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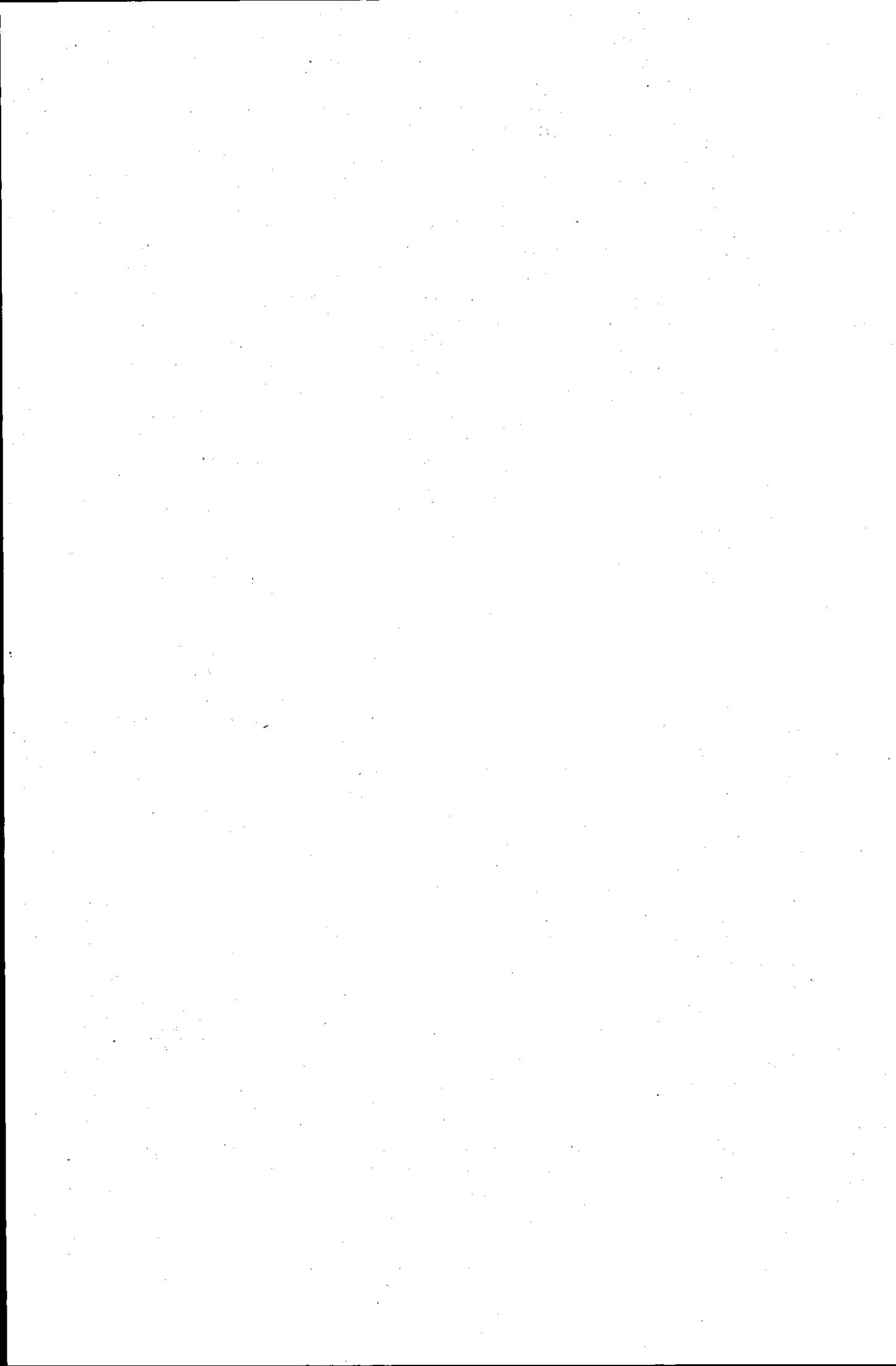
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**Information Technology and Distance Learning**  
**Aspects of Materials Databases**

**By**  
**Yan Wang, B. Eng.**

A master dissertation submitted in partial fulfilment of the requirements for  
the award of the degree of

**Master of Philosophy**

**Loughborough University**

**August 2000**

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**Institute of Polymer Technology and Materials Engineering**

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## Abstract

Distance learning is a flourishing area, with the number of programs, provided via remote delivery, increasing daily. At the same time, however, progress in the field of accessibility and support for learners, who want to pursue education and training in the area of materials science and engineering, has not always kept pace. An individual interested in taking a materials course, or in simply finding out what is available, may find himself/herself forced to locate and then plough through many unwieldy online course listings. This may discourage many learners from pursuing the distance learning option.

In recent years, more and more distance learning databases have been developed and made available on the World Wide Web. These distance-learning databases are aimed to offer an information pool on many courses and programs that are available online and to cater for users' specific needs of locating information. This need is equally applicable to the area of materials science and engineering.

The purpose of this current research has been to explore Information and Technology aspects of materials databases and closely study distance learning aspects. The exploration of IT aspects of materials databases focuses on discussion of existing technologies, tools and computer packages that have been involved in the development of online packages. This thesis concentrates on literature reviews of past, current and future developments in distance learning, preceded by an overview. A close look is then taken of some distance learning programs followed by an evaluation of distance learning databases. Finally, a new type of materials database is proposed and discussed.

The development of the proposed novel materials databases focuses on exploration of user-friendliness, search capability and connectivity of distance learning materials. Using existing computer packages, computer technologies and software products, each part of the database is discussed and developed in terms of its utility in the materials study process. This is done from the perspective of learners, or potential learners, with basic computer proficiency. Based on literature searches, development of databases, and evaluation, the research concludes with several novel recommendations for further

development of distance learning databases relevant to the study of materials science and engineering.

### **Keywords**

**Information Technology, Distance Learning, Materials Science, Database, Expert System**

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## Contents

Figures .....	vi
Tables .....	viii
Introduction .....	1
Chapter 1 Literature Review .....	1
1.1 Review of Database.....	1
1.1.1 Definition of a Database.....	1
1.1.2 Formats of Database.....	1
1.1.2.1 Data.....	1
1.1.2.1.1 Data Abstraction.....	1
1.1.2.1.2 Schemas and Instances .....	2
1.1.2.1.3 Data Independence .....	2
1.1.2.2 Data Models.....	2
1.1.2.2.1 Object-based logical models .....	3
1.1.2.2.2 Record-based logical models .....	5
1.1.2.2.3 Physical Data Models.....	7
1.1.2.3 Database Languages.....	7
1.1.2.4 Transaction Management.....	7
1.1.2.5 Storage Management .....	8
1.1.2.6 Users and Designers.....	8
1.1.3 Types of Databases.....	8
1.1.3.1 Analytic Databases.....	8
1.1.3.2 Operational Database .....	8
1.1.3.2.1 Relational databases .....	9
1.1.3.2.2 Hierarchical Database .....	13
1.1.3.2.3 Network Database .....	17
1.1.3.2.4 Client/Server Databases .....	20
1.2 Review of Distance Learning.....	20

