program.

7.3.6 Exercises

True or False

1) The Open University of the United Kingdom was started in the early 1960s through a successful political maneuver that brought traditional university leaders into the plan.
2) The Open University has granted fewer than 100,000 degrees.
3) The greatest single expenditure of the Open University is towards content production.
4) American universities have a smaller distance audience than the Open University and thus have more difficulty investing in courseware production.
5) The California State Universities are targeting only state residents for their part of the California virtual university.
6) Washington State University is anticipating a doubling of students over the next decade and is seeking new ways to address this market.
7) The Reliable Academically-Related Activity value reflects the extent to which an organization uses the web in teaching.
8) No correlation could be found among attributes of a university and the extent to which it offered courses on the web.
9) Non-technical disciplines, such as the humanities, tend to use the web in education more than other disciplines.
10) The Open University is increasing its offerings on the Internet and the first such offerings are naturally enough on topics were students are likely to have ready Internet access, such as computer courses.
11) The method of the Internet courses from universities is largely virtual reality simulations.

Know Essays

1) Based on the story of Jennie Lee's getting legislative support for the Open University, how would you go about trying to get legislative support for a virtual higher education institution?
2) Why might a web content analysis of state universities not show predictable patterns of web-based course offerings?
3) WalMart founder Sam Walton wanted to reach people in their local communities with a wide-range of appropriate products at a low price. How does this relate to what the Southwest Missouri State University Computer Information Systems is offering in its virtual education program?

Do Essays

1) Argue why a university should or should not ally itself either with other universities or with companies in order to gain market niche in virtual education.

7.4 Conclusion

Kindergarten through 12th grade schooling in the USA is free, compulsory, and public. Access can not be increased in terms of raw number of students in school. Access can be increased in terms of number of hours spent learning, if students study more in virtual mode from home. The compulsory character of this public education assures a market of millions of students which in turn attracts large investments in interactive, intelligent, multimedia CD-ROM courseware. Many schools are connecting to the Internet. Internet-supported education could support a greater flexibility in curriculum and could be a vehicle of standardization.

The number of teachers in the K-12 system is also large – approximately one teacher for every ten students. These teachers are typically required to continue their education to retain certification. Increasingly efforts are being made by various organizations to offer *continuing education* in virtual mode to teachers.

State schools have a long tradition and an enormous capital investment. When they enter into the virtual education market, non-state supported players will be at a relative disadvantage. What can we learn by studying the current activities?

The British Open University was founded by a Labor government that believed in the importance of reaching to everyone in the country with an education opportunity whether or not they were constrained to a workplace or home. The University plans systematically to reach large numbers of students and has been successful in doing that for decades. Unlike most universities that are ill-prepared to invest substantially in producing a course, the Open University is prepared to invest a *million dollars* in making one course because it knows the payoff will exceed the cost after it teaches enough students.

The Open University has developed a large stable of course material designed for distance education and a large international network (though largely United Kingdom-based) of tutors. Furthermore, it has the advantage of English being one of the most popular languages world-wide for higher education. It would seem that the Open University is well positioned to continue to extend its *global reach* and to constitute an growing export value to its home country.

The Education Network of Maine operates on a much smaller scale to the Open University but is indicative of a number of similar efforts in the United States that tend to be based on a particular state and to use interactive television. Washington State University is another university somewhat similar to the University of Maine in its situation and goals. We have presented some plans at Washington State University to facilitate movement in the direction of distance education. These moves include offering faculty adequate support and credit for the work required to provide distance education.

A content analysis of the World Wide Web was not able to reveal a pattern across land-grant American universities as to which does more in offering education on the web. One of the possible explanations for this returns to the revenue theory of cost—namely, state schools spend whatever money they get, but the relationship between the quality of their work and the revenue is not obvious. The pattern which was strong, however, was by discipline across universities. The *high technology disciplines* manifested the most educational activity on the web. This is not surprising given the principle that technology applications only succeed when they fit smoothly into the workflow of those who are expected to use them.

A survey of distance education around the United States has shown that many universities offer distance education via video. Public schools are more active in this regard than are private schools, generally speaking. However, plans in the educating people in the workplace, we would be remiss to not note that technology-oriented *private universities* have been the aggressive in the pursuit of distance education to the workplace. Some of the most active organizations in distance education to the workplace are New Jersey Institute of Technology, New York Institute of Technology, Drexel University, and Rensellear Polytechnic Institute. All of these institutions are private, have a strong technical bias, and have close relationships with industry.

The most famous private technical universities attract students to the residential campus but are considering expansion in virtual mode. An MIT Committee said (Abelson et al, 1995):

> Of all the possible futures for MIT, the most disturbing is the one in which others find out how to offer distance education using advanced technologies, and MIT either does not learn how, or elects not to offer it. The economic strength of MIT could be seriously undercut by competition as a result.

The MIT Committee noted that in a few years most higher education institutions would be expected to have large fractions of the student and faculty population heavily engaged in cyberspace. The challenge is how to differentiate oneself in this new marketplace.

Companies pay taxes that in turn support the state school system. When a company needs education that is not company specific but is the kind that state schools teach, then the company has a right to expect—in this modern information superhighway age—that the state schools will make an effort to bring that education to the company. One can find scattered evidence around the world of companies exerting influence on their governments to encourage the state schools to address the *workplace educational needs* of companies.

7.4.1 Exercises

True or False

1) Home schooling occurs when state-employed teachers go to the home and teach.
2) Quality but not access is the target of the virtual university.

Know Essay

1) Compare and contrast the current market for K-12 students and for higher education students.

Do Essay

1) What is a discipline that might serve simultaneously the K-12 and the higher education audiences and one that would necessarily serve only more narrow audiences.

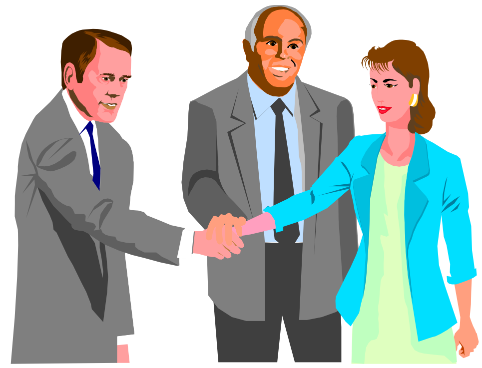
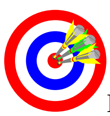


Figure 68: Broker. The man in the middle has brokered a relationship between the man and woman shaking hands.

8. Brokering Education

 Learning Objectives

- To understand the notion of a broker in virtual education in connecting students and teachers.
- To differentiate sole function brokers, publishers, professional societies, and government for their roles as brokers.
- To anticipate the conditions under which a broker succeeds.

8.1 Introduction

According to the dictionary (American, 1994) a *broker* is: "one that acts as an agent for others, as in negotiating contracts, purchases, or sales in return for a fee or commission." A broker functions partly as a clearing house which exchanges checks and drafts and settle accounts. The broker in virtual education would not be a check clearing house but an education credits and fees clearing house.

The broker in the virtual education marketplace may or may not be concerned to persuade people to adopt some *product- or service-specific knowledge*. For instance, when Microsoft helps teachers and students meet to learn about Microsoft Windows NT, the model that Microsoft advances is particular to the product which Microsoft sells. Microsoft achieves its educational purposes with a brokering strategy. However, many brokers would not have an investment in knowledge about a particular product. For instance, a broker that offers education about computer operating systems might want to present information about Microsoft Windows NT, about Sun Solaris Unix, and about Apple Macintosh Operating System as illustrations of the principles by which operating systems work.

How will content experts be able to enter information into a brokering system, and that system and expertise become accessible to those who need it to learn? We need to provide incentive for experts to express their knowledge, so from an economist's perspective, such a system would resemble a quick version of a *copyright clearance center*. The copyrighted material would be purchased in the end by the students, although teachers and administrators will typically choose required content.

Teachers and administrators would offer courses at a certain fee for students and with a certain limit on enrollment in the courses. Students would enroll or not as they saw fit. Teachers and administrators who had successfully marketed themselves would succeed and others not. Individual teacher performance statistics could be made available from continual quality control procedures. Students would thus know about both the quality of the teacher before choosing to enroll in a particular class. Of course this same free market type of approach could also be implemented in traditional universities where students go to physical lecture halls. Teachers would retain their traditional role as experts in the delivery of instruction, however classes would now be distributed across locales and time-zones. Thus students have more choice and the *teacher-marketplace* would become more competitive.

In summary, the broker connects students and teachers across space, time, and organizational boundaries. Teachers are placed on a wide, open market that encourages them to perform well in order to attract students. Brokering is easy to do in virtual mode over the Internet, and the activities in the frontier of educational brokering are as feverish now as the land rush to the Western United States was in centuries past.

8.2 Sole Function

The sole function broker has no other function than to bring teachers and students together. As one considers the different methods of sole function brokers, one might devise a further decomposition *of sole function broker types*. Some connect schools to companies; some connect individual teachers to the public, and some provide an open catalog.

In this subsection we will:

- develop a classification of sole function brokers,
- show how teachers or students are represented by other organizations,
- study a self-organizing catalog of courses, and
- consider franchising of educational brokers.

The sole function broker must be a lean creature in order to compete with the other participants in the brokering business who have primary revenue from other sources and can subsidize the educational aspects as a means of facilitating their primary business.

8.2.1 School ⇔ Company

Realizing that much of the teaching expertise is in schools in the form of full-time teachers, a brokering organization might seek to make alliances with schools for their teachers to participate in special educational programs. Likewise, realizing that companies may represent students with educational needs, a broker might seek contracts with companies for their students to be enrolled in courses. Thus we have the *school ⇔ company broker*.

For higher education, the pre-eminent example of such a school ⇔ company brokerage comes in the form of the *National Technological University* (NTU). NTU is a private, accredited, non-profit institution founded in 1984 to meet the advanced educational needs of working engineers, scientists and technical managers. NTU serves as a broker between universities and companies. Courses taught at a university are broadcast by satellite to receiving stations at certain, enrolled companies.

More than 1300 courses are available through NTU, and a student can earn one of 13 Master's of Science Degrees. These courses are taught primarily by the faculty of 46 engineering schools from some of the best universities in the United States. NTU engages in careful quality control procedures and will only allow teachers to participate in the program when they continually receive good student reports. Thus we see here a larger selection of *courses and teachers* than a student would have at any one university.

To enroll in courses, students are typically employees of a company which is a member of the NTU Satellite Network. NTU has contracts with the companies, and the *companies provide the students*. Currently, there are more than 880 participating NTU sites across the United States. The companies involved include giants like General Motors, and their downlink sites can be anywhere in the world.

The NTU example has not been as exploited in the world by other organizations as it might. It takes advantage of the administrations already existing in schools and companies. We will look later in this chapter at the Western Governor's University which incorporates many of the features of NTU. By connecting sets of teaching organizations with sets of companies one reduces the *administrative overhead* at the brokerage house. Thus the broker has a natural advantage in offering a large amount of education to the workplace in virtual mode.

Figure 69: International University Home Page. The introductory links take one to degree offerings, courses, faculty, administration, and online registration.

In summary, the school ⇔ company broker arranges contracts whereby schools provide teachers and companies provide students. The National Technological University (NTU) is a prime example of such a broker. Companies make contracts with NTU for their employees to get NTU education from teachers around the world. Other educational organizations are increasingly adopting this broker mode of operation.

8.2.2 Teacher ⇔ Student

At the other extreme from the NTU model of making alliances with schools and companies for their teachers and students, respectively, we have examples of organizations that only make individual contracts with students and with teachers. Many organizations exist that connect teachers to students by advertising broadly for teachers and students. In a sense anyone in the public is welcome to come forward as a possible teacher or student. In this subsection we will explore further the properties of such *teacher ⇔ student* virtual educational organizations through the International University and the International School for Information Management University.

Jones Intercable is a large cable and broadcasting company. It established the Mind Extension University to offer video-based education. *Mind Extension University* is the broker for many higher education institutions who license their broadcast courses to the Mind Extension University which then reaches a further market of students than the higher education institution was able to reach on its own. Thus the Mind Extension University is similar in its contract with universities to the National Technological University, but the Mind Extension University did not focus on its student audience on contracts with companies but rather was open to any individual student to enroll.

Jones Intercable subsequently created the *International University* to serve the internet community and with a somewhat different business model from the Mind Extension University (see Figure 69 "International University"). The Mind Extension University serves the broadcast video community, while International University courses are offered on the internet. Also the teaching contracts are with individual teachers from universities who form a virtual faculty of International University. The faculty work full-time at other universities and work on short-term, part-time contracts for the International University. Students are recruited from the general public, as is the case for the Mind Extension University.

The International University degrees include a Master of Arts in Business Communication and the Bachelor of Arts Completion Degree in Business Communications (Pease, 1997). The *curriculum* combines the fields of Human Communication and New Communications Technologies. Examples of courses include one on

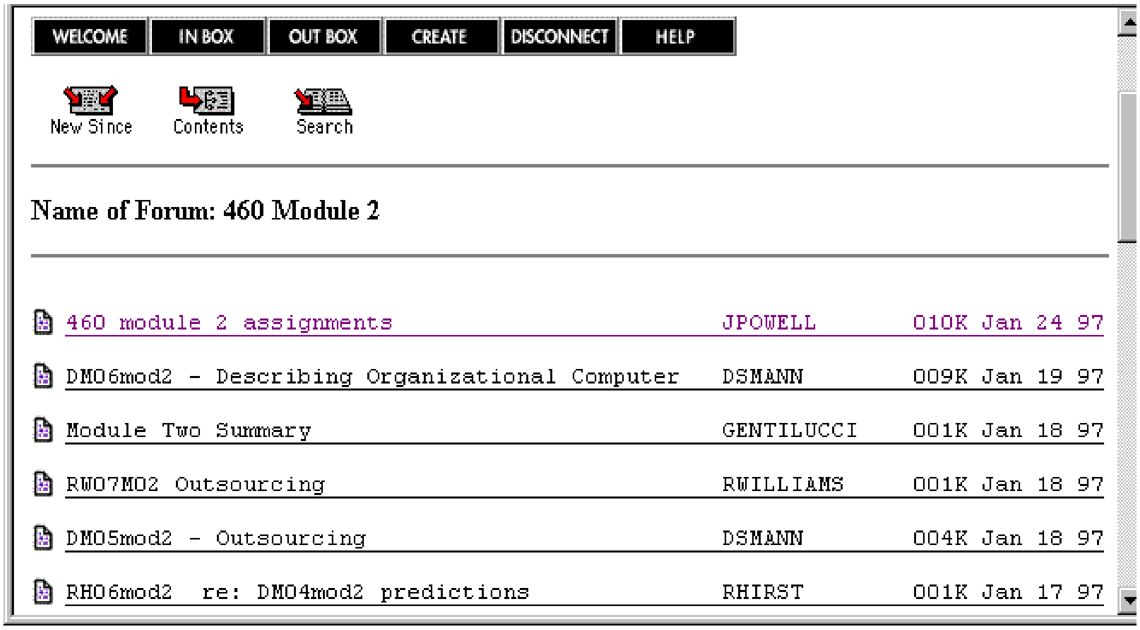


Figure 70: ISIM interface. This is a portion of the screen as the student sees it, while taking a course. The top icons give access to the email in box and out box and other opportunities. The rows in the lower half of the screen link to a teacher or student submission.

Communications Ethics and another on Using the Internet in Business. Thirty-five credit hours must be completed to earn the Masters Degree, and a Bachelors Degree requires 120 credit hours

Students can visit samples of the courses online without registering to decide whether or not the course and method are for them. . Students *apply online* for admission to the B.A. or M.A degree program. Upon admission into the B.A or M.A. program, students work with an advisor to establish a Degree Plan that is tailored to meet the student's individual learning needs. Students also enroll in individual courses on-line. The student pays approximately $200 per credit hour.

Another example of a teacher ⇔ student virtual educational organization is the *International School of Information Management* (ISIM). ISIM is similar to the International University in several ways. ISIM is part of an education-oriented business founded in 1953 by Eric Boehm. The first company was ABC-Clio, a publisher of reference books, serials, and CD-ROM products. Following the success of ABC-Clio, Boehm started ISIM in 1987(Boehm, 1997).

ISIM has a *faculty* of experts around the world. ISIM faculty include university professors, business executives, and consultants. As for the International University, faculty have full-time employment elsewhere than ISIM.

ISIM has 100 students enrolled in its graduate degree program and 250 students taking various individual executive courses. The biggest market for ISIM is contracted instruction with corporations who want this instruction for their employees. However, ISIM also actively recruits *students* from the general public via advertisements in trade journals and elsewhere

ISIM is *accredited* through the Distance Education and Training Council which is in turn recognized as the sole accrediter for distance education by the United States Department of Education. Students pay $375 per credit hour and a course is typically 3 credit hours. A Masters Degree requires 36 credits but 40% of these may be transferred into the program. Students work at their own pace and graduate whenever they finish the requirements. Ten students had graduated from ISIM with a Masters Degree prior to 1997.

