# Chapter 1

# INTRODUCTION

> If we do not invest all our resources of energy and will in education, the race with catastrophe will be lost and the balance between man and nature will be re-established by disasters that are not only unthinkable, but also avoidable. The choice is ours, and the time for action is now.

Frederico Mayor, Director General of UNESCO
Education for All - Summit of Nine High-Population Countries
New Delhi, 12-16 December 1993
UNESCO Paris France 1994

We are at a critical moment in the history of human learning, and in the history of humans. Learning is vitally important in our future. With six billion people on earth, our current educational systems everywhere at all levels have major problems, probably not curable with present approaches.

In many areas very little education is available, and where it is plentiful it is all too often inadequate. Our current learning systems are weak. We need new learning modes and structures, and we need them quickly and globally.

This book presents a new system for learning, a system not reflecting current practice. We believe that it has great potential for the future of education at all levels worldwide. The learning units in this system will be available everywhere worldwide, at any time, at a cost-effective rate for each student.

This approach is based on a new paradigm for learning, computer-based tutorial learning. The most common delivery system will be

through a new form of distance learning, giving a new meaning to this important concept. Current technology is adequate for this system.

Interaction between the students, singly or in small groups, and the computer, will be very frequent and through the student's native language, such as English or Chinese, similar to that between a student and a human tutor. All these details and others are explained further in the chapters that follow.

We emphasize the word 'potential' in describing the new system. Additional experimental work should explore these ideas, to demonstrate the full effectiveness of the approach suggested. The current problems of learning are great, and, we believe as indicated, not solvable by the approaches currently being pursued. So we strongly urge that this empirical data be carefully gathered and evaluated with this new approach.

Creating new learning materials and systems will require great imagination and determination on our part. We need new ideas that go beyond the learning situations of today, and the ability to develop the necessary materials and institutes. Learning should be greatly improved, less expensive, and available to all in all subjects from birth to death.

Given these serious problems, not enough discussion occurs on desirable futures for learning. The following factors for learning might be considered.

1. Provide a more personalized individualized learning environment for all students. Many lectures offer little individualized help for students, so need to be replaced by individualized approaches. These units must all be developed, as very few exist today.

Highly interactive material, almost conversational in nature, will respond to individual student problems. Learning will be an active process for all students, so that knowledge can be constructed directly by the students.

2. Verify that more students learn and learn better than today, in a shorter time and with better retention. This requires careful experiments with large numbers of students. A major increase in student learning will be attained and verified by large-scale summative and formative evaluations, so that the learning gains are empirically documented.

3. Significantly reduce the costs of education, now too expensive for many students. Interactive technology allows us to reduce costs.

The traditional model of one professor teaching 25 students per class, three times a week . . . will not scale to meet this increased demand because it is too expensive

Carol Twigg, 'The Value of Independent Study'
EDUCOM Review, July-August (1995).

4. Promote research in learning. We must improve our major product, student learning. This should become a primary aim of research.

5. Develop full new modules for many areas. 'This new learning material will use computers and media. The content will be fully revised to meet modern standards. New modes of student assessment will be part of this development.

6. Market these materials. The units will be marketed widely to institutions and to the general public. Eventually these units should not only recoup the financial costs that have gone into them, but could become major profit sources. We will develop in languages other than English to allow worldwide use.

7. Use these segments as the basis for new distance learning institutions. We would thus greatly increase worldwide student access to learning. Eventually through these efforts we will extend lifelong learning components and work towards an educational system covering everyone from birth to death.

We need a society that focuses on learning, where everyone loves to learn. Solving many of the world's major problems, including population, water, violence, health, and environmental destruction will depend to a major extent on improving learning.

A school or university may undertake this development perhaps in partnership with other schools and universities or commercial partners or these efforts might be entirely commercial.

## 1.1   Summary of each chapter

We realize that not all readers will be interested in all the details in this book. The following brief summaries of each Chapter may help you to determine what you want to read carefully, at least initially, and what you want to scan. We use some repetition, so those chapters are partially independence.

### 1.1.1 Problems and vision of learning

We start with the problems of education today, Chapter 2. This will suggest a collection of visions for the future of learning, the basis for the remainder of the book.

### 1.1.2 Factors of distance learning

The approach proposed in this book assumes distance learning or e-learning which is the fashonable term these days. Many forms of distance learning are possible. Chapter 3 reviews the variables in distance learning, and shows many of the types of distance learning that are possible.

### 1.1.3 Distance learning – present and future

In Chapter 4 we consider examples of distance learning, using the factors discussed in Chapter 3. Some of these are important historical examples, such as the United Kingdom Open University. Others are imaginative possibilities found in fiction, making interesting and informative suggestions for the future of distance learning.