1.2.1	Definition of "Distance Learning".....	20
1.2.2	Distance Learning and Open Learning.....	21
1.2.3	Types of Distance Learning.....	22
1.2.3.1	Broadcasting .....	22
1.2.3.2	Study Discussion Groups.....	22
1.2.3.3	Informal independent learning.....	23
1.2.3.4	Online Distance learning.....	23
1.2.4	Early Developments of Distance Learning.....	24
1.2.5	Current Growth Areas .....	24
1.2.6	Benefits from distance learning.....	25
Chapter 2	IT Aspects of Database.....	26
2.1	Some Background .....	26
2.1.1	Internet.....	26
2.1.2	World Wide Web.....	26
2.1.2.1	Simple use of the Web .....	26
2.1.2.2	What is the World Wide Web? .....	26
2.1.2.3	How Did the World Wide Web Begin? .....	27
2.1.3	The difference between the World Wide Web and the Internet.....	27
2.1.4	Basic components of the World Wide Web .....	27
2.2	Interface Design .....	28
2.3	User Interface Domain .....	29
2.3.1	Review of other available Software and Difference between Them.....	31
2.4	Review of Related Tools for User Interface Design .....	33
2.4.1	DHTML.....	33
2.4.2	VRML.....	33
2.4.3	XML .....	33
2.4.4	CGI .....	34
2.4.5	Java .....	34
2.4.6	JavaScript.....	35
2.4.7	Perl.....	35
2.4.8	Active Server Page .....	35

2.4.9	SQL.....	35
Chapter 3	Distance Learning Aspects of Database.....	36
3.1	Background .....	36
3.2	The Use of WWW in Distance Learning .....	36
3.2.1	Resource-based Learning (RBL).....	36
3.2.1.1	What is Resource-Based Learning.....	36
3.2.1.2	Current Development of RBL in UK Higher Education .....	36
3.2.1.3	RBL with WWW .....	37
3.2.2	Online Distance Learning.....	38
3.2.3	Distance Learning/Education Associations and Projects .....	39
3.2.4	Distance Learning Programs .....	41
3.2.4.1	The Open University, UK.....	41
3.2.4.2	The University of Catalonia (UOC).....	42
3.2.4.3	The University Licensing Program (TULIP).....	42
3.2.4.4	University of Phoenix Online .....	42
3.2.4.5	UT TeleCampus.....	43
3.2.4.6	World Lecture Hall .....	43
3.2.5	Overview of Distance Learning.....	44
3.3	Distance Learning Database.....	45
3.4	Distance Learning Aspects of Materials Database.....	47
3.4.1	Materials Databases.....	47
3.4.2	Distance Learning Aspects of Materials Database .....	48
3.5	A New Distance Learning Materials Database .....	49
Chapter 4	The Experimental Development of a DL Materials Database.....	52
4.1	Online Distance Learning Components .....	52
4.2	General Process.....	53
4.3	HTML Site Hierarchy .....	54
4.4	The Content of Web Site.....	56
4.4.1	Courses .....	56
4.4.2	Tutorial System.....	56
4.4.2.1	What is the Tutorial System?.....	56

4.4.2.2	The Use of Microsoft NetMeeting in Tutorial Systems.....	57
4.4.2.3	Hosting a Tutorial .....	58
4.4.2.4	Embedding the NetMeeting into a Web Page.....	58
4.4.3	Online Assessment .....	59
4.4.3.1	What is Online Assessment?.....	59
4.4.3.2	Reason for Online Assessment .....	59
4.4.3.3	Identification Problem: .....	60
4.4.3.4	The Use of "Question Mark" in Assessment .....	61
4.4.3.5	Creating Question Database with QM .....	61
4.4.3.6	Assembling Questions into Tests, Exams and Quizzes .....	62
4.4.3.7	Delivery of Sessions .....	64
4.4.3.8	Reporting.....	65
4.4.4	Showcase Window .....	65
4.4.5	Virtual Workshop .....	67
4.4.5.1	Virtual Laboratories.....	67
4.4.5.2	Direct Links .....	68
4.5	The Distance Learning Database.....	68
4.6	Conceptual Design of the Learning Database .....	69
4.7	Logical Design of the Consultation Database .....	71
4.8	Normalization.....	74
4.9	The Table Definition .....	74
4.10	A Logical Model for Data-Intensive Hypertexts .....	81
4.11	Setting Up the ASP Application .....	83
4.12	Search Engines.....	84
4.12.1	Searching Functions .....	84
4.12.2	Searching Principles .....	85
Chapter 5	Expert Systems .....	87
5.1	What is Artificial Intelligence (AI)? .....	87
5.2	What is an Expert System (ES)? .....	87
5.3	Basic concepts of an Expert System Function .....	87
5.4	Basic Elements of Rule-Based Expert System.....	88

5.5	Creating Expert System.....	89
5.6	Integrating Expert Systems and Database.....	110
Chapter 6 Innovative Feature.....		113
6.1	A New Model of Designing Distance Learning Programs.....	113
6.2	An Expert System.....	113
6.3	Virtual Workshop.....	114
6.4	Direct Links.....	115
6.5	The Routers.....	115
6.6	The Use of NetMeeting as a Tutorial System.....	115
6.7	The Use of Question Mark as Online Assessment.....	116
Chapter 7 Field Trial Web Site.....		117
7.1	Access - Easy of Use.....	117
7.2	Access - Ease of Searching.....	118
7.3	Access - Easy of Assessment.....	119
7.4	Expert System – Ease of Operation.....	119
7.5	Establish Limitations and Problems.....	120
Chapter 8 Final Conclusions.....		123
Appendix A: Table of 84 Materials Databases and Queries.....		126
Appendix B: Simple Questions.....		127
Standard Bibliography.....		128
Reference:.....		148

## Figures

Figure 1.1 The Three Levels of Data Abstraction .....	2
Figure 1.2 A Entity-Relationship Data Model.....	3
Figure 1.3 A Object-Oriented Paradigm.....	5
Figure 1.4 A Network Structure .....	6
Figure 1.5 A Hierarchical Model.....	7
Figure 1.6 A STAFF Relation .....	9
Figure 1.7 A Multidimensional Set Structure of A Relation.....	9
Figure 1.8 S# and STAFF.....	10
Figure 1.9 STAFF and STA-DEPT .....	10
Figure 1.10 A Relational Structure Concept .....	12
Figure 1.11 A Hierarchical Database .....	14
Figure 1.12 "Many to Many" Relationship by Duplication .....	16
Figure 1.13 Conversion into a DBTG Network Database.....	20
Figure 2.1 Basic Components of World Wide Web.....	28
Figure 4.1 A General Process .....	53
Figure 4.2 HTML Sites Hierarchy.....	55
Figure 4.3 A Web Page with Embedded NetMeeting .....	58
Figure 4.4 Registration System .....	60
Figure 4.5 A Design of Question Database.....	62
Figure 4.6 A Score Band .....	63
Figure 4.7 A Session Publishing Message.....	64
Figure 4.8 A Showcase Web Page.....	66
Figure 4.9 A Simple Application Form .....	67
Figure 4.10 The Skeleton Schema.....	70
Figure 4.11 Search with Abstract Field.....	85
Figure 4.12 HTML Source File of Abstract Field Search .....	85
Figure 4.13 Source Code .....	86
Figure 5.1 Basic Elements of Rule-Based Expert System.....	88
Figure 5.2 A Process of Defining A Problem.....	90
Figure 5.3 Factors of the Expert System .....	91