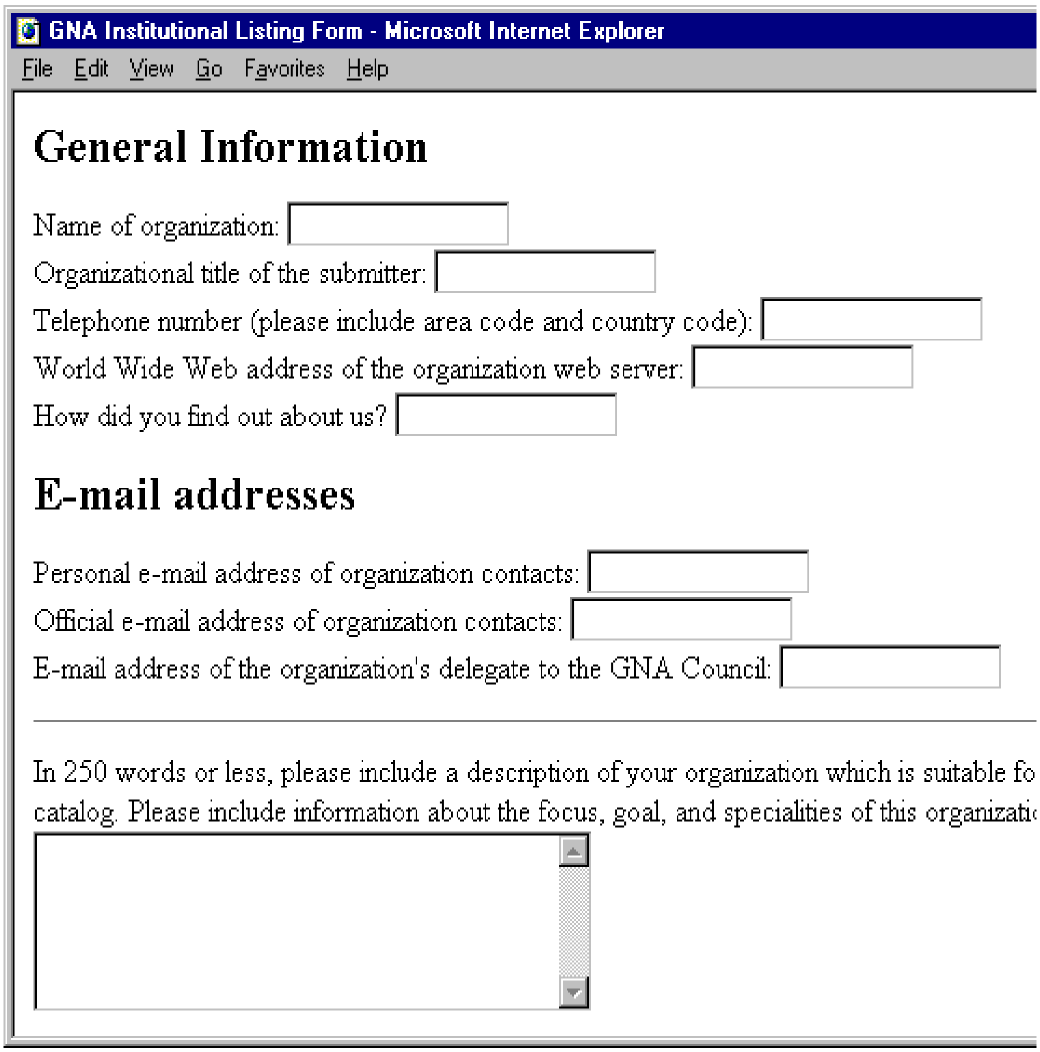
Through ISIM one may study online interactive programs (electronic classrooms) or guided self-study programs (print-based materials). ISIM won the "Best Distance Learning Program in Corporate Training" award in 1995 for a corporate leadership training program delivered in partnership with The Xerox Management Institute. Although special training packages are developed for certain clients, the standard online offerings at ISIM are based on essentially *email news groups*. The teacher posts readings and assignments via email and students ask questions and submit exercise answers via email. The internet infrastructure for ISIM is a kind of bulletin board that has been tailored for ISIM's educational purposes (see Figure 70 "ISIM Interface"). Students may read assignments submitted online by the teacher. They submit exercise answers or questions via electronic bulletin board. The teacher or student can search or browse the archive. The email and bulletin board system that ISIM uses is provided through a contract with Connect, Incorporation (described in a previous chapter).

In summary, the teacher ⇔ student broker makes contracts with individual teachers and individual students. Jones Intercable's International University is an internet-based educational organization that contracts with individual teachers and individual students for internet-based education. The International School of Information Management University operates in a similar fashion.

8.2.3 Self-Organizing Catalog

One can do marvelous things with a simple program on the World Wide Web that solicits others to enter information about themselves. The *Globewide Network Academy* (GNA) is an interesting example of a brokerage. Educational organizations can enter descriptions of courses that can be taken at a distance. Students can browse the database to find courses that they might want to take.

The operation of GNA is basically automatic. Institutions or individuals go to forms at the GNA site and enter descriptions of their offerings including pointers to web sites (see Figure 71 "GNA Entry Form"). In addition to the questions indicated in the figure, the form collects information about the accreditation status of the institution, the details of the courses being offered, and registration information. In


GNA Institutional Listing Form - Microsoft Internet Explorer

File Edit View Go Favorites Help

General Information

Name of organization:

Organizational title of the submitter:

Telephone number (please include area code and country code):

World Wide Web address of the organization web server:

How did you find out about us?

E-mail addresses

Personal e-mail address of organization contacts:

Official e-mail address of organization contacts:

E-mail address of the organization's delegate to the GNA Council:

In 250 words or less, please include a description of your organization which is suitable fo catalog. Please include information about the focus, goal, and specialities of this organizati

Figure 71. GNA Entry Form. The educator enters a description of course offerings into the GNA database through this form.

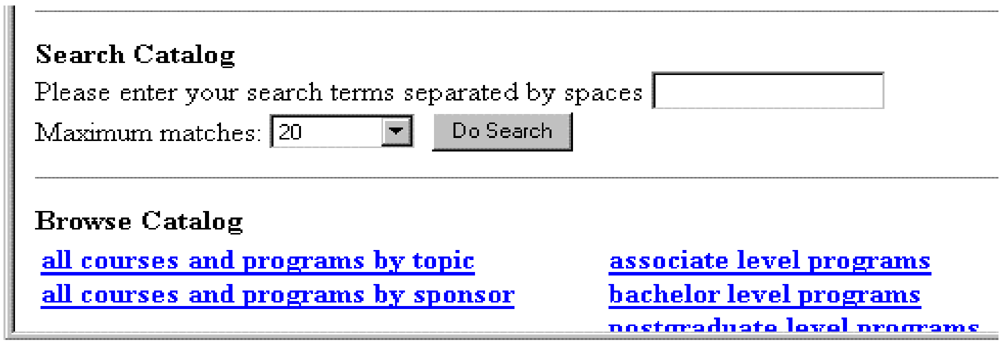


Figure 72: Globewide Network Distance Learning Catalog. Part of the interface that students use to search and browse the online catalog.

this way, a student who wants to take a course that has been identified on GNA, can go directly from the GNA site to the site where registration for the course is handled or, at least, instructions are given as to how one might register. Another forms interface allows institutions to modify their own course descriptions anytime. We call this a *self-organizing catalog*. The GNA web catalog (GNA, 1997) describes over 9000 courses and 500 degree programs from 400 institutions.

The catalog that is created by these submissions from institutions and individuals is the product offered to students. The catalog is *searchable and browsable*. The user can find listings of hundreds of courses that are offered in distance education mode in a wide range of disciplines from around the world (see Figure 72 "GNA Catalog"). On identifying relevant instructional offerings, the student is then expected to contact the teaching organization directly, as GNA does not itself register students or engage in the actual delivery of education. GNA has attracted a loyal following and gets over 1,000 visits every day to its web site.

GNA was founded in 1993 by a group of graduate students at the Massachusetts Institute of Technology. Philosophically GNA is striving to create a marketplace of courses and to make distance education competitive with traditional education. By facilitating competition among institutions, GNA hopes to stimulate the drive to higher quality and lower prices but has not asked for any revenue from the stakeholders. GNA currently has no substantial source of income. Institutions or individuals pay no fees to either enter and store information about course offerings in the database nor to search or browse the database. GNA is a *charitable service*.

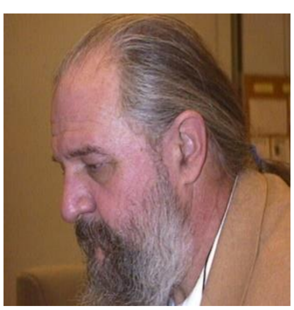


Figure 73: Pat Burnstad, Chairman of the Board of the Globewide Network Academy.

GNA has contracted with an advertising agency to place appropriate advertisements on the web site. In this way GNA earns a very modest *income*. GNA funding since 1995 has included about $300 in donations, $300 from advertising banners, and about $50 from Amazon books for GNA's pointing to their site. The Chairman of the Board Patrick Burnstad (see Figure 73 "Burnstad") of GNA is eager to work with various groups to increase the value of GNA. Burnstad has said: "We at Globewide Network Academy have been involved in trying to increase access to education for people worldwide since 1993. …. We have seen a tremendous growth in this field and think that we are just starting. We are planning on branching out from just presenting other people's courses to actually hosting some of our own and also to trying to provide some of the services that we have found that people need to make some of their educational experiences more productive."

Many organizations can create a web site and invite others to enter information into it. However, to make this activity respected enough that many people regularly visit it is difficult. Once created, someone must also regularly *maintain* the web server. The institutions and public that visit the site must be somehow convinced that the information is current and comprehensive.

In summary, the Globewide Network Academy (GNA) invites educators to enter descriptions of their course offerings and student to access these descriptions. The catalog is self-organizing in that GNA staff only provide the web interface and database and all content is provided by users of the system who have already, however, entered descriptions of over 10,000 course offerings. The searchable and browsable catalog attracts over 1,000 visits per day but students must then contact those who entered the content, if the student wants to take advantage of the described offering. The catalog has attracted enormous interest but for a charitable organization to maintain such a catalog is a peculiar challenge. Numerous non-profit organizations have established web sites that offer a public service based on users entering information into a kind of self-organizing resource. The long term role of such organizations remains to be established.

8.2.4 Franchise

A *franchise* is a type of business in which a group or individual receives a license to conduct a commercial enterprise. Corporate franchises enable a franchisee to market a well-known product or service in return for an initial fee and a percentage of gross receipts. The franchiser usually provides assistance with merchandising and advertising. Major franchise networks, which have grown rapidly in the U.S., include fast-food restaurants, gasoline stations, motels, automobile dealerships, and real-estate agencies, and the system has expanded into many other fields. Government franchises are issued to public utility and transport companies.

Within the virtual education marketplace, we have already seen how The Microsoft Corporation effects franchising to provide Microsoft Certified Professional training. The federal government could franchise virtual schools. One example of a franchise operation that does nothing but support virtual education is *The Fourth R* -- its sole function is education and computers are both the subject and the tool. The term Fourth R refers to the four Rs of **r**eading, w**r**iting, a**r**ithmetic, and info**r**mation technology.

The Fourth R offers *courses* about computing and particularly targets public schools. The Fourth R Authorized Education Center program includes:

- Needs Assessment and Technology Planning - Design a plan that matches school resources with technology objectives.
- Curriculum Licensing - Step by step activities and projects that can be integrated with current classroom objectives.
- Hardware and Software - Special purchasing relationships with hardware vendors and software publishers
- On-Site Staff Training - Initial start-up and software specific training for school staff.
- Ongoing Local Support - Periodic updates of curriculum, software and training.

The Fourth R goal is to teach students how to take advantage of the computer as a tool for research, homework and communication. The age groups targeted are divided into 4 categories: ages 3-8, ages 9-15, college preparation, and adult. In the age 3-8 group, The Fourth R supports a wide range of activities from birthday parties where computer learning is an integral activity to the more traditional classroom exploration of computer software that involves students meeting together for one hour a week over a twelve week period

The education offered by the Fourth R may be in traditional face-to-face mode. This student-computer mode is one aspect of being *virtual* in contrast to student-teacher mode when there is courseware being used that performs otherwise teacher functions. The administration of The Fourth R franchise itself illustrates a virtual mode of administration.

Our interest in the Fourth R is for its implications for the role of franchising in virtual education. What does it take for an organization like that to succeed? What kinds of leadership are required? The Fourth R was founded by a father and son team in 1991 (Park, 1997). Their background was in investment banking. They entered the computer education market because they saw it as a good *business opportunity* rather than as committed educators.

How does a franchise in the virtual education market operate financially? An organization that wants to become a franchise of The Fourth R needs to initially pay The Fourth R an initiation fee of about $20,000 (Fourth, 1997). Once in operation the franchisee pays The Fourth R a monthly royalty fee of 5% for all sales plus a flat fee of $100 per month. In exchange for these *fees* the franchisee gets support in being an Authorized Education Center of The Fourth R. These franchisee financial arrangements are similar to what they might be in non-education businesses that are successful.

How successful is the Fourth R financially? The Fourth R sold 8 franchises in 1992 and saw its number of outlets grow rapidly to 36 in 1993, 68 in 1994, 110 in 1995, and 162 in 1996. In 1996 the gross sales of the franchises were $10 million of which $1 million went to the franchiser. Of that $1 million, $600,000 was profit. This represents a very impressive doubling in size for each of the first three years and a consequent substantial profit for the small central franchiser operation. We wonder what other business opportunities are appropriate for the franchise model.

In summary, a franchise is a business in which licenses are granted in return for support with merchandising and advertising. The Fourth R is a sole function educational broker that operates in franchise mode. The substantial success of the Fourth R should suggest this mode of operation for others with an interest in marketing virtual education.

8.2.5 Exercises

True or False

1) The National Technological University focuses on course offerings to the general public rather than targeting companies whose employees would enroll.
2) Some brokers market directly to the public for both teachers and students.
3) Students submit assignments to a self-organizing catalog of courses.
4) A franchiser for education could be like a MacDonald's restaurant franchiser in some sense.

Knowledge essays:

1) Describe the mechanisms of an organization that connects schools with companies and illustrate this mechanism with details from the National Technological University.
2) What are the similarities between International University and the International School of Information Management as they illustrate the operations of a virtual educational organization that connects teachers and students?
3) What are characteristics of a self-organizing catalog and how does the Globewide Network Academy manifest those properties?
4) In what way is a franchiser a broker. Illustrate with the case of the Fourth R.

Doing essays:

1) How would you see yourself creating a private, global virtual educational broker that would only market directly to students and that would compete effectively with state-funded organizations.
2) How would you assure the long term success of the self-organizing catalog.

8.3 Publishers

Publishers in the education marketplace have long served a kind of broker role. They contract with expert authors to produce books or other products that they feel students will want to buy. Actually, *publishers* often work between the author of content and the teacher who will deliver the content. In any case, the publisher is fundamentally a broker in education. The growth of the internet and particularly the web has threatened the traditional revenue stream of some publishers, and some are moving aggressively to stake their claim in the new information superhighway part of the market. We next study the cases of McGraw-Hill, Ziff Davis, and NovaNET as publishers moving onto the internet.

Our learning objectives for this subsection are to:

- Appreciate the broker role played by publishers.
- Know some of the diverse holdings of one of the largest publishers McGraw-Hill, as they relate to virtual education.
- See how a popular computer literature publisher, Zipp Davis, has parlayed its large public audience into a high-volume, low per-user-cost virtual university.
- Follow the history of the PLATO system into the new retailer called NovaNET.

Overall, the reader who wants to be active in the virtual education arena must be prepared to interact with publishers one way or another.

8.3.1 A Diverse Conglomerate

Founded in 1888, the McGraw-Hill Companies today provide information and analysis in multiple media. Sales in 1996 were over $3 billion. Two of the many divisions of *McGraw-Hill* that are involved in virtual education are NRI and the Continuing Education Division. NRI has permanent teaching staff and is thus not a true broker in the sense used in this chapter but has important brokering characteristics. The Continuing Education Division is a broker in the strict sense.

In 1914 a high school teacher names James E. Smith started giving extra instruction to four of his students in the new field called “wireless radio.” When Mr. Smith turned his part-time efforts into a full-time career, the *National Radio Institute* (NRI) was born. Subsequently McGraw-Hill purchased NRI.

NRI offers high-tech electronics, computer-based, and occupational training programs. NRI is an accredited member of the *Distance Education and Training Council*. NRI enrolls over 38,000 trainees annually.

NRI claims (NRI, 1997) to be the first organization to

- train students on a digital computer with training software or
- use multimedia computers and the web to familiarize students with cutting-edge technology.

NRI utilizes technical publishing resources of The McGraw-Hill Companies. However, NRI also invests about $3 million annually in *course development*. Its 200 staff include development engineers, writers, editors, illustrators, instructors, and technical support personnel. NRI is moving progressively more onto the Internet with its TeleGrading, TeleService, and Online Connection services.

The *Continuing Professional Education Division* of McGraw-Hill, as its title suggests, supports continuing education for professionals. One component addresses Certified Public Accountants (CPAs). CPAs need to engage in life-long continuing education in order to remain certified. The McGraw-Hill online and self-study courses allow CPAs to fulfill their Continuing Professional Education credit requirements over the Internet (McGraw-Hill, 1997a). The CPA gets study guides, takes examinations, and earns credits over the Internet. McGraw-Hill CPA courses are written by experts throughout the USA. These experts are either practicing accounting somewhere or working for a higher education institution, in addition to authoring material for McGraw-Hill.

McGraw-Hill draws its online educational offerings through the McGraw-Hill World University (McGraw-Hill, 1997b). This university offers education in virtual mode and includes three major branches:

- the School of Degree Studies offers primarily Associates Degrees in accounting and business management,
- the School of Continuing Education offers certificate-based education on popular subjects like being a webmaster or continuing education for accountants, and
- the Corporate Training Division serves human resource managers at companies who want to upgrade the skills of employees.

The McGraw-Hill World University is accredited by the United States Department of Education and has special access to all McGraw-Hill resources.

In summary, McGraw-Hill is a giant publisher with major virtual education initiatives. Through its recent purchase of the National Radio Institute, McGraw-Hill indicates one of its many strategies for extending its educational reach. The McGraw-Hill World University has the services of hundreds of professional courseware developers and many teachers experienced with online teaching. This virtual university has been certified by various major organizations and has a global reach. McGraw-Hill is typical of other large publishing companies for its growing involvement in virtual education.

8.3.2 Specialty Publisher

Ziff Davis is a specialist publishing company. It publishes books and magazines about popular computing subjects. Its magazines include PC Week and Mac Week. In late 1996 Ziff Davis extended its offerings by creating the ZD Net University. Courses at ZD Net University are typically based on material published by Ziff Davis and taught in part by the authors of the published material.

ZD Net University (ZDU) offers online computing classes and seminars taught on private, moderated *message boards* (Ziff Davis, 1997). Once a week, a qualified ZDU instructor posts an assignment on the class message board. All discussion resulting from the assignment is managed by the instructor, teaching assistants, moderators and other students. Further details about the operation of a course include:

- Students log onto ZDU at least once a week to read assignments and post questions.
- Most classes last 4 to 8 weeks.
- Instructors offer bi-weekly live chat 'office hours' for real-time interaction.

Typical web browsers can view the message board classrooms. The technology is fairly straightforward as students largely engage in email discussion that is archived on the web and read a paper document for detailed content (see Figure 74 “ZDU Classroom”).

ZDU offers exclusively *computing courses*. Topics are offered for programmers who need to learn the latest languages, executives trying to keep up with the latest trends and gamers who just want to build their own game level. Titles of the classes that have been offered include:

- Beginning C++
- Intro to Java Applets
- Lotus Notes 4.0 for Executives
- How to Code with HTML

Students learn practical skills of immediate use in the working world.

Classes often require the student to purchase literature published by Ziff Davis. Thus these courses serve as a kind of marketing arm for the core Ziff Davis product. The *tuition fees* that ZDU charges is very low and one not cover the full cost of creating and running a virtual university. Students pay no more than $5 a month to be enrolled in as many ZDU courses as they can enter. Students can earn Continuing Education Units from the American Board of Education when they complete a ZDU class online (for an additional processing fee.)