### 1.1.4 Individualization and Interaction

We consider, in Chapter 5, first the importance of individualization in learning. Then we look at student computer interactions, with individualization in mind. We develop a methodology for highly interactive learning, considering both frequency and quality of interaction.

### 1.1.5 Multimedia in Learning

Many media are possible in computer-based tutorial learning units. They will help and motivate many students. In chapter 6 we review here the use of pictures, video, sound (in both directions), and computers.

### 1.1.6 Tutorial learning

We have mentioned several times earlier the suggested new paradigm for learning. In Chapter 7 we explore the concept of computer-based tutorial learning, using the ideas of interaction just developed.

### 1.1.7 Delivery of learning

Learning units must reach students in many locations in distance learning. In Chapter 8 we look at various delivery methods that are available, some in common use. Satellites seem particularly important for the future.

### 1.1.8 Learning and assessment

Learning and assessment are often separated, considered different activities. In computer-based learning they can be combined. This implies that assessment is not used for assigning grades, not needed in a mastery environment, but is used to determine what learning material is to be presented next. We discuss the way to include assessment into learning in Chapter 9.

### 1.1.9 Structures for technology based learning

New technology in learning suggests new organizational structures for learning material. Particularly important are ways to organize learning that stress mastery and experiential learning, we discuss these issues in chapter 10.

### 1.1.10 Developing tutorial learing units

Chapter 11 presents the system developed at the University of California, Irvine, and the University of Geneva for developing highly interactive tutorial computer-based learning. Management, design, implementation, and evaluation are considered.

### 1.1.11 Cost of highly interactive tutorial learning

In Chapter 12 we investigate the important considerations concerning the cost of learning, focusing on the approach considered in this book and comparing it to some extent with other educational strategies. We argue that computer-based tutorial learning is a cost-effective method for the future of learning.

### 1.1.12 Initial tutorial learning units

We review, in Chapter 13, the possibilities for development, in all areas. The emphasis is on what should be developed first, in terms of both market and need.

### 1.1.13 Starting new distance learning institution

In this final Chapter (14) we consider the problems in starting new learning programs of the type discussed in this book. Both conventional institutions and new ones, possibly for profit, are considered.

### 1.1.14 Bibliography

We list the references used in preparing this book.

# Chapter 2

# PROBLEMS AND VISIONS OF LEARNING

In a passage from Lewis Carroll, Alice is seeking directions from a cat.

> 'Would you tell me please, which way I ought to go from here?'  'That depends  a great deal on where you want to go to.' said the Cat.  'I don't much care where.' said Alice.  'Then it doesn't matter which way you go.' said the Cat.
>
> Alice in Wonderland
> 1960, page 62

Alice's situation, not knowing where she wants to go, and so not having any reasonable choice of how to start out, is common in education today. It is a major problem in planning for the future of education. We need to know our direction for learning.  This chapter attempts to give the 'educational Alice' some direction to head toward, a vision for the future.

The question we ask is "What do we want learning to accomplish, both for the individual and the world?"  Having such a vision for the beginning of a new millennium is critical, since we need a new direction.

We first begin with some problems in learning today.  Then we will look at some visions for the future of learning, based on our consideration of these problems.

It should be obvious at this point that we need a completely new plan and vision for worldwide access to education at all levels, if the next century is to see a quantum leap in educational opportunities everywhere. Obviously this is a great challenge and no easy task.

Theodore Hesburgh
Looking Forward, ed. John Templeton
HarperCollins New York 1993

## 2.1 The problems of education today

Learning has many major problems. In this section we discuss the major factors that we think are important.

### 2.1.1 Too many people

Perhaps the major problem for humans is that the world population has increased from two billion in 1927 to six billion people in 1999. Population is still increasing. We have too many people on earth. The *World Population Profile: 1999* (United States Census Bureau) estimates that we will have over nine billion people on earth in 2050.

This large population brings us many problems. Our concern in this book is with learning problems. We have far more people to educate today than we have ever had.

Many of the other problems mentioned are affected by the large number of people who need to learn. Our existing systems will not handle such numbers. They were developed for far fewer people than we have now. Life long learning has also grown dramatically. Although the popularion would not grow at the samt rate it has, the number of learners will.

### 2.1.2 Many students do not learn

In the developed countries many people do not learn, as seen by our grading systems; grades other than the highest grade indicate incomplete learning. In the poor parts of the world, only limited education is available for most people. All too often no learning is available, except that gained by daily living.