Figure 7.1 Demonstration..... 117  
Figure 7.2 Search Help ..... 118  
Figure 7.3 Search Field..... 119

## Tables

Table 4.1 Table of Volumes .....	71
Table 4.2 Table of Operations .....	72
Table 4.3 Table of Accesses .....	73
Table 4.4 DLCourse Field Specification .....	74
Table 4.5 DLAssignments Field Specification.....	75
Table 4.6 DLLectures Field Specification.....	75
Table 4.7 DLAssessments Field Specification .....	76
Table 4.8 DLLabs Field Specification.....	76
Table 4.9 DLTutorials Field Specification .....	77
Table 4.10 DLStudents Field Specification.....	77
Table 4.11 DLStudentCourses Field Specification .....	78
Table 4.12 DLStudentAssignments Field Specification.....	78
Table 4.13 DLStudentLectures Field Specification .....	79
Table 4.14 DLStudentLabs Field Specification .....	79
Table 4.15 DLStudentTutorials Field Specification.....	79
Table 4.16 DLStudentAssessments Field Specification.....	80
Table 4.17 DLShowcases Field Specification.....	80
Table 4.18 DLDireckLinks Field Specification .....	81
Table 5.1 Database Records of Rules.....	109

## Introduction

“Distance” learning is one type of “open” learning and consists of a variety of forms of learning at all levels. Distance learning is regarded as non-contiguous learning, in which the teaching and learning occur separately, in contrast to contiguous classroom learning where teaching and learning occur simultaneously.

Distance learning systems are many and various. It is possible to regard them as encompassing a range of possible teaching-learning arrangements, including: correspondence study, educational broadcasting, individualised instruction, face-to-face tuition, self-help study groups, online distance learning. A variety of instructional techniques and settings are available to teachers and students in such systems.

Online distance learning is currently available using the World Wide Web and other compatible technologies. It serves a widely distributed community of students and researchers who are engaged in study and for those who need college credits but cannot either attend regularly scheduled classes or who cannot register for a class at their home campus. Online distance learning uses the most popular communication technology to support learning and knowledge exchange, communication between practitioners in laboratories, and training and educational divisions. It is also a method of learning that is both enjoyable and flexible for students. The concept of the online campus has facilitated communication between students, tutors and the academic administration.

Distance learning databases allow detailed descriptions of accredited courses, plus information about institutes all over the world that offer remotely accessible learning programs. The information contained in such databases comes from collections of course-specific data offered at approved institutions or educational organizations.

The integration of such database to the process of distance learning is shown in this thesis to be an effective and practical way to promote its development. Databases can be used to contain abstracts of books, journal articles, research reports, conference papers, dissertations and other types of literature relating to all aspects of the theory and practice of distance learning. They can also offer links to searchable databases providing study support and links to mailing lists for online teachers offering help and assistance.

Many universities and educational organizations are working in this area. They are developing databases, which can provide access to open and distance learning literature for planning, decision-making and study, both for students and more mature adults. They can encourage practitioners to become better informed in open and distance learning theory and practice worldwide. This is also happening in Materials Science study areas. For example, the Cambridge Scientific Abstract Internet Database Service is widely accepted in the scientific field. It provides comprehensive coverage of all aspects of materials science and its contents include: international literature on ferrous and non-ferrous metals, polymers, ceramics, plastics and composite materials; the practices of materials science and engineering as they relate to these substances; technical and commercial developments in materials science.

It is proposed in this thesis that there is scope for the design of a new Web site dedicated to specific application needs and capable of co-ordinating subjects comprehensively. It would be data-intensive and have the primary purpose of being able to deliver large amounts of materials related information to a variety of users in a harmonious fashion.

This online distance learning web site is proposed to consist of HTML Web pages, the SQL Server database and use an Internet Information Server (IIS) application. Almost all of the Web pages would have Active Server Pages. The database for this application would be SQL format. With minor modification the database would be ported to "Access" or any other ODBC-compliant database server. The Active Server Pages would be placed on the server in a common directory structure and would be installed as an application within IIS.

There would be several aspects to the proposed Web site. It would consist of five basic modules: **Courses, Tutorial System, Online Assessments, Showcases and Virtual Workshop**. Each module would have interconnection with the others. A search engine working with each of them would allow exchange with most commercially available databases. There would be a common interface to make all modules look and "feel" the same. The use of Internet resources such as MS NetMeeting and Ms Media Player could offer enhanced learning and understanding, modify the learning environment, reduce the barriers which time, space and culture differences may create, be a source of motivation,

and redefine the role of teachers and learners. With the use of "Question Mark" type software, it would be possible to create tests, surveys, questionnaires, and assessments for use via the Web or Intranet.

The proliferation of databases has led to a growing demand for skills in navigating and manipulation of them. These online databases can be said to require considerable expertise to manipulate them. When users are searching databases, and decide that they are not making the progress they would like, they need to know what to do next. In a physical library, they might go to a help desk and talk to a librarian. When surfing on the Internet, they may wish to communicate with an expert by telephone or email. The expert would then "call up" a resume of the users' search history and compose suitable advice. This advice could be specific, general or remedial. It could, for example, help to solve the current task, explain a generic browsing technique and also correct any apparent misconceptions. As part of the explanation, the expert would pass on an annotated searching procedure which the users could view and even use on their own terminals

Thus it is envisaged that an expert system could be introduced and set up as a small rule-based system. It could be developed to handle classification and selection problems. It would be backward chaining in the sense that rules would be used in order to determine appropriate values for the search goal. The rules would be grouped together in one set and then be examined them simultaneously.

This distance learning "materials study" web site is envisaged to provide an alternative approach to traditional methods by allowing access to all learning material at a single location and to be sufficiently feasible for students to attend courses from wherever and whenever they like. The starting point for all students would be an appropriately designed browser to give access to the "courses", "tutorials" and "assessments" sections

All learning material would be "virtually" available via the database itself. It would be very easy to add new material at any point (by "links") or by direct insertion and display it in HTML format later. Thus there is inherent flexibility for both designer and instructor. There would also be freedom to modify or correct data later to meet the requirements of new students. It is envisaged that this concept of a new type of coordinating database could be extended into other subject fields.

# Chapter 1 Literature Review

## 1.1 Review of Database

### 1.1.1 Definition of a Database

Computer databases came into existence to overcome the limitations of file systems and to reduce the burden on programmers and users. They also alleviate the unnecessary rewriting of sections of code when changes occur in data structure or application requirements.

Databases are large collection of structured data stored in one or several computers in order to serve several data processing applications. [1] Facts and figures can be stored data and can be represented as numbers, text strings, images, and voice stored in files on disks or other media.