ZDNet University had by the spring of 1997, less than six months after its inception, *several thousand students* during any of its four-to-eight week sessions. Although no official demographics are available, the program managers say that about 80 percent of the students come from the United States and the remaining 20 percent are from countries such as Germany, Malaysia, Indonesia, and Bulgaria. The average student is a male, between 30 and 50, who is interested in enhancing knowledge about computers or learning new skills. ZDNet University's program manager says (Black, 1997b): "These are people that want to keep on top of what is going on with Java, ActiveX, or HTML. Their goal is to get a new job or enhance their skills for their present job."

In summary, Ziff Davis is a major publisher of popular computing titles and in late 1996 opened the ZD Net University (ZDU) online to provide instruction about Ziff Davis publications for a wide audience. ZDU provides largely online bulletin board discussion over a few week period about material that is available in the printed form from Ziff Davis. Within a few months of its inception ZDU was already enrolling thousands of students per month. ZDU is a leader in a new way of working for a publisher. The costs of participation for the student are small, but ZDU gains its profit not so much from the student fees but from the stimulus to its publishing business sales.

8.3.3 A Large Courseware Library

NovaNET has a longer computer-based history than most virtual education activities. It is an offspring of the PLATO project at the University of Illinois in the 1960s. So much content was developed that the University of Illinois started a company to ensure that the courseware

Figure 74: ZDU Classroom. This online discussion system shows the topic of a participants contributions, the name of the contributor, and the date. The descendant relationship in the hierarchy is automatically created as one person replies to another person's contribution. Most of the discussion comes from students in the course and some from the teacher and teaching assistants.

library would remain in use. NovaNET is this offspring of PLATO.

8.3.3.1 PLATO

PLATO originated in the early 1960's at the Urbana campus of the University of Illinois (Woolley, 1994). Professor Don Bitzer became interested in using computers for teaching, and with some colleagues founded the Computer-based Education Research Laboratory. Bitzer, an electrical engineer, collaborated with a few other engineers to design the PLATO hardware. To write the software, he collected a varied staff ranging from university professors to high school students. Together they built a system that was at least a decade ahead of its time in many ways.

PLATO is a timesharing system. It was, in fact, one of the first timesharing systems to be operated in public. Both courseware authors and their students used high-resolution graphics display terminals, which were connected to a central mainframe. A special-purpose programming language called TUTOR was used to write educational software. This combination of timesharing system, high-resolution graphics display terminals, and the TUTOR programming language was a *landmark engineering accomplishment*.

Throughout the *1960's*, PLATO remained a small system, supporting only a single classroom of terminals. About 1972, PLATO began a transition to a new generation of mainframes that would support one thousand users simultaneously. Control Data Corporation became a principal for PLATO.

From the late 1960s and through the 1970s, the development of courseware for PLATO proceeded at an impressive rate. A large *library of courseware* for a wide range of topics, including biology, literature, and mathematics, was accumulated. The techniques were targeted to exploit the technology of the time, though they seem dated relative to the multimedia capabilities of computers in the 1990s.

PLATO and its courseware were popular but not popular enough. Additionally, Control Data ran into financial difficulties in the late 1980's, and sold or closed many of its businesses. At the same time, microcomputers were becoming a more cost-effective platform for education than PLATO with its mainframe-based architecture, and many of the Control Data systems were closed. The revenue generated by PLATO had not been enough to merit the *costs of transforming* the tools and courses to new platforms.

The PLATO name was purchased by TRO, Inc., but TRO no longer runs any PLATO systems. Control Data's PLATO was renamed CYBIS. Control Data Systems supports about a dozen CYBIS systems at university and government sites. At the University of Illinois PLATO has been renamed NovaNET. So PLATO as a named entity has essentially become of only *historical interest*.

In summary. PLATO was one of the first computer-based educational systems and started in the early 1960s at the University of Illinois. PLATO applied graphics terminals, computer networks, and specialized educational programming tools in a landmark engineering accomplishment. Large libraries of PLATO courseware were developed in the 1960s and 1970s. The market penetration of PLATO courseware was not enough to support the transition of the courseware from the mainframe to minicomputer environment in the 1980s. PLATO as a commercial entity has been superceded by its descendant NovaNET. PLATO is landmark in the history of virtual education that has continued its life in another form.

8.3.3.2 NovaNET Business

NovaNET is a descendant of the PLATO project. In 1986 NovaNet Learning Incorporated was selected by the University of Illinois to operate, develop and provide an online learning environment that would among other things market the PLATO courseware library. NovaNET operates in partnership with the University of Illinois but as a private, *for-profit company* (NovaNet, 1997).

NovaNet Learning Inc has gradually grown in size. It has about 100 full-time employees. NovaNET boasts a library of almost 10,000 hours of instructional software in more than 150 topics. In 1996, NovaNET delivered more than 2.5 million hours of instruction to adult and young adult students throughout the United States. NovaNET was used in over 500 schools and educational programs nationwide that enrolled *100,000 students each semester* in NovaNET.

NovaNET allows free use by individuals in the home of the NovaNET system and library. However, organizations that want to subscribe to the NovaNET service pay various fees. One way of charging monitors usage. The system is able to monitor the amount of time that each user spends on each feature of the NovaNET system (see Figure 75 “NovaNET Billing”). An organization can then pay based on the amount of usage.

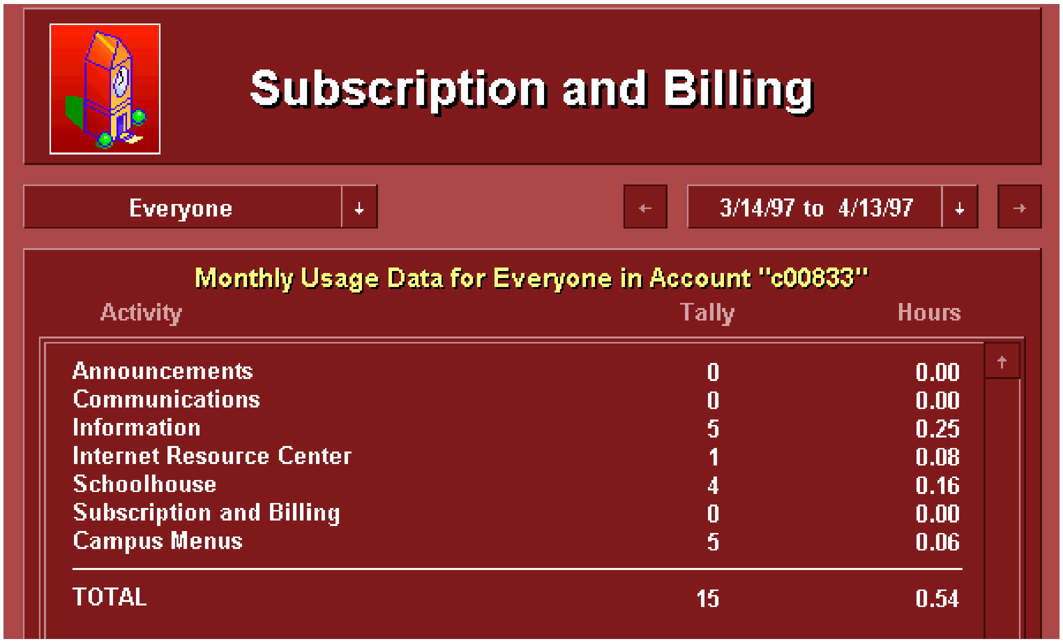


Figure 75: NovaNET Billing. The web interface provides detailed information for billing with activity type identified in the leftmost column and hours usage in the rightmost column.

One example of the successful use of NovaNET comes from the *Hanks Academy*. The Hanks Academy is part of the Ysleta Independent School District, located in El Paso, Texas and serves over 200 high-risk, high school students (Coleman, 1997). In cooperation with members of the NovaNet staff, the Hanks Academy staff placed NovaNET before their students. To facilitate access to NovaNET, the Hanks Academy opens its doors from 6:30 a.m. to 9:00 p.m. Students average five hours of instruction per day. Students are expected to earn an 85% score on NovaNET lessons and retake them until that proficiency is attained. Teachers deal with each student individually, and students are encouraged to help one another to learn, as well. In its second year, the Hanks Academy graduated over 100 high-risk students.

In summary, NovaNET started in 1986 as a for-profit company cooperating with the University of Illinois as an extension of PLATO. NovaNET has grown to have 100 full-time employees and to attract 100,000 student users per semester. NovaNET is providing access to the oldest and most extensive library of courseware intended for public education. NovaNET illustrates an interesting marketing approach that is different again from that of McGraw-Hill or Ziff Davis but suggests a class of marketing strategies that we might expect to be adopted by some other organizations.

8.3.3.3 Courseware

For home use one can download the *NovaNET Campus software* for free and visit a substantial library of material. On first entering the online campus, one can select the Schoolhouse icon and be taken into a set of options that are either to manage student accounts or to take courses (see Figure 76 “Schoolhouse Window”). The library of lessons is hierarchically sorted.

If one selects one of the many English courses one is not surprised to find *text-based lessons* that emphasize important concepts of English and take advantage of multiple choice questions. For instance, after selecting the course called “Reading for Main Idea” one first sees a title page that notes the authors and the copyright by the University of Illinois in 1977. One then reads various descriptions of the ways to find the main idea in a reading. Then the student is given a multiple choice question about whether the main idea is at the beginning, middle, or end of the paragraph. The student gets feedback as to whether the student answer is correct or wrong.

For an introductory biology course entitled “Cellular Structure and Function” one is taken to a home page that gives a copyright date of 1984. *Simple graphics* of the sort available in 1984 are used in helping students answer questions about the components of a cell (see Figure 77 “NovaNET Cell Lesson”). So while the lesson is not purely text-based, its graphics are constrained because the graphics were developed in the early 1980s.

By going back to the main campus map and selecting the icon of a globe on a roof, one is taken to the Internet Resource Center. By choosing the discussion notes-files one is taken into a discussion or *bulletin board* system on which students, teachers, and others can share ideas. This notes-file system was developed in the 1980s for PLATO when such systems were not yet popular on the Internet.

NovaNet offers packaged *curricula*. Topics include fundamental skills education, high school and college subjects, life skills, study skills, job skills, vocational training, and English as a Second Language. Each curriculum is organized into a number of units.

Units are composed of:

- a diagnostic and prescriptive pre-test
- three to twelve NovaNET lessons
- a post-test to confirm mastery of unit objectives

Students begin with a pre-test that diagnoses skill deficiencies. If no deficiencies are identified, NovaNET promotes the student to the next unit. Otherwise, NovaNET recommends a customized prescription of lessons. After successfully completing the lessons, students take the post-test to ensure they have mastered all the unit's objectives. Instructors may override the system at any point to modify the prescription, reassign *pre- and post-tests* or advance students to the next unit.

NovaNET subscribers generally establish one or more computer "labs," each of which is connected to NovaNET via a single data circuit. Once connected, subscribers may access the full library of NovaNET lessons and tests. NovaNET automatically stores all student data for instructor review. Instructors also can develop customized courses and communicate using NovaNET's Internet-compatible electronic mail. NovaNET is compatible with DOS, Windows, and Macintosh computers and does not require specialized hardware. NovaNET can also be distributed through existing local or wide-area *networks* to bring educational software to every computer in a facility.

NovaNET's *student management system* promotes individualized instruction. Instructors have a means of managing instruction and monitoring, evaluating and reporting on student progress. A menu-driven format lets instructors add and remove students and assign instruction. Assignments can be altered and re-prioritized. Options are available for making assignments to an entire class at once, copying assignments from one student to another and assigning either individual lessons or entire curricula. NovaNET automatically notifies instructors when students complete coursework or require new assignments.

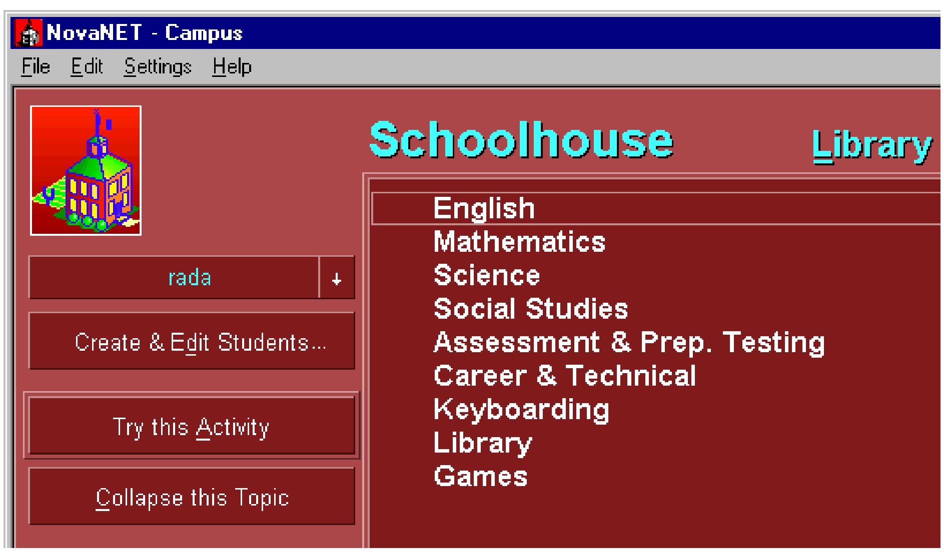


Figure 76: Schoolhouse window. Top half of NovaNET's Schoolhouse window.

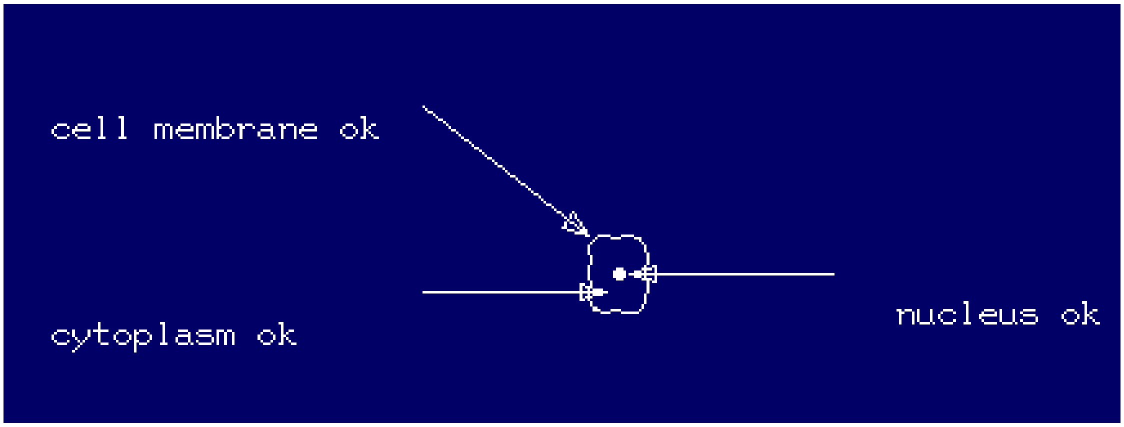


Figure 77: NovaNET Cell Lesson. The most sophisticated graphics used in a 1984 NovaNET lesson

A complete *history of each student's work* can be viewed at any time. The history includes data on when lessons were completed, how long each took to complete, total time on the system and attendance. NovaNET stores the students' most recent tests, which allows instructors to review the errors and, if desired, go over the test with the student. Summary statistics for the entire class are automatically captured.

In summary, the NovaNET Campus includes a large catalog of courseware. Lessons are largely text-based with extensive use of multiple choice questions to test users comprehension. The NovaNET curricula focuses on basic knowledge and skills for young adults and each curriculum is organized into units. Units in turn are composed of pre-tests, lessons, and post-tests. A student management system allows the teacher to tailor programs for students or to have any number of students in the same program. NovaNET software monitors every online transaction of each student and the teacher can review the progress of each student through this information. Whereas most virtual educational organizations still rely heavily on paper-based material and online discussions, NovaNET shows a special approach that starts with a full library of courseware and augments that with a discussion and management facility for the classroom situation.

8.3.4 Exercises

True or False:

1) The McGraw-Hill World University offers Ph.D. degrees.

2) The Ziff Davis Net University charges students only a few dollars a month for unlimited course access.

3) PLATO was developed for video broadcasting.

4) NovaNET markets the PLATO courseware to schools.

Knowledge exercises:

1) Describe the role of publishers in virtual education.

2) Why might McGraw-Hill's Continuing Professional Education division target Certified Public Accountants?

3) How can the private, for-profit ZDNet University manage to prosper while charging students less than $5 per month for unlimited access.

4) What is the publishing resource on which NovaNET is based and why did this resource come to be in the hands of NovaNET rather than of its PLATO originators?

Doing Exercises:

1) Imagine that you are to work with a publisher to create or extend its virtual educational organization, choose a publisher and describe your plan.

2) How would you extend the range of ZDUNet services to merit different per month costs?

3) Given that libraries of courseware exist that are not optimized to deal with current platforms, what criteria would you use to decide what libraries to exploit and what to reinvent?

8.4 Professional Societies

A *professional society* is an organization of persons engaged in a common profession who choose to ally with one another for the sake of sharing information and other resources. In various professions there has existed for some time the need for members of the profession to continually be educated in order to retain certification.

This applies, for instance, to high school teachers, doctors, and accountants. Professional societies are often concerned to provide continuing education to their members for professional advancement or recertification. We present some examples of what some professional societies are doing on the Internet to offer education to their members and then look at a detailed proposal for online tutorials from one society.

The reader of this subsection should understand:

- why professional societies are involved in virtual education.
- how to develop virtual tutorials by extending a professional society's conference tutorials.
- the role of professional societies in accrediting degrees.

As organizations look for different ways to market virtual education, we can expect professional societies to play an increasingly active role in brokering this education, as they are major sources of credibility in education.

8.4.1 Various Societies

The *Oncology Nursing Society* has a web site that includes information about education and offers continuing education for nurses (ONS, 1997). This may be very important to nurses as in that profession the ability to continually certify oneself as competent is relevant to job success. The Oncology Nursing Society education web site includes listings continuing education activities and educational materials.

The American College is an independent educational organization that offers certificates and degrees for professionals in the financial services. The College works closely with the relevant professional societies. For instance, in conjunction with the College students may attend local classes sponsored by the *American Society of Chartered Life Underwriters* and Chartered Financial Consultants (American, 1997).

ISWorldNet is a *society of management information science academics* that lives on the web (ISWorldNet, 1997). The society aims to provide information management scholars and practitioners with a single entry point to resources related to information systems technology and promote the development of an international information infrastructure that will dramatically improve the world's ability to use information systems for creating, disseminating, and applying knowledge. The Web site includes a substantial education component in which online courses can be found and other information germane to education is stored.