> Schools in developing countries face problems of relatively low school participation in terms of enrollments of eligible age groups, low levels of school completion, even at the primary level, and low levels of achievement . . . their lack of effectiveness is not a mystery, for resources sufficient to provide even the most rudimentary conditions for success often are lacking.

> Marlaine E Lockheed and Henry M Levin
> Effective Schools in Developing Countries
> Falmer Press, London, UK, 1993.
> Copyright by The World Bank

We have a billion illiterate adults in the world, two thirds of them women. This is intolerable; reading is often the key to other learning. Further, this learning shortage is a major handicap in trying to solve the major problems of our earth, such as population, water, violence, and poverty. Although these are often considered to be economic or technological problems, learning is a major ingredient in seeking solutions.

### 2.1.3 Learning is seldom individualized

A major flaw in lecture-textbook courses, the common strategy found in schools and universities, is that students are mostly treated in the same way, with only minor attempts at individualization. Learning proceeds in lock-step fashion, with all students moving at the same rate and with little attempt to accommodate students who need more time, perhaps to pick up background they are missing or for many other reasons. Most students use the same learning approaches, even if it is ineffective for some students.

Students seldom get much individual attention. This is not surprising, given the numbers of students in the courses and the teaching strategies involved, usually lectures, video, or textbooks.

Often large university introductory course lectures are not taught by the tenure-track faculty, but either partially or totally, by graduate students or by lecturers brought in especially for the courses. As universities continue to lose financial resources, or increase numbers without adequate additional funding, this situation grows worse.

Schools and training have the same problems. The numbers in classes assure that students receive little individual attention to their

learning problems.    We have come in the United States a long way
from the little red schoolhouses, where each student worked at an
individualized pace and on material unique to the student.    The
pressure of large numbers of students is one factor responsible for this
change.

### 2.1.4 Most learning is not active learning

Another major problem with contemporary educational approaches
is that a large amount of learning is passive for most students.
Listening to a lecture, or reading from a book, or watching video, is an
active experience only for students who have  either special training or
aptitude. Students mostly are not engaged.  Learning remains passive.

The   current   media   available   in   classes   bore   students.   Many
students fall asleep in lectures or while reading. Most of their lives
students  today  spend  more  time  watching  television  than  reading;
classrooms   are   not   interesting   to   many   of   these   students.     In  the
United   States,   many   students   do   not   purchase   textbooks   for   the
courses  they  take,  and  often  do  not  retain  what  is  learned  for  long
periods after cramming for tests.

### 2.1.5 Lack of creation of knowledge

Discovery learning is important for retention.   Students learn better
if they construct their own knowledge.

Students  in  classes  today  seldom  create  their  knowledge. Discovery
methods  are  very  difficult  in  the  lecture  environment  at  all  levels  of
learning.    Curricula  that  have  depended  on  discovery,  such  as  the
elementary  science  material  developed  at  Berkeley,  have  not  been
successful   in   typical   school   environments.     Again,   the   numbers  of
students,   and   their  need   for  individualized  help,  is  the  barrier.    Even
science laboratories, often mentioned for their hands-on approach, are
mostly cookbook, with little student creation.

### 2.1.6 Our courses are old

Many  courses  at  all  levels  have  old  content.    We  can  see  this
clearly  in  textbooks.   Thus beginning United States physics texts have
changed  little  in  40  years,  except  that  they  have  become  steadily
longer.    Although  many  experts  believe  that 'less is more'  should
apply  to  learning  as  well  as  architecture,  our  learning  activities  do  not
show this happening.

Recently Project 2061 of the American Association for the Advancement of Science has conducted several projects examining science and mathematics texts for secondary school.  The results are depressing, particularly because so many courses at this level are highly dependent on these texts.

An aspect of old content is the focus on many facts and student memory, rather than on more important intellectual skills.  This focus is pointed out in the 2061 studies.  Another aspect is the problem of political control that has no place in schools.  The poor showing for teaching evolution illustrates this.

### 2.1.7 Learning systems in the world are mostly fixed-paced

As mentioned often, our current approaches to learning mostly keep the times fixed, and vary the amount of learning.  But this is not a rational approach.  It has been imposed for the convenience of teachers and administrators, before computers were commonly available.

People are different and may require different times for learning. We want everyone to learn everything, even if some learn faster and some learn slower.  We should hold learning fixed and vary time.

### 2.1.8 Inadequate assessment is typical

Current courses assess student learning infrequently and in modes that do not assist student learning, such as multiple choice.  Testing also leads to negative student attitudes toward learning. We have known many students that are afraid of exams and do not perform at a level indicating their level of learning. Exams are often used as threats, a poor form of motivation, a stick rather than a carrot.