A database system is an integrated collection of related files, among with details of the interpretation of the data contained therein. [2] A database management system (DBMS) is a software system that allows access to data contained in a database. [2]

### 1.1.2 Formats of Database

#### 1.1.2.1 Data

A major purpose of a database system is to provide users with an abstract view of the data. [3] Data are known facts, such as names, telephone numbers, addresses and so on, that can be recorded and that have implicit meaning. [4] A collection of related data with implicit meaning forms a database.

##### 1.1.2.1.1 Data Abstraction

Data abstraction can be divided into three levels, known respectively as view, logical, and physical level. Physical level is the lowest and describes how the data are actually stored. Logical level describes what data are stored in the database, and what relationships exist among those data. The highest level of abstraction is view level, which describes only part of the entire database. [3] The interrelationship among these three levels of abstraction is illustrated in Figure 1.1.

three different groups of the various data models, which are object-based logical models, record-based logical models and physical data models.

#### 1.1.2.2.1 Object-based logical models

Object-based models are used in describing data at the logical and view levels. They are characterized by the fact that they provide fairly structuring capabilities and allow data constraints to be specified explicitly. [3] The most widely known ones are entity-relationship model and the object-oriented model.

(a) The entity-relationship model was developed by Chen to facilitate database design by allowing the designer to express the logical properties of the database in an enterprise schema. [5] The word enterprise means the organization for which the database is kept. Entity is any object that exists and can be distinguished from other objects. The entities are linked by associations or relationships, which are connections or interactions between the entities.

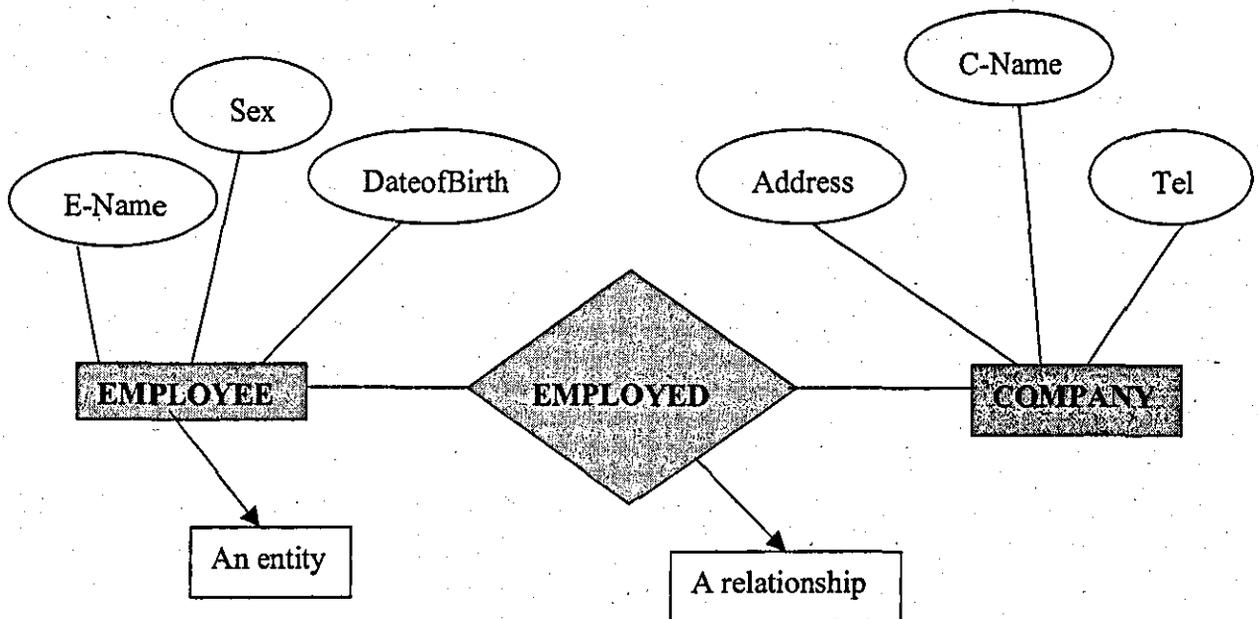
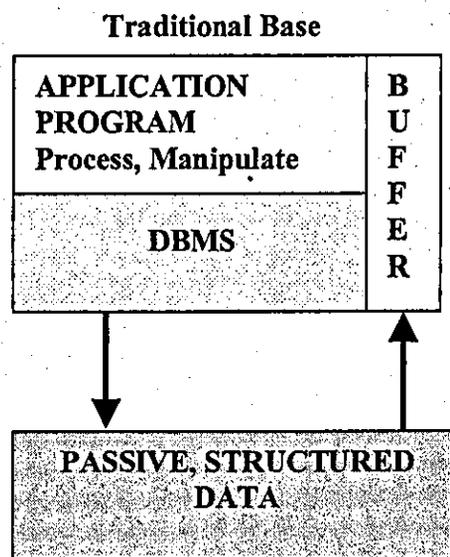


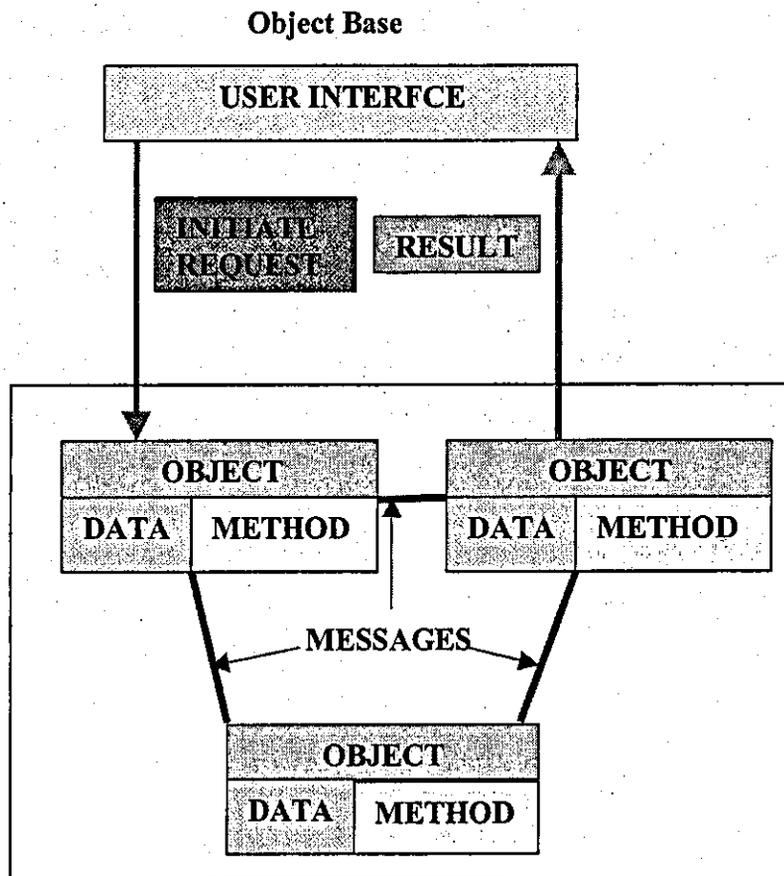
Figure 1.2 A Entity-Relationship Data Model

(b) The object-oriented model is based on a collection of the object-oriented-programming, which was first introduced by the language Simula 76 designed for programming of simulations. [3] The object-oriented model provides a higher level of abstraction and more powerful modelling capabilities with respect to a traditional database system. An object-oriented database has not only structured data, but also representations for abstractions, as shown in Figure 1.3.