The *Association for Computing* (ACM) was founded 1947 and has about 80,000 members. This professional society is dedicated to advancing information technology by fostering the open interchange of information and by promoting the highest professional standards. Like other societies, it wants to use the web to provide education for its membership. Computer professionals are particularly likely to be comfortable to use the web for education. However, in the computing profession there are not generally agreed certifications required of all professionals so the motivation for continuing education is less strong than it would be for nurses or underwriters who must continually document that they have been involved in professional education. We could continue to give examples of professional societies that want educational activities supported by the information superhighway. Instead, we will next give a case study of plans developed by the ACM as an illustration of what a professional society might do.

In summary, a nursing society provides continuing education on the web to help its members retain certification as nurses. A society for underwriters works with a college to offer online continuing education for its members. A new society of information scientists has formed on the web in part to support education to the profession. The society for computer professionals has members who would be particularly comfortable with education on the web due to their intrinsic comfort with such technology. The range of societies that might be involved in virtual education is very large.

8.4.2 Virtual Tutorials

Many professional societies hold meetings at which experts lecture on important issues. These lectures may be called *tutorials* when their intent is particularly educational. The ACM regularly organizes conferences with tutorials. Distinguished experts throughout the world compete for opportunities to present their specialist knowledge in tutorial form at ACM conferences.

The ACM *Virtual Tutorials* project would help tutors and tutees come together in cyberspace. Students would submit work online to demonstrate mastery of the tutorial material. The online offerings would use the same content that the tutor used for the face-to-face presentation but would use the Internet to allow tutees to interact with the tutor and the tutorial content.

A natural outgrowth of the Virtual Tutorial project will be the grouping of tutorials into sets and the assignment of *certificates* to students who successfully complete all tutorials in the set. Such a certificate program would add another dimension of utility to the tutorials. For professions were re-certification is a requirement, such certificate programs would be especially meaningful.

The Virtual Tutorial project will be *self-financing*. Financial reward to teachers and administrators will be linked to tuition revenue. Tutees will pay tuition either directly or through their employers. Tutors who successfully deliver courses to students will earn a percentage of each student's tuition payments. The Conference organizers that arranged the original tutorial will earn some revenue.

In summary, professional societies often have tutorials at conferences. Virtual tutorials would complement the face-to-face tutorials. A student who completed a related set of tutorials could earn a certificate. Tuition payments would pay the tutee and the organizers. This model for a tutorial program can be expected to be applied in many professional societies.

8.4.3 Degrees

Should a professional society offer *degree-granting education*? In the middle ages the professions were often responsible for the training of people to enter the profession and this was as close as people typically got to a degreed education. In modern days the state typically takes responsibility to organize and subsidize degree-based education. Professional societies are not generally well positioned to compete with the state in offering education for degrees. However, these societies are often involved in accrediting degree granting institutions.

The Association for Computing Machinery. and the Institute of Electrical and Electronics Engineers Computer Society together accredit computer science departments. In order to be considered for accreditation, full-time faculty should oversee all course work and should cover at least 70% of the total classroom instruction. Typically, a program should have a minimum of five full-time faculty with primary commitment to the program. In no case should teaching loads exceed the equivalent of twelve semester-hour credits per semester. Upper Division class sizes should not normally exceed 30 students. These requirements are tailored to a *bricks-and-mortar* higher education institution. If professional societies wanted to encourage virtual education, they could help develop accreditation criteria that were relevant to the virtual mode of operation.

In summary, professional societies are not well positioned to compete with the state in the awarding of degrees. Some professional societies do accredit degree-granting institutions and could produce accreditation criteria suited to virtual education. The exact role of professional societies in virtual degree programs is not clear.

8.4.4 Exercises

True or False

1) Some professional societies are offering education on the web.
2) A tutorial that is traditionally offered face-to-face would not be suitable for also offering in virtual mode.

Knowledge exercises:

1) Why do some professional societies in the health care sector support online continuing education?

Doing exercises:

1) Sketch a proposal for a professional society to enter into virtual education activities.

8.5 Government

Government is typically involved in education by collecting taxes that subsidize general education in the state. This is already one kind of broker role. However, in this section we wish to examine a new kind of phenomenon whose possibilities are enlarged due to technology and the opportunities for virtual education. We will make a case study of The Western Governors University. Some of the Western Governors of the United States have formed an alliance to facilitate the development of a virtual university that operates as a broker of education. The reader should note that what is what being done by the western states of the United States could be done by any other group of *states*.

The learning objectives for this subsection are:

- to see an example of a state-initiated, multi-state virtual university that operates as a broker,
- to learn how a virtual catalog might be at the core of such a virtual university, and
- to understand the political challenges that such a multi-state initiative faces from its own constituents.

In the end we might well imagine that government-sponsored brokerages for virtual education would be the dominant ones.

8.5.1 A Virtual University

The plans for the *Western Governors University* (WGU) began in June 1995 at the Western Governors' Association. The governors wanted to expand educational opportunities by offering courses from a wide array of sources and reaching a wide array of students. The particular focus is on reaching students at the workplace with teachers coming from various existing educational organizations. Thus WGU is a virtual university that operates as a broker.

The WGU is a nonprofit, independent corporation with a board of trustees composed of the governors from each participating state. The WGU is

- *market-oriented*, paying particular attention to developing education markets and needs;
- *client-centered*, focusing on the needs of students and employers;
- *degree-granting* and *accredited*, empowered to grant degrees that are recognized by employers and academia;
- *competency-based*, certifying learning and competency, not seat time;
- *nonteaching*, having no faculty of its own, but drawing from other institutions and other sources;
- *regional*, sharing resources and taking advantage of economies of scale.

Standards of quality for courses are developed by both faculty and industry experts. These are used by a Regional Review Council to screen courses and programs that are candidates for listing in the WGU catalog.

8.5.2 Mechanisms

The central operation will be small, responsible for governance and policy, create and maintain the WGU's key assets (the catalog and management systems) and do quality control. A pilot of the WGU catalog became operational in 1997. Educational organizations have submitted course descriptions to the WGU for inclusion in the catalog. In 1998, the WGU will market courses for institutions whose courses qualify for inclusion in the WGU *catalog*. For successful completion of certain collections of these course offerings, WGU will award its own Associate of Arts degree and certification for an electronic technician.

The Internet-based catalog will list various courses offered by traditional and non traditional providers, but will be much more than a course list. Most importantly, it will map out the skills that need to be mastered in order for a student to pass assessments and receive WGU credentials. Students will be able to use the catalog to assess their existing skills and knowledge to help determine what courses they need and are prepared to take. They will also use it to create a profile, including convenient times for taking courses and the types of technologies they prefer, such as the Internet, computer software, videotapes or satellite. The catalog will use the profile to identify learning options for students leading to certificates of competency, professional certification programs, academic degrees or individual courses. In this interpretation, the catalog is more than a static listing of course offerings. Rather the catalog operates on student profiles to find the best match of educational programs for the student and could be called a *smart catalog*.

Each of WGU's participating states must establish at least one learning center that will provide one-stop shopping for WGU services, including access to the delivering technologies. These *learning centers* will be located at existing organizations such as public libraries, school extension sites or companies training their workforce through the WGU. The centers will conduct assessments of specific competencies; offer counseling; provide access to information technology, including computers, audio and video classrooms and Internet connections; and identify unmet education and training needs in the area.

Instruction will come from institutions of higher education, public and private, in addition to nontraditional providers of education services. WGU will not have permanent teaching faculty. Rather it will make contracts with other organizations to provide *teaching services* on a case-by-case basis.

The WGU will use a variety of *technologies*, including the Internet, CD-ROM, satellite and videotapes. Providers will make offerings available through the technologies of their choice, and students will choose courses based on the technologies they prefer or to which they have access. The governors want to make sure that access to educational opportunities is increased, that states coordinate their technology infrastructure development to lower costs and that the WGU accommodates, and even fosters, technologies of the future.

In summary, the catalog of the WGU contains courses submitted by various educational organizations and students can select certain courses to earn a WGU Associate of Arts Degree. The catalog will match student profiles against the offerings of WGU and make intelligent decisions for guiding the student -- thus the term “smart catalog”. Each participating state is responsible for providing learning centers that help students have access to the curriculum and provide guidance to the students and to the WGU. Teachers will work for other institutions that will be reimbursed by WGU for the teaching services offered by the faculty of the other institutions. A wide mix of technologies, including the Internet, video, and paper, will be used. Such a model for the running of a virtual university could be implemented by other governmental organizations, such as the United States Department of Education.

8.5.3 Internal Challenges

Within the confines of the Western States of the United States, the Western Governors University faces *competition* of various sorts. For instance, the most populous state represented in the Western Governors Association, namely California, decided that it would rather develop its own virtual university than be part of an effort led by other western states. Some states that have agreed to participate have not agreed as to how to participate, and within the state universities some faculty actively oppose the WGU agenda.

California elected to go its own way and is actively involved in planning a *California Virtual University*. This new organization will include 106 community colleges, the 23-campus California State University system, the nine campuses of the University of California, Stanford, the University of Southern California, and Cal Tech. Parallel to that effort, the California State University System is also planning its own virtual university, designed to electronically provide courseware from the system's 23 campuses.

The states that have agreed to participate have not necessarily agreed to participate fully. The *participation* by some states has been in spirit rather than in flesh. Each participating Governor has asked his or her legislature for $100,000 to help start the WGU. However, the states may not all comply with this request. For instance, in May 1997 The Nevada Legislature Ways and Means Committee voted 10-4 to reject the $100,000 appropriation for that state to join the Western Governors University. At issue for the majority was the public funding of a "private venture."

More generally, some educational institutions within the political boundaries of WGU are cautious about the WGU and concerned about the impact of the WGU on traditional programs. There is tension on these campuses over faculty compensation and tenure for faculty who invest time and intellectual energy on distance education. Whether the WGU can provide a framework for institutions to get involved with distance education, while resolving *faculty tensions* on campus remains to be seen. Community colleges and 4-year colleges and universities with strong adult education programs will likely be the first to get involved.

In summary, the WGU faces competition from various factions within the Western Governors own territory. California has elected not to participate in the WGU and has initiated its own California Virtual University. Some state governors agreed to ask their state legislatures to provide funds to help start the WGU but the state legislatures in some cases have not agreed with the governor. Faculty at universities with a research orientation are sometimes opposed to the WGU because they fear a reduction in time for research when distance education is emphasized. As a government related effort, the internal challenges faced by the WGU will probably be resolved on political grounds. Generally speaking, political factors determine the fate of government sponsored education.

8.5.4 Exercises

True or False:

1) The Western Governors University is joined by all states in the Western half of the United States.
2) The smart catalog is intended to guide students to the correct courses.

Knowledge exercises:

1) What is the role of a smart catalog in such a university?
2) What internal tensions has the WGU faced?

Doing exercises:

1) If you were to develop an Eastern Governors University, in what ways would it be similar to or different from the WGU?

8.6 Conclusion

Brokers try to put together those organizations or individuals that have education needs and those organizations or individuals that provide education to external audiences. Brokers typically do not have their own staff of educators nor any particular monopoly on an audience to receive education. In virtual mode, these brokers wish to offer

certain teachers on the internet the opportunity to have a greater audience and

certain students on the internet an opportunity for an education.

For instance a teacher in Germany offers a course in computer languages via a broker in the USA. A student in Korea takes the course on the internet via the broker. Brokers fit into at least four categories: sole function, publishers, professional societies, and government.

The sole function education broker has no function other than to broker education. By contrast, a publisher that creates opportunities for authors of its textbooks to teach on the Internet is not primarily a broker but is primarily a publisher. A *sole function broker* may itself take many forms and we chose to look at 3 subcategories called "between university and company", "between teacher and public", and "open catalog":

- The National Technological University helps connect universities to companies. It has been in the business for many years and has dozens of universities and companies in its regular stable of clients.

- Various organizations recruit excellent teachers from universities or other organizations and put together a curriculum to which are then recruited students from the public or from companies -- the International University and International School of Information Management fits in this category.
- The "open catalog" broker may simply provide a web site as a catalog into which teachers or schools can enter descriptions of distance education courses and students can search to find courses that suit their educational needs. The Globewide Network Academy invites anyone to describe an online course offering and anyone to search the database that has resulted from these entries.

Brokers have the advantage of great flexibility. They have no long term commitment to teachers or students and can thus quickly shift their alliances. At the same time, this weakens their credibility in the marketplace.

Publishers are natural for-profit organizations to move into the virtual education broker business. Publishers have been brokers for centuries. Within the educational sector their job has been to find teachers to write textbooks and then to persuade other teachers to order the book for their classes. This is a short distance from finding teachers to offer courses and students to take the courses. Furthermore, the publisher can gain further exposure for its own publications by using them in the virtual courses that it brokers.

McGraw-Hill is one of the largest publishing companies in the world and has several subdivisions that are engaged in education. In its Certified Public Accountant educational program teachers from various organizations are aligned with students. Publications from one division of McGraw-Hill may be used for virtual educational activities in another part of McGraw-Hill.

The *Ziff Davis* publishing organization has a most unusual pricing structure for its virtual university. Its virtual university charges students less than five dollars per month for unlimited enrollment in courses that last about a month eacg. Ziff Davis can thus sell more of its publications because those publications are used in its courses.

NovaNET acquired a large library of courseware developed in the 60s, 70s, and 80s in the PLATO project. One weakness of NovaNET is that most of the courseware is developed for older technology that did not support multimedia. However, the courseware domain models and pedagogical principles are sound, as are the facilities for managing student data.

The NovaNET library of courseware is available free to home users across the Internet. If an organization wants, however, to make a contract with NovaNET for access to this library, then the organization pays NovaNET usage fees. Part of the motivation for NovaNET of having a *free home service* is that they then attract interest in the organizational service.

While the number of NovaNET student users is over 100,000, far more students exist. Perhaps the market for high school education on the Internet is not as extensive as some claim. The *high school system* is perhaps poorly equipped with computers and computer networks, and thus education delivered by computer is not easily accessed by teachers and students. Students that might most comfortably receive education on the Internet are perhaps the same ones that do not particularly need a curriculum that focuses on high school subjects.

The *government* could implement changes in public education consistent with the virtual education manifesto. For instance, if the public high schools were to be richly supplied with information technology, high school students and teachers could more readily access education on the computer. The government's role in education is the richest and most diverse of any organization in society. In the states of the United States, for instance, the taxes that are collected by the state go more into education than into any other activity. The federal government provides support to education in numerous forms but does not generally attempt to orchestrate education within state boundaries.

The Western Governors of the United States have begun a *Western Governors University* that is a superior example of a brokering educational organization. Across about a dozen states, educational organizations will contribute courses to an electronic catalog. The Western Governors University will arrange contracts with companies for their employees to access this education. The Western Governors have enough power to persuade the accrediting agencies to change their criteria so that this new university gets accredited and to also modify the laws in the various states that would normally work against such an entity. How effectively they will enlist the support of existing education institutions remains to be seen.

What is happening in the *marketplace* is mind boggling for its speed of development and its variety. How the market will settle remains unclear. Many alliances are possible, particularly among brokers themselves. The conditions under which one alliance will succeed and another will fail are not obvious. On the one hand, we can adopt the friction free capitalism view and say that this unbridled competition in the marketplace will lead to the best options for the consumer. On the other hand, the government's responsibility for educational support would seem to be neglected, if it does not take responsibility for those parts of virtual education that are in the public best interest. If workers are going to earn masters degrees in the workplace via the Internet, this would seem to be a responsibility consistent with the state mission.

In summary:

- Brokers connect teachers and students.
- Sole function brokers have no source of income other than from brokering and they have no permanent staff other than administrators.
- The simplest virtual broker is a self-organizing catalog that collects information from teaching organizations which information can subsequently be retrieved online by anyone.
- More active brokers contract with teachers to deliver education to certain students.
- Publishers connect book authors to book buyers and now extend that service in virtual education.
- Professional societies have good reputations that can be leveraged in the virtual educational realm.
- Government has the deepest pockets for investing in virtual education.

The function of broker is a broad one and many organizations may appropriately assume that function. Some organizations are, however, better equipped to enter this market, and we have focused our attention on three such types of organizations, namely, publishers, professional societies, and government.

We watch with great interest the unrolling of the virtual education panorama and the opportunity to understand where brokers will ultimately fit into the overall picture. Brokers should be able to be dominant players in certain market niches. While we presented Microsoft's virtual education activities in the chapter on corporate education, Microsoft's method is that of a broker, and Microsoft has established a dominant position in its educational market niche. Publishers, professional societies, and government also have natural advantages and should as brokers be able to dominate certain educational market niches.

8.6.1 Exercises

True or False:

1) A broker connects teachers and students.
2) Publishers are in the business of getting books from authors to readers and have no role in virtual education.
3) Education should be sponsored by organizations that are trusted, and professional societies tend to have this "trust" advantage, as they enter the virtual education market.

Knowledge essays:

1) Compare and contrast sole function brokers, publishers, professional societies, and governments for their roles as virtual education brokers.

Doing essay:

1) Describe the key partners with whom you want to start your virtual information technology college and why you choose them.

9. Conclusion

Learning Objectives

- To be able to summarize the contents of the book chapter by chapter.
- To predict the short-term and long-term future.
- To integrate the accumulated knowledge around one dialectical model.

Figure 78: Logo. Globe with scholar's cap. The title of this book wrapping around the picture.

What have we learned from this tour of virtual education? We have examined theories and examples of

- individual learning in virtual mode,
- virtual classrooms, and
- virtual schools.

A virtual educational organization transcends space, time, and organizational boundaries to offer a better education to certain market niches. We have particularly focused on the developing marketplaces for the delivery of virtual education.

9.1 Summary

Education *perpetuates* a culture. Whether the cultural bias is religious, political, economic, or social, through time education has become more institutionalized. The evolution of technologies for dealing with knowledge has been intimately linked to education. Technological advances of the past half century allow for large document collections and individual documents to be electronically manipulable over arbitrary distances. People can communicate over computer networks in multiple media. Through the continuing evolution of education and technology culture will be perpetuated in increasingly sophisticated and diverse forms.

Education is achieved through learning. Learning is, in turn, achieved through the modification of a model in the student's mind. Rote memorization is a crude learning task, while synthetic reasoning accomplishes more sophisticated learning. Through *courseware* the computer supports learning tasks. At its simplest, courseware holds linked text that gives the student a different kind of flexibility with browsing the information for memorizing content. For different learning tasks different presentations of information are appropriate. The book printed on paper remains a valuable tool for some understanding tasks and is likely to remain so for the foreseeable future. On the other hand, the new technologies offer new possibilities. An intelligent tutoring system uses domain, pedagogy, and student models in ways that human teachers do. These models can help guide rich multimedia interactions in the form of virtual realities. However, the cost of building intelligent, virtual reality tutoring systems is currently prohibitively high for most occasions. Standards for the components of these intelligent, virtual reality tutors do not exist. The paucity of courseware standards interferes with the perpetuation of courseware.