### 2.1.9 Few students enjoy learning

Many students today do not like to learn.  It is not uncommon to hear students in the United States refer to schools as prisons. University students are often only there to get degrees, and have little interest in learning.  This not only negatively influences current learning, but also restricts the possibilities and interest in future learning, important today.  People spend as little time as possible in activities they do not like.

### 2.1.10 We do not have enough good teachers and professors

Our learning systems are based on teachers and buildings, both in schools and in universities. But the supply of teachers is inadequate, and likely to continue to be so.

In the United States we need hundreds of thousands of schoolteachers in the near future, and we are not currently producing enough teachers to meet that demand.

Similar situations exist elsewhere. Further, many people leave teaching for other occupations that are more pleasant and pay more. The buildings are often not there either. The situation is much worse in the developing areas, as already noted.

The same situation exists at the university level. Sir John Daniel, Vice Chancellor of the United Kingdom Open University, has forcefully pointed this out.

> In the last seven days, somewhere in the world, a new university campus should have opened its gates to students. Next week, in a different location, another new university ought to begin operations.
>
> At the end of the millennium in which the idea of the university has blossomed, population growth is outpacing the world's capability to give people access to universities.
>
> There are similar problems at other levels of learning.

> Mega-Universities and Knowledge Media –
> Technological strategies for Higher Education Kogan Page,
> London, UK, 1996.

### 2.1.11 Learning is too expensive

We have always had examples of excellent learning. But in most cases, even in the wealthy communities, good learning is too expensive for either individuals or societies. Governments talk about improving education, but are reluctant to spend the money needed to improve the current educational institutions. In poor countries very little education is affordable.

> If you do not change your direction,
> you are likely to end up where you are headed.

> Ancient Chinese Proverb

## 2.2 The visions

Education is . . . the key to . . . development that is both
sustainable and humane, and to peace founded on
mutual respect and social judgement.  Indeed in a world
in which creativity and knowledge play an ever greater
role, the right to education is nothing less than the right
to participate in the life of the modern world.

Education for all, UNESCO, Amman, Jordan, 1996.

. . . education is an essential human right, a force for
social change - and the single most vital element in
combating poverty, empowering woman, safeguarding
children from exploitative and hazardous labour and
sexual exploitation, promoting human rights and
democrarcy, protecting the environment and controlling
population growth.  Education is a path toward
international peace and security.
130 million children in the developing world are denied
this right [education] - - almost two thirds of them girls.
Nearly 1 billion people are illiterate - - the majority of
them women.

Kofi Annan
Secretary General of the United Nations
The State of the World's Children 1999

The problems just reviewed and the importance of learning for our
future suggest a set of visions for learning, the other side of the coin to
the problems.  These visions should provide us with the direction that
Alice did not have.

### 2.2.1 Everyone should learn

The first goal for learning proposed is that EVERYONE SHOULD
LEARN to full capacity and desire. It implies that the poor of the
world have learning opportunities as good as the wealthy of the world.
It implies that learning availability should not depend on gender, race,
economic factors, age, previous learning, or any of the other items that

distinguish one human from another.    It implies that learning is available in all subject areas, from birth to old age.

This goal also means that learning should include the intellectual skills essential for today, such as creativity, intuition, and problem solving.    Learning should include experiencing the great creative products of the human mind, Beethoven's music, Shakespeare's plays, Newton's Laws of Motion, Henry Moore's sculpture, among many others.

It implies that everyone should want to learn and that learning should be enjoyable for all.    This is democracy in education, giving equal opportunities to all.

Some of these ideas will be expanded further in the next sections. Note than we emphasize learning over teaching and instruction.

### 2.2.2 Individualized Learning

Educational psychologists have long pointed out that students are different, in many different ways.    They have, at any point in learning in a subject, different backgrounds of previous learning and different interests.    They have different learning styles, although we still have much to learn in this area.    An effective educational system should treat each student as a unique person.    We will discuss this issue again later in more detail.

A learning sequence that is effective for one person may not be effective with another.    So in an individualized learning environment providing several approaches to learning a given topic may be essential.    We may eventually be able to pick the most effective learning approach for a given individual, but this is beyond our present capabilities.

We can also expect better retention.    The learning sequences can occasionally check on previous learning, and give additional help if necessary.  So learners will know more after a long time.