At the top of the figure, a traditional database with a data pool can be seen. The data pool is passive in sense that there is no code associated with the data in the files. All the code appears in the user's application program. Several tables of data can be used in the passive database and a package of database queries can be written to the model, which is an object in all application programs. If a change is required, all these application programs must be updated.

At the bottom of the figure, the object-based version of the same application can be seen, in which active object instances are stored in the database. The database can be used to represent data as well as code for implementing all characteristics. In an object base, objects can interact by sending messages to each other. (An example is an automated office where each object instance is an office object, i.e., a workstation, clerk, etc.) Application programs can also interact with the object base using messages.





**Figure 1.3 A Object-Oriented Paradigm**

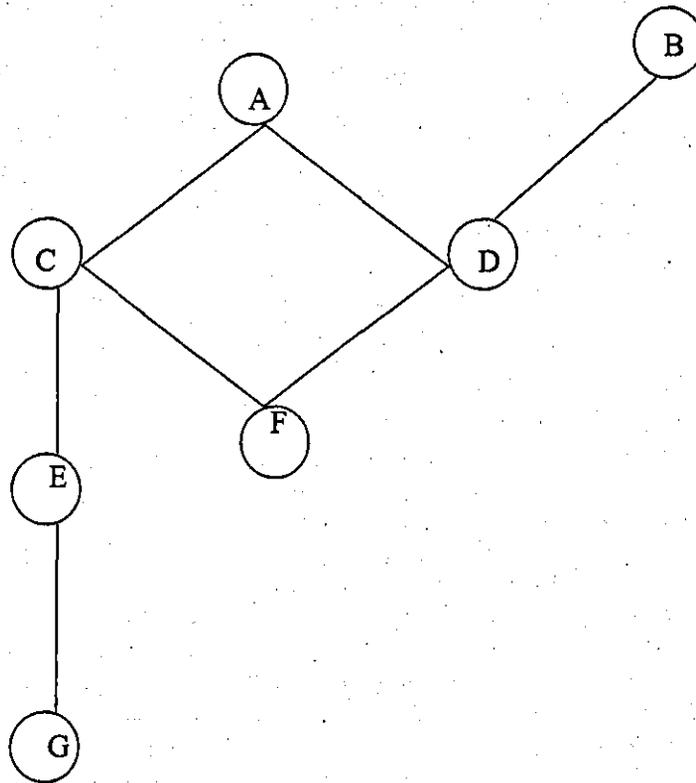
#### 1.1.2.2.2 Record-based logical models

Record-based models are used in describing data at the logical and view levels. In contrast to object-based data models, they are used to specify the overall logical structure of the database and to provide a higher-level description of the implementation. [3] The three most widely accepted record-based data models are the relational, network, and hierarchical models.

(a) The relational model was first introduced by Ted Codd of IBM Research in 1970 in a classic paper "Codd 1970", and attracted immediate attention due to its simplicity and mathematical foundations. The model uses the concept of a mathematical

relation, which looks somewhat like a table of values, as its basic building block, and its theoretical basis in set theory and first order predicate logic. [4]

(b) **The network model** was the basis of one of the oldest database management system, Integrated Data Store (IDS), developed by Bachman at General Electric during the 1960s. [5] The network model uses the network or plex structure as its basic data structure. A network is a directed graph consisting of nodes connected by links or directed arcs. The nodes correspond to record types and the links to pointers. [5]



**Figure 1.4 A Network Structure**

(c) **Hierarchical Model** is the oldest of the three record-based data models, dating from the 1960s. Unlike the relational model, which was firmly grounded in theoretical research, and the network model, which developed along with carefully written specifications, the hierarchical model simply grew out of practice. [5] The hierarchical model uses the tree as its basic structure. A tree is a data structure that consists of a

hierarchy of nodes, with a single node, called the root, at the highest level. The node may have any number of children, but each child node may have only one parent node on which it is dependent. The parent-to child relationship in a tree is thus a one-to-many relationship, but the child-to-parent is one-to-one. [5]

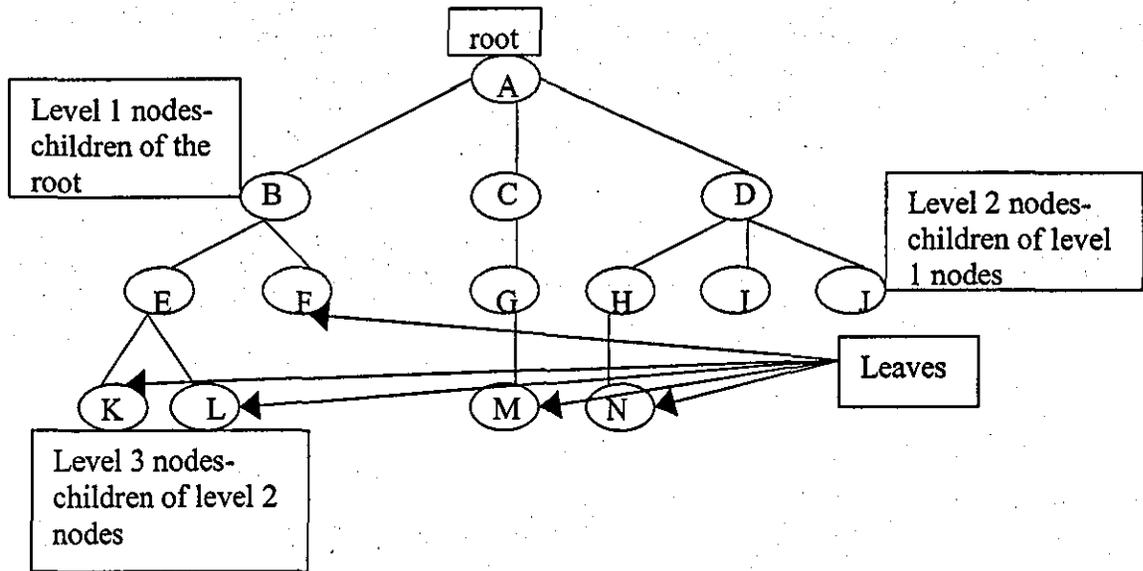


Figure 1.5 A Hierarchical Model

### 1.1.2.2.3 Physical Data Models

Physical data models are used to describe data at the lowest level. [3] Two of the widely known ones are unifying model and the frame-memory model.