Courseware may be used by a lone student or in the context of a classroom. In classroom learning the student interacts with other students and the teacher in order to gain further insights. The *virtual classroom* exists on the information superhighway. Groupware technologies are particularly apropos to the classroom. Groupware supports the activities of a group in synchronous or asynchronous mode. The simplest way to do this is to provide for online submission of exercise answers and electronic bulletin boards for discussion of those answers. Students may use a paper book for the core reading material. Groupware may be used for courses that still have regular face-to-face meetings, or all meetings might occur via the groupware and none in face-to-face mode. In the Studio Course, groupware complements lectures and courseware. The Studio Course has been shown to reduce the cost of traditional teaching and to improve quality. The virtual classroom allows teachers to manage the submission of work and student-student interactions in ways that would be impractical without the computer support.

A classroom exists within a school. The *virtual school* is a type of virtual organization. In a successful virtual organization, the technology fits into the workflow of the people. To place a school onto the information superhighway, one needs a model of the school. This model must accommodate students, teachers, administrators, marketers, and more. Information systems are commercially available which implement the standard model of a school and which can be tailored to a particular school's needs. One of the impediments to progress in this arena is the idiosyncratic character of individual schools and the corresponding high cost of tailoring an information system to a particular school. Standards for schools and their information systems reduce the costs of individual school information systems. Standards for operation also facilitate quality control. Furthermore, with computer networks one can monitor many of the transactions within a school and automatically give feedback about the quality of performance of individuals within the school.

The production of sophisticated courseware may require specialist teams. This is not for the lone teacher to do, as is too often the case in universities. Instead a manufacturing process may be applied to courseware production. Different people play highly specialized roles in keeping to a precise schedule of sequentially linked deliverables that form the courseware life cycle. People involved in *courseware production* require substantial organizational support.

Given the organizational overheads associated with virtual education, investment should go first where the greatest market need exists. The captive student is an employee of the company managing the education. Many large companies have education programs for their employees, and these employees constitute a captive audience for education mandated by the employer. In a very different kind of way, a company that sells a product has a captive audience for education. For instance, the Oracle Corporation is in a privileged position for providing education about Oracle database products. Furthermore, providing such education helps the customer use the product and thus improves customer loyalty. Thus customer-targeted education represents a major *market* for virtual education. State universities do not have a captive audience of students in the sense of company employees or customers. However, the state university is able to offer reduced costs to students from the state, and this is an enormous advantage in that marketplace.

Education brokers link students and teachers. *Brokers* can be categorized as sole function, publisher, professional society, or government. Sole function brokers have no other purpose than to broker education and gain their strength by their extensive reach into the market of teachers and students. Publishers are another kind of broker that traditionally focuses on the relationship between authors of content and teachers who recommend the material to their students. However, these publishers can take advantage of the information superhighway and try to become brokers that go directly from the authors to the students. The challenge for the broker in part is to have credibility in the marketplace. Professional societies may sponsor education functions for their members and be seen as highly credible. Professional societies could partner with others to extend virtual education and provide quality control.

Government is the biggest provider of education in most countries. The *government* collects taxes to hire full-time teachers, to place them in buildings, and to give students in the government's tax area subsidized education. Government is in a strong position to finance virtual education initiatives that bring together state-supported schools with other organizations in the state in order to meet educational needs. The Western Governors University is a prime example of such a government-brokered virtual education initiative.

In summary, education perpetuates a culture and the ways and means for this are multiple:

- through courseware the computer supports learning tasks;
- the virtual classroom supports the classroom across time, space, and organizational boundaries; and
- the virtual school is to the traditional school what the virtual classroom is to the traditional classroom.

From a market perspective, we see that

- companies have a captive audience for certain education to their employees and their customers;
- brokers connect teachers and students from different organizations; and
- government has massive investment in education and will be a major player in the virtual education arena.

Our emphasis has been on the merging of people and technology in education. We've viewed this from the perspective of learning, teaching, administering, authoring, and marketing.

9.1.1 Exercises

True or False

1) The virtual classroom is a kind of groupware.

2) The virtual school is a kind of virtual organization.

Knowledge Essay

1) Describe in your own words the key concept in each of the preceding chapters with one sentence per chapter.

Doing Essay

1) Develop a different organization of the book that covers similar material but has different chapter headings. What would your chapter titles be?

9.2 Future

We suggest the creation of a virtual information technology college as one immediate step that would satisfy a market need. More generally, we predict that over the next five years the use of technology will increase and rely more and more on the web. Over the next thirty years corporate education to employees and customers of global companies may play an increasingly vital role in global, virtual education. In this subsection we will

- develop a proposal for a virtual college that is needed now and
- anticipate the trends in virtual education over first the next five and then the next thirty years.

Our goal is to help shape the future.

9.2.1 Next Step

We live in a society in which lifelong learning is increasingly important. Educators are challenged to meet these needs. Rather than coming to the traditional classroom, many students want to be reached in the home and workplace.

In the developed world the need for information technology education throughout the workforce is enormous. For instance, the number one barrier to expansion of Microsoft Solution Providers is the shortage of adequately trained information technologists. Microsoft is using the Internet to help reach these people. One key to a successful virtual educational activity is that the participants are comfortable with information technology and are highly motivated. Accordingly, one discipline that is particularly ripe for virtual education is the *information technology discipline* itself. Where else could one be more assured that the teachers and students would be comfortable with the tools and that the demand is great and growing?

We are recommending as one immediate step the development of *virtual information technology colleges*. The colleges will help students and teachers of information technology work together across time, space, and organizational boundaries. These colleges will help other organizations educate their employees and their customers on the subject of information technology. More generally, these colleges will as part of their mission help through education other organizations appreciate the role that information technology can play in improving the organization.

In these self-financing colleges, *financial reward* to teachers and administrators will be linked to college revenue. Students will pay tuition through their employers. Teachers will earn a percentage of each student's tuition payments.

Rigorous descriptions of the roles in the College will facilitate the automation of clerical functions and increase the opportunities for diverse people to select appropriate roles for themselves. The *roles* of teacher, student, and administrator need to be carefully refined.

The *student roles* may vary. In one case, the student works alone and takes tests on content learned. In another case, the student learns primarily from interacting with other students and passing of the course is based on the ability to interact successfully with other students. In this latter case, one role of student may be as mentor to other students. In the first two years of operation of the College the demarcation of student roles will be left entirely in the hands of the teachers, and the College will simply monitor that quality is maintained.

The *teacher roles* might include content producer and deliverer. In the first two years of the College, the content production roles will be de-emphasized. Rather the teacher as a deliverer will be expected to choose the content from some existing source. In the third year of the College, the marketing role will begin to consider contracts for content production. Prospective teachers will be required to demonstrate their qualifications before their course is offered through the College.

Each course should have criteria for successful completion which are documented in advance by the teacher. Students and teachers will be required to document critical transactions during the course that will allow certification of *quality processes* occurring in the course. The colleges should recommend a set of environments for teachers to use. However, teachers may use whatever technological infrastructure they want so long as that infrastructure meets certain basic requirements of the college for providing virtual mode, quality education that can be easily monitored from the central administration.

These new colleges should approach information technology organizations, such as Oracle, MCI, Microsoft, and Xerox, to ask for partnership in linking product-based education into a broader curriculum. The colleges should also approach employers to make contracts for continuing education—organizations such as The Boeing Company and the Department of Defense. Finally, the colleges should make *alliances* with selected other higher education organizations, such as the British Open University.

While we have talked abstractly about creating virtual information technology colleges, we have actually put our money were our mouth is. The *Globewide Network Academy* through this author has created a Virtual Information Technology College. Those who have submitted entries to the online catalog of the Academy are first asked whether they want to teach in the new College.

In summary, as the tool must fit into the life style of its intended user, one ripe target for virtual education is the student of information technology. For this same reason, virtual information technology colleges are particularly likely to be self-financing and to be amenable to computer support. Our anticipation is that virtual education will be important in numerous areas but that for the short-term the best target is the *information technology student*.

9.2.2 Five-year Future

Even in the medium term of five years, we have not proven adept at predicting what specific forms of technological support will be the most cost-effective, or even in common use, within higher education. For instance, in 1990 there was little inkling that use of the Internet would have the impact on higher education that it has had. Conversely, ten years ago, the use of artificial intelligence techniques was widely predicted to impact education and training but did not. However, general trends can be *predicted*.

We safely predict that the use of information technology will increase. This will correspond with an increasing access to appropriate facilities. Activities routinely in need of support will include:

- individual learning from courseware,
- local and distance communication, and
- access to remote resources.

The use of the *Internet* to support the latter of these two is expected to show particularly dramatic gains over the coming years.

Currently the principal strategies for teaching and learning in higher education are based on the spoken *lecture*. Although the lecture may be viewed as a cost-efficient means for transferring knowledge, in many lectures little student learning occurs and passive rather than active learning strategies are reinforced. Current educational approaches favor focused and purposeful problem-based learning, and appropriate use of dialogue among learners. This includes the ability to reason and seek creative solutions individually and in groups. Such interactive learning should increase over the coming years and be often mediated over computer networks, such as the Internet.

The *management* of classrooms, schools, and entire educational systems can be facilitated by information technology. By tracking each transaction between a student and the educational system, the computer can facilitate the decomposition of the educational enterprise in ways that give new options to the student and reduce costs. This process is occurring in numerous other enterprises, such as financial, manufacturing, and retail enterprises. The government also continues its adoption of information technology but with neither the speed nor the effectiveness of private enterprise. Thus our prediction is that traditional, state-funded educational organizations will continue to invest in automation but that they will be relatively ineffective with these investments.

What students will have the most to gain from virtual education over the next five years? Imbalances in demands for skills and the needs for life-long learning mean that *graduate retraining* is a growth area. Education offered over the web is likely to be effective for graduates who are well motivated and comfortable with the web. This education would arrive at the workplace or home and be suited to the career advancement of the student. Companies will play increasing roles in sponsoring such education.

The uses to which information technology might be put over the next five years in education are many and varied. One principle will surely apply: when the technology *fits smoothly into the life style* of the intended users, then success is likely, and otherwise not. For instance, if the target audience has no computers but has to go to special facilities to use them, then some of the advantages of virtual education may be diminished. Likewise for teachers and administrators, if routine computer use is awkward, then the opportunities to have a virtual organization are limited. Before the virtual educational organization can offer an excellent service and operate in virtual mode, its members must be comfortable on the information superhighway.

In summary:

- Changes in technology used by education have proven difficult to predict. However, the next five years should see a continued increase in the use of networked computing, such as via the Internet or its World Wide Web application. Lectures are no longer considered a quality method of educating, and interactive learning with the support of *computer networks* should become more common.
- The *management* of educational enterprises could benefit enormously from tracking extensively the transactions of its business. However, the lack of

direct financial incentives for such improvement will mitigate against the kinds of improvements that one can witness in other lines of business.

- Students in continuing education should become an increasingly large part of the total student population and be particularly suited to education delivered at the workplace or home. As the tools must be comfortable to the students who will use them, *high technology, continuing education students* will be prime targets initially for virtual education delivered via high technology.

While the rapid pace of change makes precise predictions even a few months in advance impossible, we feel the aforementioned three, broad categories of trends are reliable.

9.2.3 Thirty-year Future

Some experts say higher education is in crisis. Renowned management consultant and author Peter Drucker says (Lenzner and Johnson, 1997): "Thirty years from now the big university campuses will be relics. Universities won't survive. It's as large a change as when we first got the printed book. Do you realize that the cost of higher education has risen as fast as the cost of health care? ... Such totally uncontrollable expenditures, without any visible improvement in either the content or the quality of education, means that the system is rapidly becoming untenable. Higher education is in deep crisis... Already we are beginning to deliver more lectures and classes off campus via satellite or two-way video at a fraction of the cost. The *college won't survive* as a residential institution. "

We do not see an end to traditional, residential campuses. Massy and Zemsky (1995) have said: "One must remember not to *confuse 'contact' with 'contact hours'*" . Some students will continue to want a traditional collegiate education with all its socialization (or contact), while others will just want the certification (or contact hours). Information technology will allow this separation and—moreover—allow the learner to choose either or both.

While the automation of schools systems was seen as unlikely in the five year forecast, the educational organization will have become in thirty years more *effective and efficient* through the proper use of information technology. The judicious use of technology under inspired leadership can help a school separate content production, from delivery, from assessment. Students, teachers, and administrators will better share information in ways that improve quality control.

The detailed shape of information technology thirty years hence is *difficult to predict*. Wireless computers the size of a credit card will receive data or multimedia information anywhere and anytime for some people. Artificial intelligence techniques will allow some roles in the organization to be performed by computers. To the extent that these or very different technologies become prevalent, they will be implemented first in non-educational organizations. For instance, the financial sector will use multimedia information and artificial intelligence before the education sector does. Nevertheless, in thirty years time some educational organizations should be significantly different from those we know today, while some will be little changed from their current situation. The exact shape and extent of the changes in the activities of public education are difficult to predict.

New education marketplaces will rise in prominence over the next thirty years. More and more organizations will need to educate customers in order to keep their customers. State funded organizations have rather well defined audiences and boundaries that often limit their ambitions as regards reaching new markets of students. Companies with a product to sell do not have the same constraints. In certain markets virtual education is already occurring between companies and customers. If political boundaries remain as crustacean as they have for millenia but the globalization of business continues, then corporate education may play an increasingly prominent role. Virtual *education between company and customer* could become the dominant mode of continuing and life-long learning in thirty years.

In review, some experts predict that the large, residential campus will cease to exist in thirty years. Others, including this author, believe that the acculturation of students on campuses is such an integral part of our society that the campus will remain. Over thirty years time, increased automation in schools should have had a generally positive impact on effectiveness and efficiency. While the exact shape and extent of the changes in the activities of public education are difficult to predict, virtual education between company and customer could become the dominant mode of continuing and life-long learning.

9.2.4 Exercises

True or False

1) Students of the arts are the most likely to feel comfortable with virtual education.

Knowledge exercises:

1) Why did we suggest to develop next a virtual college that teaches about information technology rather than about any other topic?
2) In five years time what information technology should be more used?

3) What kinds of organizations might have risen to new prominence in virtual education thirty years from now?

Doing exercises:

1) Propose a topic for your own virtual college and explain the strategy for successfully marketing that college.
2) Make your own predictions for five and thirty years forward.

9.3 Dialectics

Dialectics is a practice of arriving at the truth by the exchange of logical arguments. In particular the practice is associated with the Marxian process of change through the conflicting of opposing forces, whereby a given contradiction is characterized by a primary and a secondary aspect. The secondary aspect succumbs to the primary but is then transformed into an aspect of a new contradiction.

We will approach the mapping among *tools, problems, and people* from a dialectical perspective (see Figure 79 “People, Tools, and Problems”). If we say that a certain tool supports virtual education, then we mean that for certain people with certain educational needs that a certain tool can help. For other people or other educational needs the tool may well be inappropriate. At any point in time, we could develop an extensive set of maps for various combinations of people, tools, and problems.

Now consider *changes across time*. For instance, a new tool appears. This new tool may be better for some combination of people and problems than the tool that they currently use. We have a tension between the established way of working and the new way that uses the new tool. For these people to resolve this tension, they need to move to the new way of working. This move should occur gracefully and peacefully but sometimes the change may be awkward and conflict-laden. After the change, a peace prevails only so long as developments in people, their educational needs, or their tools do not require another transition in the way of work.

Consider the traditional classroom lecture for a fully-employed adult who wants to earn a Master’s Degree in Business Administration. Now the tool of the web creates opportunities for students to earn their degree in virtual mode. As some students and teachers move to this form of study, they experience the tension of adapting to new ways. Examples for other tools, other students, and other courses of study are endless and through time new *combinations arise*.

The educational system has evolved rather slowly over the centuries but the pace of change is quickening. To understand that directions that will be followed, we need to understand the mapping among people, their tools, and their problems and how this mapping will change over time. We will examine next some of the dominant *themes* that help explain how the maps are redrawn.

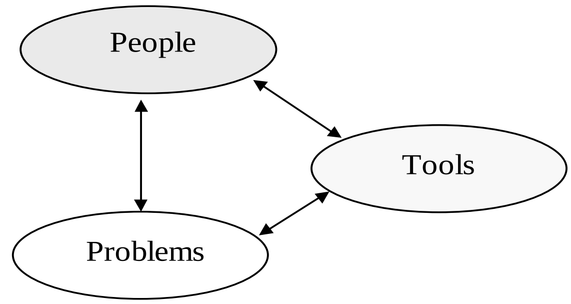


Figure 79: People, Tools, Problems.

For people to take advantage of the power of the computer to help manage the *transactions* of virtual education, the information about a transaction must be known by the computer. To this end, any activity involving non-computer media for which records should be maintained and monitored should also be encoded and entered into the appropriate computer storage. One theme of change will be the continued move of information into computers and the monitoring of student and teacher transactions through the computer networks.

Massy and Zemsky (1995) have said: “Information technology’s strongest potential influence is that it will place the advantage with the learner rather than the institution, by creating a more effective market in learning, as opposed to a controlled allocation of scarce teaching resources.” For the learner already committed to a *physical location*, such as a child in a school, the options for that student are different from those of a student in the workplace. Students at work may want different tools to facilitate their learning. Their demand for education with new tools will lead to changes in the dominant patterns of education for this population and be one key driver in the evolving geography of education.

States want children educated in the accepted ways of the state. States typically finance general education for children. The states have built schools in many neighborhoods How would virtual education solve a problem for *children* not already well addressed by the schools? Publishers are offering educational, multimedia, interactive CD-ROMs from which children can enjoyably learn basic literacy. The student can use these products equally well at home as at school. The increasing presence of these tools will drive parents, schools, and the state to readjustments in the supported mapping of students and tools.

Figure 80:Gates

In his book The Road Ahead Bill Gates (see Figure 80 "Gates") emphasizes the role of *friction-free capitalism* in the information age. When Adam Smith described the concept of markets in The Wealth of Nations in 1776, he theorized that if every buyer knew every seller's price, and every seller knew what every buyer was willing to pay, everyone in the market would be able to make fully informed decisions and society's resources would be distributed efficiently. To date we have not achieved Smith's ideal because would-be buyers and would-be sellers seldom have complete information about one another. The information highway may extend the electronic marketplace and make it the universal middleman (Gates, 1996). For this low-friction, low-overhead scenario to attain, market information must be plentiful and transaction costs low.

The application of friction-free capitalism to education means that the only humans involved in a transaction will be the actual *student and teacher* – with students and teachers from anywhere in the world able to connect. Why should a student be restricted to enrolling in one institution and taking a course from that institution when there is another version of the course elsewhere that better suits him? If a student simply wants a course, why bother to have a school and not just let the student contact the teacher?