### 2.2.3 Individualized learning time

Another factor in individualization is that students learn at different rates, perhaps differing from subject to subject, and differing with changing interests outside of school or other learning locations.    Thus someone might be ready for advanced mathematics at an earlier age than another student.    Many students in an individualized learning environment, tailored to the needs of each student, might finish a

subject much earlier than is typical today. We expect that most students will progress much faster in an individualized system, shortening the time for learning.

We envision a good future educational system as allowing all students to move at different rates through learning, each progressing as natural for this individual student.  This implies that the concept of grade-level will vanish in our future systems.  Further, students will probably be at different learning levels in different subjects.

These last two considerations imply that realization of our goals requires a continuing way to evaluate students, almost moment by moment, to know when a different approach is needed, and to know when it is time to proceed to the next learning sequence.  This is critical.

### 2.2.4 All students should succeed in learning

Success is important in learning.  This implies that all learners should master fully each lesson, each subject, even though it may take different times and different learning material. Mastery can be achieved through treating each learner as a unique learner and continuing to work on a subject until mastery is attained, as measured by the evaluation approach just mentioned. Learning activities should focus on learning, not time, as already suggested.

### 2.2.5 Learning should be enjoyable

It is important that learning be a pleasant activity for all students. Continual success in learning is important in this regard.

A critical factor in learning is the amount of quality time devoted to learning.  So we want students to stay at learning, even difficult learning, for long periods of time.  A major factor in encouraging this is that students should enjoy learning.

Another factor that should be considered that that we want to encourage future learning, our next topic.  If people have enjoyed learning in the past, they are more likely to consider it in the future.

### 2.2.6 Learning should be lifelong

We live in a rapidly changing world, and people live longer.  The median age is rising.

> At the moment the median age of the world's population is about 26 years. If the trajectory anticipated by the current United Nations low-variant projections were to come to pass, this figure would rise to 44 years.
>
> Nicholas Eberstadt
> World Depopulation
> The Milken Institute Review, First quarter 2000

A person may have several different jobs and avocations during a long lifetime. Schools and universities are not enough. Learning needs to be a continuous activity from birth to death for everyone, perhaps with intervals where learning is at a low level because the person is engaged in other absorbing and important activities. One science fiction novel, *The Troika Incident,* by James Cooke Brown, mentioned in more detail in chapter 4, portrays a community in which learning almost stops while people are raising their children, for example.

### 2.2.7 Learning should be affordable

The individual and the world must be able to afford learning, everywhere, for everyone, and at all levels. A future learning system must be economically possible.

The critical factor is the cost for an hour of student learning, considering all costs. It is very important to include every cost associated with learning in making this calculation of costs.

## 2.3 Need for a new approach to learning

These goals cannot be attained with our current systems of either traditional or distance learning. We need a new form of learning to reach our goals.

We will explore such a form in this book. This new form of learning has great potential for realistically reaching the visions just described. But as we will mention frequently we need much more experience and research with this new proposed approach.

Our present educational institutions are at the service of the teacher's goals. The relational structures we need are those which will enable each man to define himself by learning and by contributing to the learning of others.

Ivan Illich
Deschooling Society
Harper and Row 1971

# Chapter 3

# FACTORS OF DISTANCE LEARNING

Distance learning, where the learner can be anywhere, anytime, is an important component of the future learning system discussed in this book. Often people have a limited view of the various types of distance learning that can be conceived; for some, distance learning is 'what I do.'

We need to consider the full range of possible types of distance learning. This chapter will provide that examination. Many different factors determine just what kinds of distance learning are to be found, or are possible. Most of these choices are spectra, not just a simple yes/no choice.

These myriad possibilities lead to a variety of distance learning strategies. Some are closely aligned with the visions in the last chapter. The following chapter discusses some realizations of these possibilities of distance learning, and later chapters develop a new possibility.

> Although distance education is a 'hot' topic, how well do we understand it? Our definitions and expectations of distance education tend to be fuzzy. New firms, alternative organizational models, and venture capital funds are emerging with startling rapidly, further complicating matters.
>
> Diana Oblinger and Jill Kidwell
> Are We Being Realistic?
> EDUCAUSE Review, May/June 2000, page 31-39

## 3.1 Learning paradigm

A key factor in learning is the underlying view of the learning process, the paradigm. The developer or deliverer of learning units seldom actively makes the choice of learning paradigm. This important choice is almost always an unconsciousness decision, influenced by the current dominant paradigm. Our concern is with paradigms for distance learning.

### 3.1.1 Information transfer

Almost all learning efforts for centuries, both conventional and distance learning, have followed a paradigm that can be called the information transfer paradigm. It sees the learning activity as transferring information for a knowledgeable individual to a student, through some intervening media. The focus is on information.