### 1.1.2.3 Database Languages

A database system provides two different types of languages: one to specify the database schema, and the other to express database queries and update. [3] The data definition language is used to define the logical, external, and physical schemas and access authorizations. [6] The data manipulation language (DML) is used for querying and updating database instances. [6]

### 1.1.2.4 Transaction Management

A transaction is a collection of operations that performs a single logical function in a database application. Each transaction is a unit of both atomicity and consistence. The all-or-none requirement is called atomicity. The correctness requirement is called

consistence. The persistency requirement is called durability. Ensuring the atomicity and durability properties is the responsibility of the database system itself – specifically, of the transaction-management component. [3]

#### **1.1.2.5 Storage Management**

A storage manager is a program module that provides the interface between the low-level data stored in the database and the application programs and queries submitted to the system. The storage manager is responsible for the interaction with the file manger, that is storing, retrieving, and updating of data in the database. [3]

#### **1.1.2.6 Users and Designers**

Various categories of people can interact with a database or with a DBMS. They are database administrator (DBM), application designers and programmers, users (end users, and casual users).

### **1.1.3 Types of Databases**

#### **1.1.3.1 Analytic Databases**

Analytic databases are primarily static, read-only databases, which store archived, historical data used for analysis. [7] For example, a hospital might store patients' records over the last ten years and use it to analyse health in relationship to demographics.

On the Web, it is possible to see analytic databases in the form of inventory catalogues. An inventory catalogue analytical database usually holds descriptive information about all available products in the inventory.

Web pages are generated dynamically by querying the list of available products in the inventory against some search parameters. The dynamically generated page will display the information about each item (such as title, author, ISBN), which is stored.

#### **1.1.3.2 Operational Database**

Operational databases were created to manage more dynamic data. These types of databases allow more than simple viewing of archived data and modification of data (adding, changing or deleting data). These types of databases are usually used to track real-time information. [8]

According to different logical data structure, it is possible to represent an operational database with three main divisions: relational database, hierarchical database and network database.

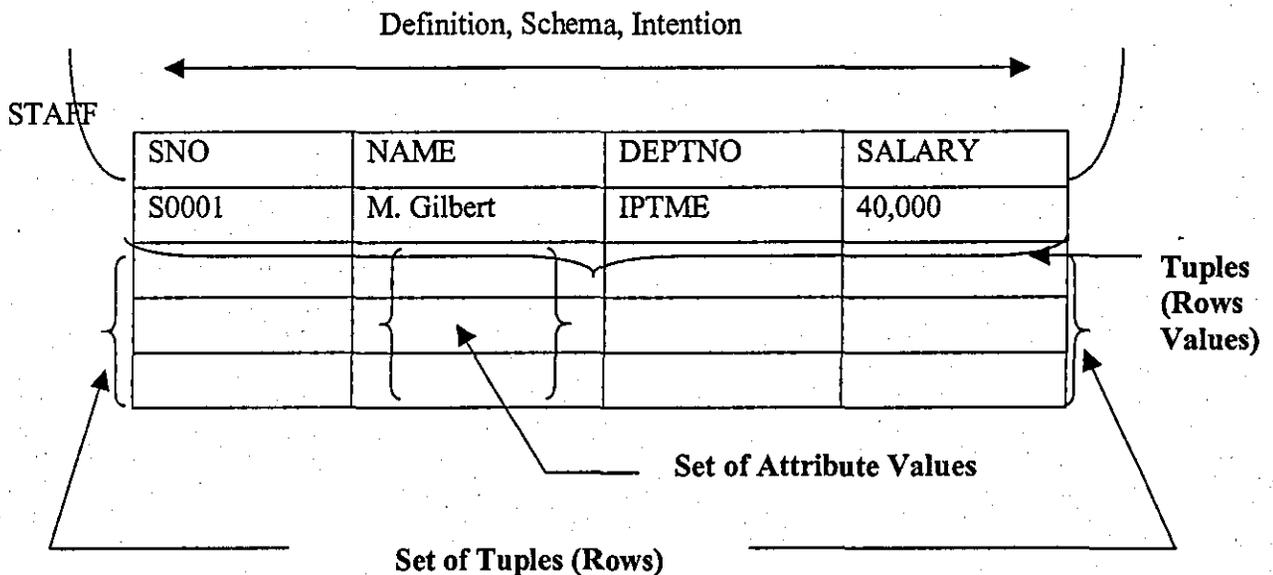
### 1.1.3.2.1 Relational databases

**Definitions:** relational databases are based on the relational model whose base is the mathematical theory of relations. The relational structure can be depicted as shown in Figure 1.6. A collection of relations constitutes a relational database, and relations are like tables, which have columns, called attributes, and rows, called tuples. Therefore, in a relational database, a part of a relation identifies an entity and its attributes.

**STAFF**

SNO	NAME	DEPTNO	SALARY
S0001	M. Gilbert	IPTME	40,000
S0002	M. Richardson	IPTME	35,000
S0003	Z. Zhang	IPTME	30,000
S0004	J. Zhang	IPTME	30,000

**Figure 1.6 A STAFF Relation**



**Figure 1.7 A Multidimensional Set Structure of A Relation**

Columns have labels, called attribute names. An example of a relation, STAFF is shown in Figure 1.6. There are four rows in the relation, one row per individual described

as a staff. A number of concepts have been used to describe relations and restrictions, which impose upon the relational structure.

Figure 1.7 shows the multidimensional set structure of a relation, that is several sets make up a relation. There is tuple-oriented relational calculus, in which the set of rows or tuples is the base of the relational set theory and the domain-oriented relational calculus whose variables are columns. However, multisets can exist: as sets of tuple values within each tuple and set of attribute values in each column, or sets with duplicates. In short, a relation is a set-rich structure with a firm mathematical basis.

A relation can come in various forms, as shown in Figure 1.8 and 1.9.

S#	STAFF	
SNO	ENO	NAME
S0001	S0001	M. Gilbert
S0002	S0002	M. Richardson
S0003	S0003	Z. Zhang
S0004	S0004	J. Zhang

Figure 1.8 S# and STAFF

STAFF		STA-DEPT	
SNO	NAMES	SNO	DEPTINFO
S0001	M. Gilbert		DEPTNO DEPTSIZE
S0002	M. Richardson	S0001	IPTME 100
S0003	Z. Zhang	S0002	IPTME 100
S0004	J. Zhang	S0003	IPTME 100
		S0004	IPTME 100

Figure 1.9 STAFF and STA-DEPT

It is conceivable to have a relation consisting of a single column, or two columns (as seen in the relations of Figure 1.8, S# and STAFF. It is possible to continue adding more