The *school* goes beyond the teacher-student relationship to certify a curriculum. A school structures a particular sequence of offerings and certifies it. In the open-market of the information superhighway, the schools will have to continually re-assess how their certificates compare with those of other schools. This tension to compete globally will drive the adoption of new tools for managing schools.

Virtual education involves, at least, the *roles of student and teacher* (see Figure 81 "Students, Educators, Sponsors"). Beyond those basic roles, other roles include those of administrator and sponsor. Sponsors provide resources. The state is a major sponsor. Companies can also sponsor education either for employees or customers.

Who will *sponsor* the virtual school? Publishers, their retailers, and libraries provide access to content. Publishers are beginning to offer virtual education by organizing teachers and students. Traditional public

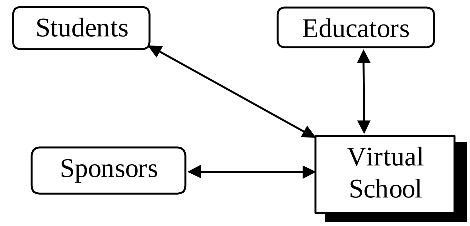


Figure 81: Students, Educators, Sponsors.

universities are entering the virtual education marketplace. The former President of The University of Michigan has said (Duderstadt, 1995) that in twenty years: "It will be a cyberspace university that provides education and information whenever students want it, wherever students want it, and in the form they want it." The competition between commercial publishers and state financed educational institutions is another change agent in the evolving map of virtual education.

Sponsors that have a *captive audience* include the organization with an educational program for its employees or that can teach about its product to a customer who has no other credible source of education about the product (see Figure 82 "Captive Students"). The role of state schools creates a different kind of captivity. Students who go to state schools in their region get the benefit of reduced costs for themselves. A somewhat different kind of competitive factor occurs when an educational organization has permanent teaching staff—this is an aspect of being captive that is quite different from having a captive student but is also relevant to an understanding of the evolving geography of virtual education.

In some scenarios friction-free education is excellent. However, the socialist view might argue for a different approach. Does friction-free education collide with universal education? For education from childhood till death, we might want records to document each student's educational past and to facilitate the seamless tailoring of further education to the student's particular needs and background. This tension between allowing people to freely connect on the one hand, and institutionalizing the support for their connections is a

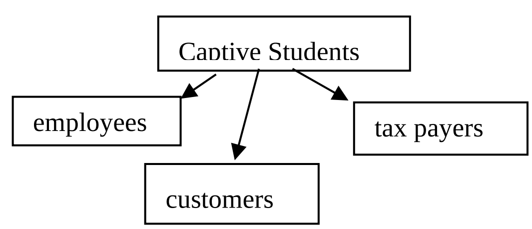


Figure 82: Captive Students

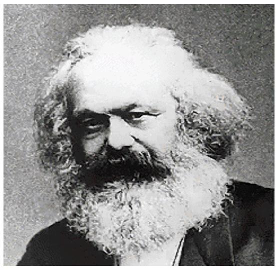


Figure 83: Marx

tension in the traditional *Marxist* sense of a dialectic (see Figure 83 “Marx”). How will we create a virtual education system in which:

1) people are free to learn but

2) the records of students and teachers are controlled by schools.

Friction-free capitalism may be good for some students. For other students, managed education is more appropriate.

While much of the popular discussion of virtual education focuses on connecting public schools and libraries to the Internet, the greatest growth in the virtual education marketplace may occur elsewhere. The largest untapped marketplace may involve the connecting of students at home and the workplace to virtual schools organized by new sponsors. Working people need continual education in our rapidly changing digital world. *Global companies* with captive audiences of employees and customers may increasingly compete with one another through their sponsorship of virtual education.

Global companies have boundaries that go beyond those of any particular government and have needs to perpetuate their own culture. To this end a company may collaborate with existing higher education institutions to better prepare the company's employees and customers to deal with the kinds of products and services that the company produces. This education may go beyond narrow training and may encompass combinations of theory and practice that will be relevant to the day-to-day experiences of the students. This growth in the breadth and depth of life-long education may become the foundation for *a new age of enlightenment*.

9.3.1 Exercises

True or False

1) Dialectics is a form of logical argument.

2) Children can either benefit from virtual education or be acculturated in the neighborhood school but not both.

3) Friction-free capitalism connects buyers and sellers through a middleman.

Knowledge essays:

1) How does the mapping among tools, people, and problems create a framework for a dialectic?

2) Give an example of the application of friction-free capitalism to education.

Doing essay:

1) Describe one popular mapping of people, tools, and problems. Then propose a different mapping to which you think these people will move in the future.

Figure 84: References to other reading.

10. References

10.1 A-D

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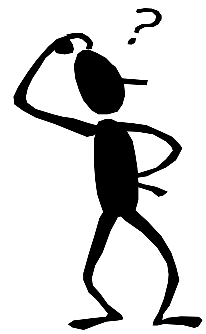
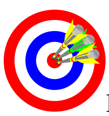


Figure 85: Answering. The stick figure is pondering an answer to a question.

11. Answers


Learning Objectives

- Reader should first attempt answers without reading here.
- True-false answers require simple recall of the presentation in the book.
- Knowledge essays involve further recall of material from the book and perhaps some analysis.
- Doing essays are open-ended.

This chapter contains the authors hints on answers to all the exercises from the book. For true-false statements, the answer is given here, and if the answer is false, then the rewording that would make the statement true is offered. For the knowledge and doing essay questions, a brief answer is provided. The essay questions do not have yes-no answers and various different answers might be equally correct. This chapter is organized so as to reflect the section of the book in which the exercises occurred.

11.1 Introduction and History

11.1.1 History of Education

True or False

1) True

2) False. Medieval universities often had no buildings and minimal administration, as professors practiced from the street and collected student fees directly.

3) False. 17th century American education was driven by religious concerns.

4) True

Knowledge Essays

1) The purpose of education is to perpetuate the society that provides the education. This society could be predominantly concerned about its religious values and have education be primarily about its religion. Or the concern could be political, scientific, or otherwise.

2) Learning by imitation means to watch someone else and to duplicate the behavior of that other person.

3) Very few children were educated in Ancient Egypt. Those who were followed a strict religious training.

4) Religion has been a dominant factor in the ideology and government of society for many centuries.

Education has been typically supported by religious organizations to perpetuate their ideals. Certain sectors of the population must be continually educated to provide further education or guidance to others.

5) The monitorial method had senior students teach junior students. For the method to be effective a substantial amount of discipline was required in the school. With current systems of monitoring transactions on computer networks it is more conceivable again that interaction among students (senior to junior and otherwise) could be encouraged and monitored in semi-automatic fashion.

Doing Essays

1) Children now often imitate what they see on television. However, in Western society the behaviors that are imitated are often extreme and materialistic behaviors because the commercial television that the children see often encourages this. Traditional imitative learning occurred through children being involved in routine day-to-day activities with their extended family. In today's highly specialized world, children do not seem to have the same kind of abundant opportunities for imitative learning that children many years ago had and virtual mode delivery is unlikely to provide realistic environments for children to engage in the traditional imitative learning. On the other hand, one could imagine that new models of interaction in virtual mode would be useful for children to learn and could be well supported in virtual mode.

2) The Ancient Egyptians physically punished students who were tardy in their school work. The Ancient world was a more physical and mystical one. We now have more emphasis on cognitive level activities and realize that cognitive type rewards and punishments may play more effective roles in learning.

3) Lecture and memorization dominated teaching in the medieval university and often seem to dominate it today too. The reasons for this lack of progress may be the economics of education. It is inexpensive for the teacher to lecture to large numbers of students in a classroom but more costly for the teacher to manage a class in which students experience individualized, meaningful interaction.

4) Why not let the student pay the teacher directly and thus create a kind of market pressure to have teachers that students like? The advantages that might accrue from students selecting popular teachers might be out-weighed by the disadvantages of a school administration arranging curricula that guide students to certain socially necessary results and assigning teachers to courses that students must take. Some healthy balance among the two is appropriate.

5) The success of the non-secular monitorial method precipitated the church's further support of education and then government support. If one wanted the national government to get involved in something like creating a national virtual information technology college, one way to make it succeed might be to have it be private first and show great success. Likewise, for companies to succeed in reaching customers with education might eventually stimulate the state or other organizations to respond similarly with further education to the workplace or home that is tailored to specific needs of people.

6) The educational branch of a private company perpetuates the company ideals. Most large companies have educational branches that educate their employees and also their customers. Success of the company depends on appropriate education to both sets of audiences. An example would be The Boeing Company's internal educational program for employees to have competency on necessary topics and also the training provided on Boeing products to customers.

11.1.2 History of Technology

True or False

1) True.

2) True.

3) False. Hypertext is an instance of hypermedia, rather than the other way around.

4) False. CD-ROM is an abbreviation for Compact Disk Read Only Memory.

5) True.

Knowledge Essays

1) Documents are a vehicle for perpetuating culture and delivering education.

2) How many bits in a one-hour long video? Each image might be said to occupy about a million bits. A second of video is about 30 images. An hour of video is thus approximately 1,800 million bits. The number depends a great deal on the size of each image which varies under compression and other factors.

3) Was there optimism for enormous video impact in the 1930s. Yes there was enormous optimism that both radio and video would transform education. However, formal education has only been modestly impacted by these representation and delivery vehicles.

Doing Essays

1) People across different historical periods fear the information explosion is most severe for them? Yes, that anxiety is certainly true now. Fortunately, the same tools that lead to the information explosion can at times help manage that explosion. The World Wide Web is a good example of a tool that supports the information explosion but education across the web could help people develop models of the new information that would make it seem less of an explosion.

2) How might one persuade the government to invest in new combinations of technology and education? The example from Index Medicus was that a large constituency of doctors and others were persuaded that it had value and then exerted pressure on the government to subsidize it. The same lesson could be followed now.

3) What kinds of learning, if any, might be supported by large document retrieval systems? Students do not typically need large amounts of documents to read but rather certain ones tailored to their current knowledge and their educational needs. MEDLARS might be particularly useful for continuing education of medical doctors who want to know the published journal medical articles that are appearing. The educational system could be linked to relevant documents.

4) How do you see the evolution of artificial intelligence and the World Wide Web coming together to influence the path of virtual education? The web provides the interface to reach large audiences. Artificial intelligence provides the backend decision-making that can guide the users in learning.

11.1.3 Conclusion

True or False

1) False. Educational systems have tended to change slowly over the centuries.

2) True.

Knowledge Essays

1) Education began with imitation and over many centuries evolved to include some further formalization and enlargement of the social community which took responsibility. Religious education was a primary content type for religion for many centuries. In recent centuries the lecture method has dominated higher education but this is widely recognized to not be the optimal form of education for any given student.

2) Information technology in a certain sense begins with natural language and continues through various tools to store or manipulate it. Documents are vital to transmission of information in education. The growth of computers and networks in the past 50 years is having a profound impact on people's ability to deal with information.

Doing Essays

1) The purpose of education is to perpetuate those who offer it. By understanding this purpose, we can see that companies that retain loyal employees or customers through education are highly motivated.

2) This century is witnessing a growing emphasis on cradle to grave education. Information technology has developed to the extent that we can see a computer in every home and on every desktop that is connected to every other computer. This need for pervasive education is completely harmonious with the development of pervasive computing. The topic of computing itself is actually one of the major subjects on which life-long education is needed.

11.2 Learning and Courseware

11.2.1 Learning and Pedagogy

True or False

1) False. At the simplest level, Bloom's Taxonomy identifies recall and at the highest level it identifies evaluation.

2) True.

Knowledge Essay

1) Learning by doing requires the student to be actively engaged in some meaningful constructive task and to learn in the course of making progress on that task. This is particularly different from learning by rote memory.

Doing Essays

1) Various cognitive learning taxonomies, such as the one called Bloom's and the one from the American Psychological Association, have been constructed. A much simplified taxonomy is one that divides learning into understanding what one has been told versus developing new insights by doing something in the world. This might roughly correspond to the Bloom taxonomy in that understanding alone would relate to knowledge and comprehension (the two lowest levels of the Bloom taxonomy) whereas new insights by doing would correspond to the highest levels of Bloom's taxonomy, namely the synthesis and evaluation levels.

2) An example of a topic that I was not taught via learning by doing follows. I was not taught the history

of the world by doing but rather by memorization along themes. To the extent that one would could revisit the historical events either by physically or simulations, one might be able to generate models that predict the future without memorizing what one is told.

11.2.2 Courseware

True or False

1) True

2) False. The PathMac tutoring system was first developed in the 1980s.

3) True

4) True

5) False. The difference between a hypertext system and an expert system is in the inference capability of the expert system and its concomitant ability to solve problems.

6) True

7) False. A meta-analysis must look at the result of many classroom experiments before determining general conclusions.

8) True

Knowledge Essays

1) An experiment was done with students learning from a paper book or a hypertext book. For questions about the overall understanding of the book, those students who used the paper book did better than those who used the hypertext. Paper is better for understanding tasks, when the student must appreciate the full complexity of the material rather than just answer one specific question about a small part of the content. People are comfortable with paper.

2) To build a computer expert a domain expert works with a knowledge engineer to develop rules that help solve problems. To build hypertext, an author works with a hypertext engineer to link text on the computer so that readers can browse the text. Hypertext is one way to present material to students. The expert system part could begin to make the system behaving intelligently by encoding rules about pedagogy, by tracking student behavior, and by simulating the domain.

Doing Essays

1) Say that you want to use a combination of paper, interactive multiple choice quizzes, and computer animations to teach a subject. Anatomy might be a good subject to teach in the indicated way. Students could read descriptions of the characteristics of the anatomical parts. Quizzes could ask students questions like "the arm is connected to a) the leg, b) the head, or c) the torso. Computer animations could show the parts of the body in action. For instance the arm could be shown throwing a ball as a motion that relates to the torso as well as the connection of the hand to the ball.

2) In an intelligent virtual reality tutoring system, various high level components are required. The intelligent part of the system would contain the typical domain module, pedagogy module, and student module. Additionally for the virtual reality component one needs to have detailed models of the domain related to computer programs that can simulate the models and furthermore to render these simulations in understandable visual ways. Given that the user interacts with a virtual reality system, the system must have a sophisticated student model that anticipates and understands the input of the student and responds appropriately. While this is true of the responses to typical questions, such as multiple choice questions, for the virtual reality simulation to seem meaningful it might face additional challenges of timing and realism.

3) When a student starts to use an intelligent tutoring system, the system should know what the student already knows in order that it can best guide the student. The system could ask the student questions and develop a model of the student from that source. During a given course the computer can observe the student's behavior and infer attributes of the student. Ultimately, if the system were part of an integrated educational system that tracked students through various courses throughout their life, then the system could refer to the previous records of the student to understand what the student had learned and in what ways.

4) An intelligent tutoring system is only cost-effective when the revenues or other rewards generated by students using the system are greater than the costs in making and using the system. For instance, if millions of students were to use the system and would learn as well as when taught face-to-face by a human, then one could justify spending millions to build and deploy the intelligent tutoring system. Alternately, the few people who would use the system may be somehow in very special situations that merit great investment. For instance, the American military spends millions of dollars to develop intelligent tutoring systems that train people on responding to disasters on advanced weapons systems.

11.2.3 Conclusion

True or False

1) True

2) False. An intelligent tutoring system contains three models, one of the student, one of pedagogy, and one of the domain.

3) True

Knowledge Essays

1) Intelligent virtual reality tutoring systems are an extension of knowledge-based tutoring systems to include the incorporation of rich multimedia that simulates reality. Intelligent is largely synonymous here with knowledge-based. The intelligent system might have learning components that were other than knowledge-based but that is less important now than it might be in the future. Likewise, virtual reality is essentially synonymous with rich multimedia that simulates reality.

2) Standards for importing and exporting text and graphics formats have been developed for courseware. This is the easiest step in a way. The standards also specify that descriptions of course objectives and lesson logic should be able to be imported and exported in text format. This later standard is harder to get widely accepted due to the lesser agreement on what are appropriate formats for lesson logic.

Doing Essays

1) Six questions relevant to the book that represent one each the 6 categories of Bloom's cognitive taxonomy are: Knowledge: When was the monitorial method first used? Comprehension: Describe the monitorial method. Application: How is the monitorial method related to the traditional classroom? Analysis: What are the separate components of the monitorial method? Synthesis: How would you design a tutoring system? Evaluation: What is the value of the standards for courseware that exist?

2) In one sscenario technology facilitates learning-by-doing and in another scenario it hinders learning-by-doing. Learning-by-doing on the one hand seems eminently suited to real-life experiences. For instance, when a student dissects a cockroach, the student learns about cockroach anatomy in ways that would be different from doing a virtual dissection on the computer. Thus the technology in a certain sense could be used as an inferior substitute for actual learning by doing. However, for someone without the occasion to dissect a cockroach, the virtual dissection might be very useful. So this second scenario is just the first tool and subject but a different student circumstance.

3) Paper may still be the best choice for people engaged in understanding tasks. The paper is more legible, tangible, portable, and familiar. For computers to replace paper, I would want to make computers more tangible, portable, and familiar and the images on their screens more legible. This includes giving desktops larger, higher resolution screens. Portables should become lighter and have longer battery life. The interface should provide easy cues as to where in the material a person is. .

4) Computers can represent models of reality and make these models come to life for students in an effort to teach the student about the models. But certain factors limi getting more of these models successfully incorporated into computers and delivered to students. One limit is the high cost of developing the systems. Almost all aspects of these systems are costly to prepare – the domain knowledge is difficult to formalize and the multimedia presentations are difficult to make engrossing.

11.3 Teaching and Classrooms

11.3.1 Groupware

True or False

1) True. Groupware includes software to support groups.

2) True.

3) False. WYSIWIS means What You See Is What I See.

4) False. Mechanistic groupware specifies roles for people and directs their execution of the roles.

Knowledge Essays

1) Four categories of groupware can be described in terms of space and time sameness. Same-time, same-place groupware would be something like a two-person, educational Nintendo game that two people would play at the same time in the same room. Same-time, different place groupware would be like audiovideoconferencing across the internet. Different-time same place would be like a physical library system, and different time, different place is illustrated by email.

2) The distributed database rests on multiple machines, whereas the centralized database is in one place. The distributed database could provide rapid response in some cases, but the centralized database is better prepared to monitor any conflicts that might occur across interactions among people in real-time.

3) The replicated backend architecture allows a student to have the system on the local computer and not be connected to the network. The difficulty is in keeping synchronized with the other participants in the virtual classroom.

Doing Essays

1) Students who have no experience with computers should not be expected to participate in a classroom where communication requires using computers. For students who can only participate in a classroom when they use groupware, then almost any groupware that they can access might be good enough. In courses where students work with a problem that is separate from other people, the groupware might more readily be asynchronous. For instance, computer science students are less likely to need synchronous groupware than students in a speech course.