In schools, universities, and training, lectures, video, and print material are the dominant media for information transfer, with lectures the most common. In distance learning following this paradigm the dominant media is video, often similar to lectures, or print-based computer units, as in current web courses online. Verification of leaning is based on testing of memory of either information or procedures.

We have argued (EDUCAUSE Review, January/February 2000, and elsewhere), that this paradigm is inadequate for learning in the new century. Learning today has many needs that can not be met by information transfer, including learning problem solving, intuition, and creativity. Further many of the students using information transfer as it now exists do not learn fully. Memory is not enough in the twenty-first century. We need to look beyond information transfer, changing the paradigm for learning.

### 3.1.2 Tutorial learning

The new paradigm that seems desirable, for distance learning and all learning, is tutorial learning. Human tutors have long been used. Perhaps the most famous example of tutorial learning is 2500 years ago, with Socrates. Oxford and Cambridge used the tutorial method. Every major physicist in 19th century United Kingdom, including Maxwell, Tait, and Kelvin, studied with the same tutor at Cambridge, Hopkins. Many other examples can be sited, mostly for the children of the wealthy who had their own tutors at home.

Tutorial learning with skilled tutors is often effective for learning, but it is very expensive and we do not have nearly enough skilled tutors. We could never have learning with human tutors as a dominant learning paradigm today.

But modern digital and communications technologies now make tutorial learning possible, with the computer as the tutor, for all for distance learning, if suitable highly interactive learning material is developed. This will be a major enterprise.

We will return to this possibility of computer-based tutorial distance learning in more detail in chapter 7 and in other sections of this book. Changing the paradigm will not be easy.

Peter Drucker commented recently, "change is an opportunity, not a threat." (http://pfdf.org/publications/news/may2000/news.html.

> Perhaps all of the stakeholders of higher education are caught in a paradigm paralysis. We have difficulty changing the way we think and the way we believe . . . To break this barrier we should consider asking some new questions.
>
> Michael Hooper
> The Transformation of Higher Education
> In Oblinger, D., S. Rush, The Learning Revolution
> Asker, Boston, MA, 1997

## 3.2 Level of interaction

A critical question for learning is how active the student is. Most educational psychologists agree that active learning is better than passive learning. In a lecture environment, particularly in large courses, often very little time is allowed for each student to ask questions. Questions asked by the instructor are often rhetorical, and few students answer them. The activity is called teacher-centered, with the instructor talking almost all of the time. Reading for most students is also a one-way activity. Today learning on the web is primarily with reading or watching video, with little interaction.

Communication in two directions is essential for best learning, but it is seldom found in learning today. It does happen with good human tutors, and it can happen with computer-based tutors. Distance learning might involve various levels of interaction.

### 3.2.1 Computer based interaction

In tutorial learning with computers the interaction is intense, with both the computer and the learner playing a very active role, and with each interaction being of high quality.

This will be discussed in detail in Chapter 6.

### 3.2.2 Peer interaction

Peer learning provides another possibility for interaction in distance learning. When a small group of students (perhaps four) work together in a peer learning environment, perhaps with a highly interactive computer program, the interaction is high; it could be called conversational. These groups could be close together physically, or could be remote groups connected through the technology.

A given example of distance learning can be evaluated in terms of the interaction possible for each student. Both frequency of interactions and the quality of each interaction are important in considering the level of interaction as discussed in Chapters 6 and 7. Again we find spectra, wide ranges for each of these factors.

## 3.3 Student locations

Distance learning implies that the students learning are not physically at the formal institutions of learning, such as schools, universities, and corporate training centers.

This leaves many possibilities as to the locations of the students.

### 3.3.1 One or many locations

The remote students may be clustered together, perhaps in a series of classrooms in other institutions. This was the situation in the Chinese TV University when visited several years ago. With this arrangement the students are still together, as they would have been at the offering institution, but elsewhere. There may be only one, or many such distant groups.

At the other extreme, very large numbers of individuals may be learning at many individual locations. They might be in their homes, in public environments such as libraries, museums, and shopping centers, or in many formal institutions. They might be sitting under a tree, or at the seashore. Perhaps two or three students might work

together in groups, gaining the advantages of peer learning as just discussed.

### 3.3.2 Close or far

Often the distance learning locations are close together, perhaps in a near community to the originating school or universities. This was the situation for the Stanford University engineering courses, given at nearby companies through video.

The other extreme is that they can be widely separated geographically. The students might even be worldwide, although there are few examples of this kind so far. We expect this to become much more common in the near future, as more effective distance learning units are developed and moved to many languages and cultures.