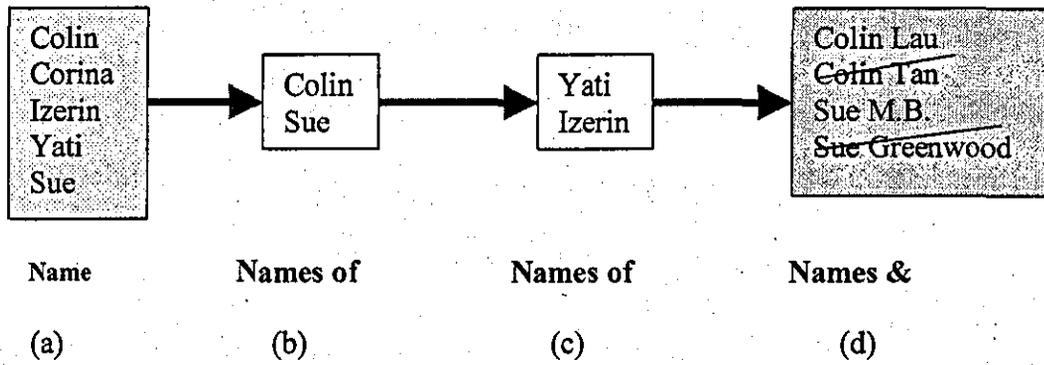
columns as in Figure 1.6 and 1.7. Therefore, relations can be unary, binary, ternary... and n'ary, corresponding to the count of columns: one, two, three, ... and n, respectively. These numbers show the degree (or arity) of relations. In Figure 1.9, other structural variations can be seen: i.e., in STAFF the NAMES column. "Attribute" in relational terminology can take a set of values whenever applicable to indicate all the legal names a person had in the records due to name change or marriage. STA-DEPT shows a nested relation where DEPTINFO is a relation, which consists of DEPTNO and DEPTSIZE attributes. Both relations in Figure 1.9 are not normalized because NAMES in STAFF is set-valued and DEPTINFO is a compound (i.e., composed of two atomic attributes).

The STAFF table, Figure 1.7 is a normalised relation, which does not allow multiple values at any of its column-row intersections. For example, Staff M. Gilbert has one staff number, one name, one department number, and one salary in her record (row). It is not possible to represent M. Gilbert's salary history by storing all the salaries she was paid in the salary entry.

**Relations and Key:** an important feature of a relational structure is that attribute values come from a homogeneous pool of values, called the domain, which represents all possible values in a finite set. However, more than one attribute can assume values from the same domain and a single attribute can take several values from a domain. In Figure 1.10(a), both research students and supervisors' names are collected in the name domain. These names can take the roles of RNAME and SNAME in all forms of the RST-SPR relation. However, the way to build the relational structure is to form the domain sets for research students Figure 1.10(b), and supervisors Figure 1.10(c), and take the cross product Figure 1.10(d), of these sets. This product shows the exhaustive set of name pairings. However, if a research student can work for only one supervisor, then two of the four possible pairings are irrelevant. After crossing these out, the relational structure RST-SPR is reached. It is important that each student-supervisor pairing is unique to arrive at the correct relational structure.

Because names may not be unique, it is possible to have the same name pair from a different research student and supervisor. However, sets cannot have duplicates. To identify each tuple uniquely, an attribute must be assigned, such as student number, ID, for every tuple, as shown in RST-SPR 2 and RST-SPR 3. Such an attribute is called a

key. Sometimes a combination of attributes is needed to make up a key. Certain relations can have more than one key, such as the social security number, SSN, in RST-SPR 3. In that case, one key was chosen as the basis for identifying (and



**RST-SPR1**

RNAME	SNAME
Colin	Yati
Sue	Izerin

**RST-SPR 2**

RNO	RNAME	SNAME
R001	Colin	Yati
R003	Sue	Izerin

**RST-SPR 3**

ID	SSN	RNAME	SNAME
R001	999449150	Colin	Yati
R003	NULL	Sue	Izerin

**Figure 1.10 A Relational Structure Concept**

retrieving) tuples and this key is the primary key, whereas the others are candidate keys. The clue in this designation is that values must always be available for the primary key, for obvious reasons, whereas there may be unknown values, or nulls, for the candidate keys. For example, in RST-SPR 3, research student R003 's SSN was not immediately available.

A key contains the minimum number of attributes or attribute compounds to distinctly identify all possible tuples that can be stored in a relation. [6] In Figure 1.10, RST-SPR 3 has keys ID and SSN. An identifier consisting of research student ID and name combined, i.e., ID-RNAME, can still identify each tuple uniquely. Such a combination is called a superkey. A key of a relation or a set of attributes that include the key is referred to as a superkey. [6] With these key notions, it is possible to emphasise that every tuple in a relation must be distinct, and so a key must have the property of uniqueness (it is not possible to store a research student record more than once).

In Figure 1.6 to Figure 1.10, every row of a relation has represented an instance of an entity set whether it is a staff (STAFF), a staff identifier (S#), or an association (RST-SPR). In that notation, a relation corresponds to an entity set. For each entity, its primary key must always be present to be representable and retrievable. This is confirmed by the restriction that primary key values must be non-null.

#### 1.1.3.2.2 Hierarchical Database

**Definitions:** a hierarchical database structures its data by using the hierarchical data model. In the hierarchical data model, hierarchies of record types are constructed. A hierarchy is a tree structure where record types are the nodes of the tree and are connected by arcs denoting parent-child relationships. [5]

In Figure 1.11(a), five record types DEPARTMENT, ADMINISTRATION, MANAGER, ENGINEER, and PROJECT define a hierarchical database, a hierarchical schema of the definition tree. The schema is about departments in a company. A department model is made for its composition of administrative staff, managers, and engineers. Here it is convenient to use the first letter to represent a hierarchy.

Figure 1.11(a) indicates a generic connection between pairs of record types. Figure 1.11(b) is an exemplar of a hierarchical database, a population of hierarchical database records (HDR). There are three HDRs, which has its own specific form. These are all legal. In other words, whatever is present conforms to the schema and there is no rule forcing the presence of a certain number of instances of all the types.