2) I like freedom and in that sense context groupware would appeal to me. On the other hand, I want to know exactly how I will be assessed and the mechanistic groupware might clarify for me the assessment criteria.

11.3.2 Communication Channels

True or False

1) True

2) False. Participants in a videoconference can see another person's facial expression.

3) False. Group hypertext for classroom learning was used much earlier than the 1990s.

4) False. When comparing various channels of communication in the virtual classroom, the conclusion is that some channels are appropriate for some kinds of learning and other channels are appropriate for other kinds of learning.

Knowledge Essays

1) Audioconferencing has been used in classrooms. However, the usage is much less than one might have expected. Perhaps students and teachers do not get enough reliable, valuable interactions from those outside the classroom for such audioconferences to be worth the costs. Although the cost of phones is small relative to some of the new computer technologies, the cost is not negligible particularly when long-distance calls are at issue.

2) The guidelines for managing classroom videoconferencing are actually remarkably similar to the guidelines for managing face-to-face classrooms, except that in videoconferences one must pay special attention to the physical isolation of some individuals from others and attempt to help them feel connected. As senses of physical location are distorted in videoconferences, one must pay particular attention to using eyes, gestures, and more generally instructions to invite various people to interact.

3) With classroom group hypertext, one is typically working from an established body of work (the document). The classroom, electronic bulletin board is normally only an archive of email and does not have a pre-planned infrastructure. The bulletin board thus lends itself more to an interaction solely among the participants, whereas the grouptext is better suited for guiding students in a certain topical direction.

Doing Essays

1) Massive, high bandwidth satellite networks and low-cost Internet devices will affect classrooms. The high bandwidth would support multimedia communication. such as synchronous audio and video. General familiarity with and access to videoconferencing would increase. One could hold seminars with people at a distance

2) Rich, multimedia communications support learning complex abstractions. Simpler learning objectives may be practically handled with leaner, single media communications.

11.3.3 Asynchronous Classroom

True or False

1) True

2) True

3) False. Students felt they learned more or about the same from Virtual Classroom courses as from traditional courses.

4) False. The costs to teachers for courses with more than 30 students is greater with the Virtual Classroom than with traditional classrooms.

5) True.

Knowledge Essay

1) The quantitative study done in the California State University Northridge Sociology course had strengths and weaknesses. Weaknesses included that all students were essentially in a position to go to class on some Saturdays. These were not students who truly had some great opportunity cost that prevented them from going to a room at Cal. State Northridge. Also, interaction was strongly encouraged and required in the online class. We get no indication that interaction was systematically required in the face-to-face groups. Thus as is usual with such experiments there are too

many variables that are different from what other people might experience for us to be able to draw firm conclusions from the study as to the impact for other classes in general.

Do Essay

1) In assessing the course success one should use more than the traditional grades in the course or the student's perception of the effectiveness of the teacher. The salient factor missing from many academic reports of virtual classroom effectiveness is the opportunity cost to the student. In assessing a virtual classroom one should ask what students would miss this education if they could not participate in virtual mode.

11.3.4 Studio Course

True of False

1) True

2) False. Students attend multiple, weekly face-to-face meetings in a Studio Course.

3) False. The Rensselear Polytechnic Studio courses have shown reduction in school costs and improved learning at the same time.

4) True.

Knowledge Essay

1) LearnLinc has synchronous abilities for teachers to poll users in real-time and to control what different students see on the screen of their computer. At the same time it includes asynchronous features such as email and testing done to each individual's schedule.

Doing Essay

1) The studio course method has been shown to work well in physics and might work well in certain other disciplines. To the extent that the courseware is a valuable part of the classroom, disciplines without such courseware would be less suited. For instance, a philosophy course has less courseware available than a physics course and would thus be less likely to be successful with the studio course approach. The studio course typically involves a laboratory but only laboratory courses in which courseware exists for some labs would be appropriate.

1.1.1 Group Roles

True or False

1) False. If students are graded based on the frequency with which others visit their homework submission, then the students do not feel that the grading is fair.

2) True.

3) True.

Knowledge Essays

1) The notion of peer-peer assessment is similar to the monitorial method that was popular in Britain over 100 years ago. In both cases students are involved in giving feedback to other students. Also both methods aim to reduce the workload of the teacher by guiding students to give feedback to other students.

2) The teacher work load is reduced in the classroom game courses, while the Virtual Classroom experience at New Jersey Institute of Technology shows teacher work load to increase. This is because the classroom game course has students interact with one another. In the New Jersey Institute case, the teacher provides the feedback to the students.

3) The student response to a course depends on multiple factors. For instance, a teacher who is expert in a topic or very interested in the topic can convey this expertise or enthusiasm to the students in a way that positively impacts the student learning experience and conversely.

Doing Essay

1) Statistical process control is a method for studying patterns across transactions and detecting those transactions that are likely to be beneath the quality threshold. Thus in the case of a virtual classroom, we might use statistical process control to detect those student transactions that might be flawed. For instance, if a student x is grading another student y and gives a very different grade from what student z gives to student y, then the teacher might expect that either the grade given by x or by z is flawed. The teacher would not have to check all transactions but only those that the process control mechanism highlighted.

11.3.5 Conclusion

True or False Exercises

1) False. Piaget felt that student-student interactions were vital to natural learning processes.

2) True.

3) False. The Studio Course emphasizes student-teacher and student-student face-to-face interaction.

4) True.

Knowledge Exercises

1) The most common virtual classroom feature currently is an asynchronous, different space feature that is basically email.

2) Advantages and disadvantages accrue to using telephones and broadcast video versus using internet communication in classroom education. The telephone and broadcast video are high quality and familiar – these are advantages. One disadvantage is that the teacher has no easily manipulated audit trail of what students have said what on the phone – thus assessment is awkward. The computer keeps easily manipulated records of transactions that occur across computer networks.

3) The New Jersey Institute of Technology Virtual Classroom require greater teacher costs per student than the Rensselaer Studio Physics Course. NJIT's system required the teacher to interact with each student on email. The RPI system encouraged students to interact with one another and to use courseware. One should note that RPI assumes students are on campus and coming to meetings twice a week. NJIT wants students to be able to participate regardless of location.

Do exercises

1) For various course topics, a group of students could have each specific roles and the computer could manage the roles. For instance, if we are to teach nurses how to work with a certain patient, then we could have nurses assume different roles of the health care setting including that of the patient. The computer could know about the role responsibilities and messages that should go from role to role.

2) The evidence for adherence to the aviation industry virtual classroom standards in academic courseware is scanty. The vendors follow general market patterns rather than the standards from the aviation industry.

11.4 Administering Schools

11.4.1 Virtual Organization

True of False

1) False. A virtual educational organization transcends space, time, and organizational boundaries.

2) True.

3) True.

4) False. The Chief Information Office must be sure to get evidence from intended users before assuming that a new information product is needed by those users.

Knowledge Essays

1) The hierarchical organization has well defined roles and strict channels of communication with authority strictly delegated. By contrast, the web structure is based on informal rules and patterns of influence, and it grows by spawning other organizations that keep financial ties to the parent.

2) The SABRE project shows how successful a project can be that works closely with users and gives software engineers clear instructions on developing modular programs. The MIDS system had a much smaller user base but still worked closely to the needs of these users. The results of both projects emphasize the importance of working closely with users.

Doing Essays

1) The hierarchy is very precise about role definitions which could facilitate automation of roles and suits some classroom situations. Teachers on the other hand are used to autonomy that corresponds in more ways with the web than the hierarchy structure. Perhaps there could be hierarchies within parts of the virtual educational organization and webs in other parts.

2) The success of Lotus Notes depends in no small part on its users wanting to share information. If students in a course are expected to compete with one another for a grade, then sharing information is not a straightforward approach. Traditionally across courses in a school relatively little information is shared, though this certainly ought to be different. One would have to be very sensitive to the culture of the users in planning the deployment of Lotus Notes.

11.4.2 Higher Education

True or False

1) True.

2) False. Responsibility centered management means that each unit takes responsibility for its own management.

3) True.

Knowledge Essays

1) Community college teachers are in the classroom much of the work week, whereas research university professors may spend less than half of their time in classroom-related activities. This is because the research university faculty are expected to spend much of their time engaged in research.

2) A typical university will have athletics and health departments, and these components are less relevant to a virtual university, since athletics and health are rather bound to physical presence.

3) In responsibility centered management units within an organization each have their own budgets and must

earn enough revenue to cover their costs. Furthermore a unit that earns above its costs can reinvest its profit in growth of the unit. In an organization were units that are not economically successful are nevertheless politically powerful, responsibility centered management will be undermined by the politically powerful units.

Doing Essays

1) Responsibility centered management is well suited to a virtual educational organization. The virtual organization has massive amounts of information on the computer. When the model of the organization is precise and gains can be related to performance and performers can spend their own gains, then rules can be formalized that support

2) Information technology applications in education support the unbundling of the product. In a classroom the students might be guided through some educational material by one person or program, while another person or program might assess student progress. Students might take a course at one school and another course at a different school at the same time and independently of geographic considerations.

11.4.3 Systems

True of False

1) False. A large university typically employs hundreds of programmers whose job is to develop or tailor software for the school.

2) True.

Knowledge Essay

1) There are similarities and differences between the SCT Banner2000 system and the Oracle Learning Architecture system. The SCT Banner2000 system is targeted at conventional schools. For instance, it has a payroll system that assumes a large permanently employed full-time staff. However, the registration and grading functions that it supports would also be supported in a virtual school. The Oracle Learning Architectures is definitely targeted at the virtual school. It focuses on supporting courses offered over the computer and attempting to standardize the tools and methods in object-oriented ways.

Doing Essay

1) I would not expect it to be cost-effective to build from scratch whatever software that I would need for my virtual school. Unfortunately, the field is still rather immature and getting good infrastructure tools may not be easy. I would make some arrangement with a vendor to use the software and perhaps have fees for the software be somehow proportional to the success of my school with the software.

11.4.4 A Common Architecture

True of False

1) False. The bitways layer is the part of the system furthest from the user's immediate view.

2) True.

3) True.

Knowledge Essays

1) Advantages could accrue to the world, if an education information system architecture were standardized. Users could find components more reliably at cheaper prices. Components of one system could be exchanged with components of another system more easily and thus increase the overall functionality available to the user.

2) The high-level structure, function model of an education information system has students interacting with teachers and teaching assistants through a student management module. Other support structures feed into this student management which is also overseen by a central administration module.

Doing Essays

1) The marketing module of an education information system must present a good image of the school to select audiences, and this entails showing how the curriculum will lead to satisfactory results for enrollees. The marketing system would also track alumni and enroll their support in recruiting new students. The marketing module would connect to the quality control module for evidence of school success that could be advertised.

11.4.5 Quality Control

1) True of False

2) True.

3) False. The University of Wolverhampton was ISO 9000 certified.

4) False. ISO does not certify organizations as conforming to ISO 9000.

5) False. Many accreditation organizations exist for schools.

Knowledge Essays

1) ISO 9000 is a standard of the International Standards Organization that describes the processes an

organization should follow so as to assure that it operates in a quality way.

2) The Distance Education and Training Council accredits virtual educational organizations. It is part of the American Department of Education. Institutions may apply to DETC for accreditation as distance education institutions. DETC looks at a variety of criteria that suggest commitment and quality in the institution.

Doing Essays

1) An extensive electronic information system make it easier for someone to determine whether or not an organization operates in a quality way. If the goals of the organization and the signs of progress to those goals are in the form of documents that are archived on the web, then it should be a relatively simple matter to connect goals and signs of progress on the web. Then people in the organization and outside should be able to readily check whether quality is maintained.

2) Certification as being ISO 9000 compliant might be more relevant to virtual educational organizations than traditional school accreditation. Traditional accrediters specify independently of the school what the school goals should be and these criteria are typically traditional. ISO 9000 on the other hand applies equally weakly to many organizations and emphasizes only the process. In this way it might be more flexible and help virtual educational organizations get certified as quality compliant. Also ISO 9000 is recognized around the world whereas other school accreditation organizations are normally geographically local in their audience.

11.4.6 Conclusion

True of False

1) True.

2) False. A successful information system must fit into the workflow of it users.

Knowledge Essay

1) Delivery is one aspect of virtual education. However, being able to keep track of students across courses and the content of those courses that they should carry with them from course to course is perhaps more important educationally than any particular delivery of education.

Doing Essay

1) My virtual educational organization would have a component for courseware that communicated with other courseware. Each classroom would follow a fairly standard format of students interacting with learning material and one another in ways that were continually monitored by sampling for quality. The marketing function would tie into this success of the students and would also allow those sponsoring the education to have influence on the content of what was being taught. The administration would be sensitive to students, teachers, and sponsors.

2) Ubiquitous computing may be attained in advanced societies within a few decades. However the political battles between neighbors remain as horrible now as centuries past and would seem to be the kind of barrier that will be hardest to overcome. People would have to first agree on ways of communicating and decision-making before a ubiquitous educational system became a reality.

11.5 Authoring Courseware

11.5.1 Universities

True or False

1) False. Large numbers of students enrolled in a course is important as a precondition for investing in courseware development but the students can come from many different universities.

2) True.

3) False. In the British state-funded courseware efforts, academics focused on quality and preferred to not consider efficiency.

4) False. The creator organizational structure does not provide enough organizational support to be effective.

5) True.

Knowledge Essays

1) Because faculty tend not to have experience with courseware authoring, they need training before they can contribute to courseware production. For books, a faculty member who wrote a dissertation already has experience. Furthermore, courseware involves more types of skill than book authoring.

2) To support courseware production the university might make a clear commitment of resources to the development and maintenance of courseware. A well-funded organization within the university is created that has some authority in relationships with other support units and faculty. This would be the integrator model described in the textbook.

3) The independent review of the British Teaching and Learning Technology Program suggested that funding go to the market and not to the supplier. The recommendation was that students be able to select

among those options which are useful for them rather than schools themselves deciding what was best for students. In this way, the system might respond more closely to the needs of students then it would when only the schools decide what is best.

Doing Essays

1) To organize a virtual courseware production operation as part of a virtual university, I would need a clear argument that we had enough expected return on our courseware to merit investment. I don't believe that a slipshod effort would do and a big effort requires a big audience. Then I would encourage responsibility centered management, while also assuring a central commitment.

2) The university support for courseware authoring is often consistent with the web-like control structure. This would be difficult to semi-automate because the understanding of what needs to be done is informal. The computer is best able to intervene when roles are precise.

11.5.2 Companies

True of False

1) True

2) True

3) False. In the small courseware company, the models for the courseware life cycle were informal and computers were not extensively used in guiding the project management.

4) True.

5) False. AMTECH predefines the overall structure for all lessons.

6) False. The AMTECH courseware life cycle includes a testing step after every phase of the courseware life cycle.

Knowledge Essays

1) Perhaps for some highly creative courses, such as writing poetry, it would be inappropriate to always follow the kind of discipline suggested by the AMTECH model. Of course, AMTECH is not teaching poetry authoring.

2) The courseware life cycle is in some ways more complex than the software life cycle. For courseware, one should have multiple media to present a compelling story to the human user. There will also be software in a courseware system and to the extent that this software is developed in the courseware life cycle, then the courseware life cycle includes as a proper subset the software life cycle.

Doing Essay

1) If I were organizing a small team to develop educational, then my methods would be similar to those of FutureMedia. I would be struggling to earn some money. My staff would of necessity be rather versatile and hard working. If the enterprise were to get larger and more stable, the opportunities to specialize and formalize the methods of work might present themselves.

11.5.3 Content Production Models

True or False

1) True.

2) False. The Activity Model Environment is used to represent work flow.

3) True.

4) False. Finding a relevant video clip to reuse and tailoring it to the needs of a courseware package is harder than the same task for a paragraph of text.

Knowing Essay

1) Activities are a high level component of the Activity Model Environment. I would also place into the category of high level components people, workspaces, and messages. People fulfill roles to implement activities. They exchange messages and work on them in workspaces. One of the lowest level components is the Information Unit.

Doing Essays

1) The instantiation of the courseware life cycle in the modeling language makes it easier for us to develop computer programs to assume some of the functions otherwise performed by people For instance, if one says that the instructional designer will get the requirements from the customer and then begin the design, then if the instructional designer has not received the requirements after some deadline, then the system could automatically send a reminder message to the customer.

2) For the "Courseware Outline" a typical information unit on any message might be the roles responsible for editing it and the dates that editing is done. The "Module Description Card" would further need to indicate what media where in the module and how they were related to the other components of the module – this would be a part completed by the media expert role.

11.5.4 Conclusion

True or False

1) True.

2) False. Specialized roles in courseware production are more common in industry than in academia.

3) True.

Knowledge Essays

1) In academia each faculty member is often a kind of entrepreneur. In industry the courseware authors are working under strict schedules to definite products.

2) The AME model requires a formal specification of the courseware lifecycle that is followed. In academia such a formal model is not followed but in industry it is.

Doing Essays

1) For elementary school children learning mathematics the traditional model has been solo authors whose work is mass-produced, marketed, and distributed by a publishing company. It would seem a natural role for some of these publishing companies to augment their staff with those specialists such as software engineers and multimedia experts who would still contract with content experts like those of earlier books. Now the publisher would take a more active role in supplying the media experts and pedagogy experts to work alongside the domain experts. For the airplane pilots case, there are industrial organizations that produce special systems such as flight simulators, and we might expect such organizations to also make courseware and to apply their industrial methods to courseware.

2) The Globewide Network Academy site helps educational organizations enter course descriptions online. Volunteer staff of GNA have various roles, such as answering questions about how to make such entries or organizing the overall site so as to best subsequently guide users to the stored information. This model could be extended so that individual courses began to be developed at the site. To the extent that the current information on the site is marketing information, perhaps these course components could be initially just fragments which also served as advertisement. The hard work involved in producing useful courseware fragments would not be done on a site which then offers it for free to the world.

11.6 Corporate Marketing

11.6.1 Educating Employees

True/False:

1) False. The pipeline industry is least active in virtual education to employees.

2) True.

3) False. United Technologies has far more than 5% of its engineers in continuing education programs.

4) True.

5) False. Office Depot uses LearnLinc to teach employees at geographically distributed Office Depot offices.

Knowledge Exercises:

1) The four phases of the corporate training cycle are identify needs, design training, deliver training, and evaluate outcomes. A shortfall on outcomes becomes a new need.

2) Boeing wants to have at least 10% of its engineers in continuing education and particularly to have some graduate program accessible to them, such as a Master's Degree. They want this education to be delivered in the workplace.

3) The virtual seminars taught at The Gallup Organization were taught on the internet with email and the web but also a very few students used fax. Students from a global distribution enrolled and appreciated this opportunity for education.