## 3.4 Time constraints

Distance learning can involve various time constraints. They are discussed in the next two sections.

### 3.4.1 Beginning time

In formal institutions classes almost always begin at fixed times. This comes from a period before computers when management practices and instructor availability and convenience demanded this.

The other extreme is that a learning segment can begin for each student at any time: on any day, twenty-four hours of the day. This is possible with today's technology, but still not common.

### 3.4.2 Pacing

Formal institutions differ from the possibilities in distance learning, with regard to student pacing. In traditional activities the learning time is fixed for a particular learning segments.

Distance learning, in some forms, allows the pacing to depend on each student. Each student takes a different time to complete each segment, depending on the background and needs of that student.

### 3.5 Size of learning segments

In our schools and universities, the usual length of a learning segment is a course, lasting a quarter, a semester, or a year. The learning material included may depend on the schedule of the institution – the length of the year, quarter or semester. In universities, professors argue seemingly endlessly about the advantage of quarters and semesters.

But another possibility is that segments can be of any length. Distance learning can follow either strategy, although fixed lengths are most common so far.

For flexibility we might find a future situation in which units are relatively small, so students could have different paths in learning, depending on their needs. Students need not be aware of the size of distance learning units. The process can appear continuous to the student, with learning in a given subject lasting for years or for life. In this situation, the concept of 'course' is no longer useful.

### 3.6 Student control of content

Learning can provide no or limited content choice to the student, as in most existing courses, or it can turn over all choice of content to the individual student. This last possibility is not likely, although some people seem to think it is ideal. Partial student control of content seems more likely.

As an example of an intermediate strategy, the online physics course we developed about twenty five years ago at the University of California, Irvine was based on two sets of material, different approaches to engineering physics. We specified six paths through the material, with the student choosing the path at each diverging point. For a meaningful choice, the student must understand the alternatives, a nontrivial responsibility of course developers.

### 3.7 Years of learning

We can no longer assume that learning occurs only for the years 5 to 25, the school and university years. In our rapidly changing world learning can and should be lifelong, a continuous activity from cradle to grave, as we emphasize in this book. This should include both very early learning and many stages of adult learning. However, breaks in learning are possible.

## 3.8 Student support

Distance learning can provide various aids to students.

### 3.8.1 Helping students in trouble

Students may not have a smooth learning path. They may, for a wide variety of reasons, encounter learning problems. A critical step for efficient learning is to locate student problems, often not understood by the student, and offer appropriate assistance.

A learning system can provide many types of help to the student for learning problems. In older learning this was often provided partially by office hours and discussion sections, not enough for many students. More recently this help has come through electronic means, such as email or chat rooms, tactics that work only for small numbers of students. In the United Kingdom Open University tutors throughout the British Isles provide this assistance.

With distance learning the electronic means are also possible. But another possibility for such help is from the learning material itself. It can actively seek out the student problems, and offer interactive aid. This approach for assisting students will be explored in detail in this book.

### 3.8.2 Peer learning

An important kind of student support comes from other students, already mentioned. Peer learning, between students at the same point in learning activities, or as tutors to other students, is a valuable aid to learning. In traditional institutions this is seldom openly encouraged.

A distance learning activity may or may not encourage peer learning. Many opportunities are available when computers play a major role in the learning activities. Programs can encourage and aid in the creating of learning circles of students, both physically with students close together and electronically for those far apart. This could be through email, of could involve more detailed interaction.

If the computer is storing frequent records of each student, as we will suggest, background programs can search these records. The computer can encourage students, at the same point in learning, perhaps those having the same learning problems or the same zone of proximal development (considered later), to work together. Or the computer learning programs can encourage students who have learned

some material to aid others who are still trying to master the unit, a valuable learning experience for both.

### 3.9 Teachers or no teachers

It is often assumed that teachers are essential for learning. But it is clear from everyday experiences and from many studies that much learning occurs without teachers. In childhood marvelous early learning occurs, such as the learning of an initial language. Much adult learning is without teachers.

Distance learning may or may not involve teachers. As the number of students increases to the thousands or beyond, as discussed in the next section, the concept of 'teacher' becomes vague, even impossible. In the system described in this book, teachers in the usual are very unlikely except in special situations.

### 3.10 Number of students

A recent online discussion asked about the 'ideal' numbers of students in distance learning environments. Several people on the list, from United States universities, recommended 20 or 25 students. They were basing this on the type of distance learning now common in United States universities.

On the other hand, some of the foundation courses in the United Kingdom Open University have over 10,000 students. Clearly as suggested many forms of distance learning are possible. So a wide range of numbers is possible, with different types of distance learning.

The problems of education are universal, in a world with six billion people, many having no or limited schools available. Distance learning, in some form, may be the best possibility for reaching everyone, at all ages. So we would need to address these problems a form of distance learning suitable for very large numbers. This will be discussed further later, as the system suggested here is for many students.

### 3.11 Grading or mastery

In schools and universities almost all students are given a grade. Several grading systems are available, with students spread over a range from good to bad. These grades are determined primarily by examinations, although other methods such as portfolios have also

been tried. In large courses tests are, unfortunately, often multiple choice exams (called multiple guess by students.) These grades are taken as an indication that some students have not learned the material. Many distance learning environments are based on this grading strategy. But such cases as Albert Einstein, a poor student in school with low grades, lead us to question the value of grades.

Benjamin Bloom and others suggest another approach. He noted, in extensive experiments he and his students conducted in the Chicago public school, that with a tutorial approach, with human tutors, almost all students could learn. This is mastery learning; almost all students learn everything. Everyone succeeds. The problem he raised in the "Two Sigma" paper was how to accomplish this in a way that is feasible economically for the large numbers of students we now have. We hope to address that problem.

A major difference between grades and mastery is the role of examinations, student evaluations. As noted, they are typically used to assign grades in approaches that require grades. However, in mastery courses evaluation determines what new learning material to present next for each student.

For mastery we locate student learning problems and offer effective assistance offered, perhaps with several different sets of learning material. This is further discussed in Chapter 9.

### 3.12 Cost factors

We cannot ignore the costs associated with learning. These must be affordable by the individual and by the society. For learning both development and delivery cost, and other costs, are important. We should better understand the costs of traditional learning and distance learning.

Courses in traditional institutes often cost very little to develop. Most of this cost is in the time the instructor devotes to the course, both before and during the course. The major consideration before delivering the course is often the selection of a textbook.

When these same individuals work in distance learning, the costs are similar, because they are still using the same paradigm. But other approaches might involve very different costs.

With learning, including distance learning, several factors concerning costs are important. Different systems will have different costs. Chapter 12 is devoted to the cost problem, focusing on the costs of the tutorial system recommended in this book.

### 3.12.1 Cost of development

A learning segment to be delivered at a distance involves some costs of development.   As with the other factors discussed, there can be a wide range of expenses.  Often, even commercially, there is not a clear view of total costs. Our experiences are that textbook publishers often not have a complete view of the expenses involved.

We had major curriculum developments in the United States in the period immediately following the USSR Sputnik, over a wide range of subjects and levels.  A more recent data point with regard to distance learning is the United Kingdom Open University.  So they give us a basis for comparison, used in Chapter 12.

Spending large sums on development will not guarantee high quality learning.   However, good units for distance learning will be costly.

### 3.12.2 Cost for a student hour

Costs of development are not the most critical costs in considering distance learning, although they are the most frequently mentioned item.  From the standpoint of both the individual and the society (the country or the world) the most important factor is the cost for a student hour, including development, delivery, possible profit, and administrative costs.   In calculating the cost for a student hour of learning it is important to consider all costs, even those sometimes hidden.

Expensive development can lead to high quality learning material, at low costs per hour, if the delivery system is inexpensive and if large numbers of students use the learning units.   When we think of the learning problems of the world, and solutions to these problems, large-scale distance learning with many students is likely to be very important.

## 3.13 Evaluation

Learning material should be evaluated for learning effectiveness, but often it is not.   Evaluation can occur at various levels, both formative and summative evaluation

### 3.14 Delivery method

Many delivery methods for distance learning are possible, even within the same product, including mail, email, cable, CD-ROM, DVD-ROM, Internet, local wireless delivery, and satellite. A given product may be delivered in several ways.

The nature of the learning, and the costs, may determine delivery procedure is to be used. We will discuss the delivery methods available today and how they could be used. For flexibility, we might use several delivery methods for the same material, so we need not pick just one.

### 3.15 Learning subjects

A given learning program might offer a single learning sequence, or an unrelated collection of such sequences. It might involve one or several degree programs, or a very wide range of material.

The facility might offer a typical school or university range of units, might be concerned with pre-school activities, after school materials, adult learning, training, new subjects, or some combination of these.

### 3.16 Credit or noncredit

Learning may be in an environment that offers credit or certification. Or the learning may be undertaken with no idea of attaining such status. Adult learning is often without credit.

### 3.17 Profit or nonprofit

The learning segments may be offered for profit or may not be part of a nonprofit organization, such as at a state university.