4) A web content analysis looks at web sites and determines the content relative to some criteria. Virtual education of employees has been assessed at the largest corporations in the categories of airlines, data services, and pipelines.

Do exercises

1) GTE Financial Policy documents are online and financial policy is being taught on the intranet. Links between the manuals and the educational packages would be worth implementing. Employees could then see the immediate practical ramification of the education as the manuals which they had occasion to use otherwise were made more understandable.

2) Employees of some companies would want virtual seminars. For the seminars to succeed the employees must want this education and the opportunity cost to attend a traditional seminar must be great. I would address a global company where employees are scattered and can not easily meet together. The topic should be one that is timely and abstract in the information sense and thus amenable to computer presentation versus face-to-face. I'd choose an audience comfortable with the web and I'd use the web.

3) If a company had 500 stores distributed throughout the USA whether we should put classrooms with 10

computers in 50 stores or put one computer in each of the 500 stores depends on various factors. If I need to have a computer knowledgeable person additionally assigned to each store to maintain the computer, then I would want to concentrate the computers in a few stores. However, if every store can manage its own computer(s) anyhow, then the advantage would seem to be in giving employees in every store direct access.

11.6.2 Customers are Students

True or False

1) False. Content analysis on the web reveals that data services companies are the most active in offering online education to customers.

2) True.

3) False. Microsoft certifies both students and trainers.

4) False. The various educational activities that Microsoft helps support in the area of customer education reach hundreds of thousands of students per year

5) False. The number one barrier to continued growth of Microsoft Solution Providers is the shortage of adequately educated (ie Microsoft Certified) people to fill the vacant positions.

6) True.

7) True.

Knowledge exercises:

1) Companies want to educate their customers so that their customers remain loyal.

2) Industries are most involved in virtual education to customers whose customers both have a need to get education about what the company sells and have the familiarity and access to tools for virtual education.

3) Microsoft's activities in the educational arena for customers are many. Microsoft has a brokering arrangement with teachers and students for some certification programs. They encourage online participation. They also try to reach into high schools for the purpose of preparing future customers.

Doing exercises:

1) I picked an arbitrary company called Levi Strauss and analyzed its educational web activity. They make blue jeans among other things. Their web site was impressive but did not yield any positive results on a search for the concept of "education". One can imagine that clothing companies are more a touch-and-feel type of operation than a virtual education operation.

2) The certified professional and certified trainer approach are appropriate for some markets. The certified professional and certified trainer approach seems to be working remarkably well for Microsoft. The world economy has a huge demand for Microsoft certified professionals due to the wide penetration of Microsoft products. For a very focused market where products are very expensive but very few are sold, the cost of a certification program might be less advantageous than other approaches.

11.6.3 Conclusion

True or False exercises

1) False. Competent employees are a key ingredient in the success of a company.

2) True.

3) False. Microsoft's drive to have a computer on every person's desk is perceived by Microsoft to be related to education.

Knowledge exercises:

1) Airline companies are more active in web-based educational activity for employees than data services companies but less active in customer education. Airline companies may have government regulations mandating regular education to employees, whereas data services companies face no such regulations. Data services companies need educated customers more so than airline companies do.

2) Employee virtual education and customer virtual education occur under different circumstances. For instance, The Boeing Company is enlisting the support of public educational organizations in reaching its employee base. For customer education we see no signs of companies working with public institutions.

Doing Exercises:

1) For my strategy for virtual education/training for employees, I would connect the normal corporate information system to the educational one. Thus employee or manager reports of needs for increased competency could be directly linked to the educational system. Second I would look for corporate educational tools that could harmonize as much as possible with the existing infrastructure of the company. Then I would relate the achievement tests of the education to the needs of the company. Finally, I would make sure that the company institutionalized all this.

2) My virtual education program for customers of my own consulting company would focus on education about the results we deliver to the client. The core consulting results would be available as much as possible in electronic form and the educational offerings would be connected directly to the core product.

3) In designing virtual education for a company, I might try to serve the employees of the company and the customers of the company simultaneously? The joint strategy could have the advantage of economies of scale and also of bringing employees more directly in touch with customers. However, barriers include that customers may have very different tool sets and work styles than employees and thus not want to be served by the same educational tools or methods. The customers educational needs may be so different from the employees that only a small subset of employees and customers have much to share – this would have to be decided on a case-by-case basis.

11.7 State School Marketing

11.7.1 K-12

True or False

1) True.
2) False. Parents may need to demonstrate that they are covering appropriate material with their children but do not need to be certified as teachers.
3) False. Educational multimedia CD-ROMs are appropriate for the K-12 market.
4) True.
5) False. Continuing education for teachers is available on a range of topics.

Know Essays

1) Free, compulsory, public education must market to its constituents in a different way than a corporation would market education that it offered to its customers. Public education tends to have market niches defined by political boundaries whereas corporate customer education is bounded by customer behaviors. Public education focuses on general purpose education, whereas corporate education focuses on the principles and applications germane to a particular type of product or service.

Do Essays

1) We have millions of first graders with similar educational objectives. While producing very appealing CD-ROM products for this audience is an expensive proposition, the potential audience return is great and merits the expense. The children in this age group are not particularly sophisticated in their social skills and learning objectives do not typically require much human-human interaction to master – thus the use of the Internet to increase interactivity among people is less justified. The CD-ROM can contain extensive media that would be too slow to deliver across networks in their 1997 state.

11.7.2 Universities

True or False

1) True.
2) False. The Open University has granted more than 100,000 degrees.
3) False. The greatest single expenditure of the Open University covers the costs of 8,000 tutorial or teaching assistant staff.
4) True.
5) False. The California State Universities are targeting both state residents and people anywhere in the world outside the state in their California virtual university.
6) True.
7) True.
8) True.
9) False. Non-technical disciplines, such as the humanities, tend to use the web in education less than other disciplines.
10) True.
11) False. The method of the Internet courses from universities is largely email discussion archived on the web.

Know Essays

1) Jennie Lee obtained legislative support for the Open University. She recruited a committee of leaders from government and academia that were supportive of the Open University plan and were able to persuade their constituencies to also be supportive. The lesson is to get leaders from the various groups that have a say and get them on your side.
2) The web content analysis of state universities dod not show predictable patterns of web-based course offerings. State university funding is based on tax dollars being funneled from the state legislature to the universities. The university spending thus follows patterns that are not necessarily reflective of need. The same may hold for web-based content analysis.
3) WalMart founder Sam Walton wanted to reach people in their local communities with a wide-range of appropriate products at a low price. This relates to what the Southwest Missouri State University Computer Information Systems is doing in its degree offering?

Do Essays

1) To reach economies of scale for sophisticated courseware production would require the merging of university audiences rather than one typical university addressing only its own students. However, for

teaching with traditional textbooks but supported by Internet communication, a university could do this without other universities. For the Internet mode the challenge in part is to find students that do not have access to the physical facilities of the public school system. Such audiences might be reached my alliances with global companies.

11.7.3 Conclusion

True or False

1) False. Home schooling occurs when parents help children learn at home.
2) False. Quality and access are targets of the virtual university.

Know Essays

1) K-12 students must be full-time in school, whereas higher education is optional. In marketing to the K-12 sector one might thus be looking particularly to augment learning in the home and parents must agree to this for their children. Higher education faces a particularly attractive new marketplace in the workplace, and here the employers (in a role analogous to that of the parents for children) must support the education for their employees. Workplace education is, however, not the major responsibility of employees whereas education is the major responsibility of children.

Do Essays

1) Digital information technology is a subject that is relatively new to the educational system, and what is learned is not necessarily special to higher education but nevertheless K-12 students seldom get much education specifically about information technology, in part because their teachers are not prepared to teach it. A virtual information technology school could without much difficulty have a number of courses and a sequence of courses that would be appropriate for both middle schoolers, high schoolers, and university students. University level English studies would not seem to be as easily exchangeable between the different age groups. American students get English studies at virtually every grade, and ostensibly each grade builds on the results and the maturity gained over the preceding grade.

11.8 Brokers

11.8.1 Sole Function

True or False

1) False. The National Technological University focuses on course offerings to employees of companies rather than targeting the general public.

2) True.

3) False. Students do not submit assignments to a self-organizing catalog of courses but rather teachers or schools submit course descriptions to such a catalog.

4) True.

Knowledge essays:

1) An organization that connects schools with companies makes contracts with schools and with companies to deliver education from the schools to the companies. NTU has been doing this since 1984 largely via interactive satellite audiovideo broadcasts. In the NTU case the lectures are the standard university lectures given simultaneously to students in the lecture room and to students seated in some downlink satellite site at a company.

2) The International University and the International School of Information Management illustrate the operations of a virtual educational organization that connects teachers and students. Both International University and ISIM recruit students from the general public and faculty from other organizations (ISIM also makes contracts with companies). Both rely extensively on the Internet for virtual classrooms that are largely asynchronous discussion sites. The parent of IU is a cable television company and the parent of ISIM is a publisher – similar companies in that they deal with the packaging of information for public consumption.

3) A self-organizing catalog is built by individual (or organizations) contributing catalog entries through a software system that guides them in making their contribution and automatically organizes the submitted information. The catalog is also made accessible to others through software tools. The Globewide Network Academy (GNA) has created such a self-organizing catalog and is the foremost of its kind on the internet. Being there first, as GNA was, can strongly favor the long survival of the organization. The GNA was created and is maintained by a group of volunteers.

4) A franchiser grants a license to other organizations to operate with marketing and other benefits from the licenser. To the extent that the franchisee is engaged in educational activity, the franchiser is immediately a kind of broker – it coordinates the work across franchisees. However, this is not directly brokering. If the franchisees were themselves engaged in brokering activities, then we would have a very strong brokering activity. Actually Microsoft does some franchising of educational brokers. The Fourth R is a smallish company with about 100 franchisees who help schools provide information technology education to their students. Each Fourth R store makes contracts with schools and somehow acquires

"teachers" to support the schools in the speciality activity of information technology education.

Doing essays:

1) Creating a private, global virtual educational broker that would only market directly to students and that would compete effectively with state-funded organizations is difficult. Competing against the state-funded organizations is difficult. For certain very specialized or high demand topics one could hope to recruit faculty that had a special reputation and attracted certain students in the same sense that private, traditional schools do this now. Alternately, to flourish the virtual school could intend to tailor the offerings to certain corporate-type needs in ways that public schools are not allowed to do.

2) To assure the long term success of the self-organizing catalog requires funds to maintain the web server and various maintenance activities. Some organization might want to fund this activity in order to gain publicity. The catalog maintainers might also look for software that reduces the maintenance load, though simply looking for this software is itself a costly maintenance activity.

11.8.2 Publishers

True or False:

1) False. The McGraw-Hill World University offers Associate Degrees and various certificates.

2) True.

3) False. PLATO was developed for computer courseware.

4) True.

Knowledge exercises:

1) Publishers have both copyright on valuable educational material and have expertise in guiding to market new educational products. They are well poised to make significant progress in virtual education.

2) McGraw-Hill's Continuing Professional Education division targets Certified Public Accountants because Certified Public Accountants need to continually get re-certified through continuing education.

3) ZDNet University manages to prosper while charging students less than $5 per month for unlimited access. The benefit to ZDNet is not necessarily the student fee alone but also the derivative benefits. Students buy Ziff Davis products in order to maximally benefit from the courses.

4) NovaNET rests on the base of courseware developed by PLATO. PLATO had a long history as first a government funded activity and then a corporate activity of Control Data Corporation. Neither the government, nor Control Data Corporation, nor the University of Illinois at which PLATO started have proved in a position to adequately market the PLATO courseware and NovaNET is focused on that marketing mission.

Doing Exercises:

1) If one is to work with a publisher to extend its virtual educational organization, McGraw-Hill is an attractive choice because of its enormous resource base and global reach. McGraw-Hill has already created a virtual educational organization. It has a large stable of existing educational products. It could marshal the authors of that material into a new teaching organization.

2) I would extend the range of ZDUNet services. I would offer students an opportunity to pay more and to get more individualized interaction with the authors and teaching assistants. Another direction to pursue is the combining of sequences of offerings from ZDUNet into certificate programs.

3) Libraries of courseware exist that are not optimized to deal with current platforms but might be reuseable. NovaNET has chosen to build on PLATO courseware because of its enormous breadth and quality. NASA is trying to get educators to build on its library of space data to create courseware. In general there are not many libraries of courseware per se. Many scattered efforts have occurred over the past four decades. Most of the technological platforms on which those products were based are no longer usable. However, some domain and pedagogical logic in those programs might be salvageable. Perhaps more useful would be to acquire educational videos, such as the Ascent of Man, and to connect those with cyberspace courseware.

11.8.3 Professional Societies

True or False

1) True.

2) False. A tutorial that is traditionally offered face-to-face might be suitable for also offering in virtual mode.

Knowledge exercises:

1) Some professional societies in the health care sector support online continuing education because their membership needs continuing education to remain certified. Also the professionals are busy and could

benefit from not needing to leave work and home to gain education.

Doing exercises:

1) The book sketches a virtual education proposal for the Association of Computing. One could imagine the same proposal going to other information technology societies. There is generally no re-certification required of professional computer scientists. A profession that requires re-certification would be particularly attractive.

11.8.4 Government

True or False:

1) False. The Western Governors University is joined by most states in the Western half of the United States.

2) True.

Knowledge exercises:

1) The smart catalog for a school might be self-organizing from the educators side (somewhat as the Globewide Network Academy) and also self-organizing from the student's side in that the student submits desiderata and the system guides the student toward the selection of the appropriate courses.

2) The WGU faces competition from its own member state educational institutions. Those institutions have a legacy of autonomy that may leave them feeling threatened by the WGU.

Doing exercises:

1) Given that there is already a Western Governors University (WGU), the Eastern Governors University (EGU) should build on the results of the WGU. This would mean reusing the models of inter-state agreement about sharing of course credits and tuition fees. It would also mean re-using the software and other tools developed by WGU. One might also go from WGU to something like a World University.

11.8.5 Conclusion

True or False:

1) True.

2) False. Publishers can extend their role of connecting authors to readers by connecting teachers to students.

3) True.

Knowledge exercises:

1) Sole function brokers, publishers, professional societies, and governments have different virtual education, brokering roles. Sole function brokers have no other function than the educational one. Publishers are very close to the educational function in what they do and enter virtual education naturally. Professional societies are largely meeting grounds for cooperation among professionals but play a role in facilitating education as it relates to their membership. Government covers many things, including education in many forms, and is a natural supporter of virtual education.

Doing exercises:

1) One of the key partners for the virtual information technology college would be a tools provider who had the infrastructure for a virtual school in place. This tools provider could be Oracle for its Oracle Learning Architecture or others. A company with expertise in information technology of the applied sort would be good – for instance, The Gartner Group could provide Ph.D.s who do research on latest developments in information technology. A publishing company in the information technology field would be helpful, perhaps Ziff Davis. These partners have already entered the virtual education market. The alliance would have to match complementary skills and shared vision.

11.9 Conclusion

11.9.1 Summary

True or False

3) True.

4) True.

Knowledge Essay

1) Education perpetuates culture. Learning from courseware can replace the teacher. The virtual classroom facilitates student interaction without face-to-face meetings. The virtual school combines students, teachers, and courses. Authoring the courseware that students might use has not been typically pursued by the school per se but separate enterprises. The corporate market for this virtual education seems particularly likely to grow.

Doing Essay

1) Different organizations of this book might have been by student type: K-12, higher education, and certificate-earning students. Another organization would have been by topic of education: such as information technology education, health care education, and business education. Another organization could have been type of learning, such as

learning through discussion, learning through memorization, or learning through simulation.

11.9.2 Future

True or False

1) False. Students that routinely use virtual education tools are the most likely to feel comfortable with virtual education.

Knowledge exercises:

1) A virtual college that teaches about information technology topics is attractive because the students and teachers will be comfortable with the tools and because education on the subject is in enormous demand across the world.

2) In five years time the information superhighway will be more used and products that help a student learn in direct interaction with the computer will be for some disciplines more prevalent.

3) Thirty years from now companies and their customers will have formed further bonds that change the contours of education for society.

Doing exercises:

1) My topic would be health care education, or any discipline in which professionals need to be continually recertified. Teachers of K-12 in the USA fall into this category and thus a virtual teacher's college might prosper.

2) Within five years, publicly funded education will have increasingly crossed state boundaries and teachers and students will interact across vast distances. Courseware may have become so popular thirty years hence that it has replaced the book and television as the media object of choice for students.

11.9.3 Dialectics

True or False

1) True.

2) False. Children can benefit from virtual education in the home at night and be acculturated in the neighborhood school during the day.

3) False. Friction-free capitalism removes the middleman.

Knowledge exercises:

1) As tools change, the best mapping of a people to their tools to serve their educational needs may change. The change needs to occur to resolve the tension that the strained, old mapping has caused. But change will continue, and new mappings will be necessary. This continual tension introduced by change and resolved by new mappings is a dialectic.

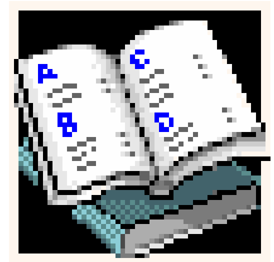
2) A teacher can advertise a course on the web and accept student's directly into the teacher's class. Of course, students have to want this education independently of the many benefits that a school, operating in the middle, might otherwise bring.

Doing exercise:

1) A common mapping for part-time graduate students in computer science who work is to commute to the neighborhood university for evening lectures a few times a week. For families, this mapping may soon be inferior to the mapping by which they stay home and participate in virtual classrooms and use courseware to complement textbook reading.

12. Index of Terms

12.1 1-D



D

12.2 E-L

E

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12.3 M-R

M

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12.4 S-Z

S

T

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V

W

X

Z

This book **Virtual Education Manifesto** describes a new market in which students learn at home and the workplace and teachers cooperate across organizational boundaries. A new era in education is dawning where companies reach to their employees and customers globally with virtual education. This book is also a review of technology and how it might be used in educational organizations. The book has three main parts entitled:

I. Learn and Teach,

II. Administer and Author, and

III. Marketing

Part I first shows how students learn and how courseware can support this learning and then describes various virtual classroom systems and experiences. Part II applies the principles of virtual organizations to educational organizations and authoring courseware. Part III analyzes the evolving marketplace of virtual education.

The author **Roy Rada,** M.D., Ph.D., is an expert on virtual education. Roy has been a professional educator for over 20 years and has authored several books on related subjects. He has served as a virtual university academic officer and as a consultant to companies developing virtual education programs. For further information please contact Roy at rada@aya.yale.edu.

Roy wants to help you develop a virtual educational organization with this book as background reading. You may also enroll in **Virtual Education Manifesto** online and plan the future.

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