**(D) DEPARTMENT**

TOTAL_EMP	NO OF SENIOR
-----------	--------------

**(A) ADMINISTRATION**

NAME	JOB_TITLE
------	-----------

**(M) MANAGER**

NAME	RANK	DEGREE
------	------	--------

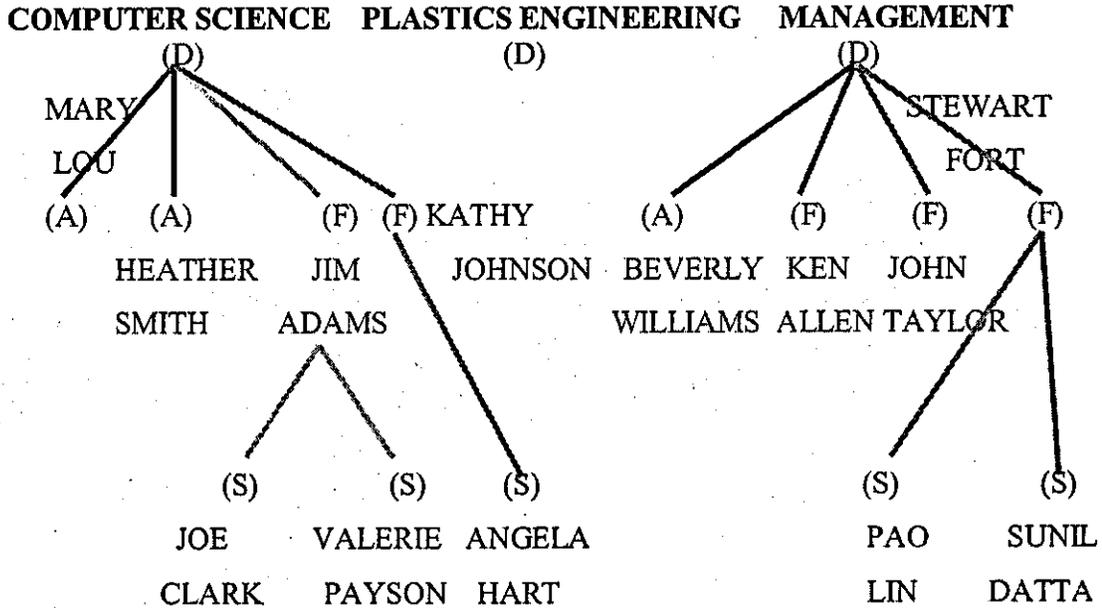
**(E) ENGINEER**

NAME	DUTY	MAJOR
------	------	-------

**(P) PROJECT**

PNO	START_YEAR
-----	------------

**(a) A Hierarchical Schema**



**(b) A Population Database with Three HDRS**

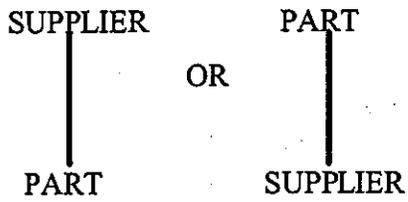
**Figure 1.11 A Hierarchical Database**

Hierarchical databases have their idiosyncrasies. They can be useful for some applications, i.e. the functional mapping between parent and children and the hierarchical structure, whereas others pose restrictions. To be specific, in a hierarchical or tree data structure, there is "many-to-one" mapping (which include one-to-one) from children nodes (records-type instances) to the root instance.

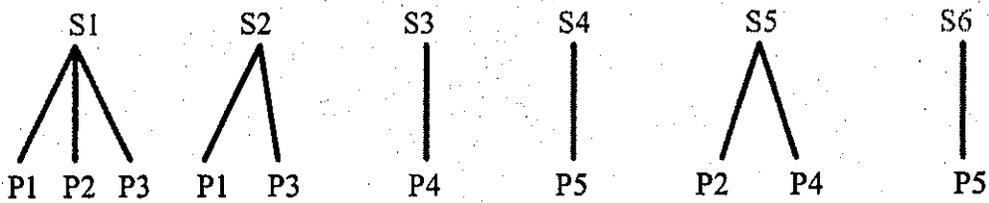
This must be total functional mapping. It is not possible to have "dangling" children unconnected to a parent. Therefore, every child must have a parent even if a dummy parent has to be made up. The hierarchy must obey the tree structure in the sense that node can exist without a parent except the root. [5] Therefore, if a parent is deleted, so is all its children. In Figure 1.11(b), if faculty member JIM ADAMS in COMPUTER SCIENCE is deleted, then his advisees, JOE CLARK and VALERIE PATSON, must also be deleted. Similarly, deletion of MANAGEMENT in the third HDR would totally delete the entire HDR consisting of seven instances.

Compared to "many-to-many" relationships, many-to-one relationship between pairs of record types (introduced earlier) is a primitive structure. It is possible to represent a complex structure in terms of a primitive structure by duplication. For example, a "many-to-many" relationship is among SUPPLIER and PART record types.

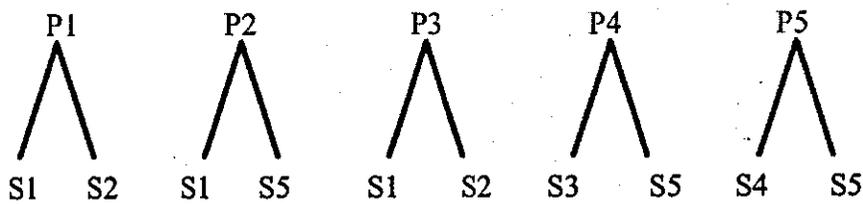
To represent this structure by a hierarchy, the hierarchy must be defined, making one parent record type and the other child type. As shown in Figure 1.12(a), there are two possibilities for this because of two record types. Figure 1.12(b) and (c) show example populations for each of the two possibilities. Both of them have all the instances of the database with applicable connections, but no symmetry in operations, and thus there will be a difference in search time. For example, the query "what is supplier S2 supplying" can be answered fast by the database of Figure 1.12(b), since only one tree below root S2 is needed to access, whereas scanning of all the database must be taken in Figure 1.12(c) to look for S2 and output their corresponding roots. On the other hand, the query "who supplies P2", which is symmetrical to the first query, can be answered much easier by the database of Figure 1.12(c) than by that of Figure 1.20(b). To provide symmetry, two versions of the database must be stored, Figure 1.20(a) and (b), by introducing duplication. However, in actuality, it is only possible to store only one, biasing the database to certain types of queries.



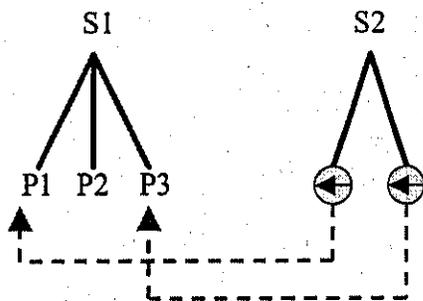
(a) Two Possible Schema



(b) Database Populated with Respect to the First Schema



(c) Database Populated with Respect to the Second Schema



(d) Physical and Logical Parents Between the First and Second HDRs of (b)

Figure 1.12 "Many to Many" Relationship by Duplication

Here a pointer mechanism has been introduced. Instead of duplicating a record instance, it is stored once in one tree and others point to that instance, hence sharing it. [5] For example, in Figure 1.10(d), this is shown between the first two HDRs of Figure 1.10(b). While P1, P2 and P3 are stored under the parent S1, P1 and P3 are not stored under S2, rather, they point to those of S1. As such, S2 becomes the logical parent of P1 and P3, whereas S1 is referred to as the physical parent.

### 1.1.3.2.3 Network Database

**Definition:** A network database can be represented as a graph. The nodes in the graph are record types and arcs between nodes indicate relationships. [5] Unlike hierarchical databases that have a tree form graph, network databases are not restricted. It is possible to have a general graph, at least theoretically. This means that a given node can have more than one arc, each for a different relationship, and there is no mapping restriction among pairs of nodes on an arc. In hierarchical databases, however, only a parent-child type relationship exists. A network can present many-to-many relationships. Compared to a network, a hierarchy is a more primitive structure. There are two typical network databases: DBTG network database and set-oriented network. The committee that standardised the business language, Cobol, introduced the DBTG network database. The DBTG gained its name from a subcommittee called DBTG (Data Base Task Group). Now the DBTG has become a guideline for many network database management systems.

Network databases were created to implement many-to-many and complex relationships and so forth, which cannot be easily performed by hierarchies. The basic building block of the DBTG network model is simple. A DBTG network database consists of a collection of set types, owner and member record types. Set types relate owner and member record types. The record type on one side of the relationship is the owner whereas that on the many sides is the member. The concise requirements are:

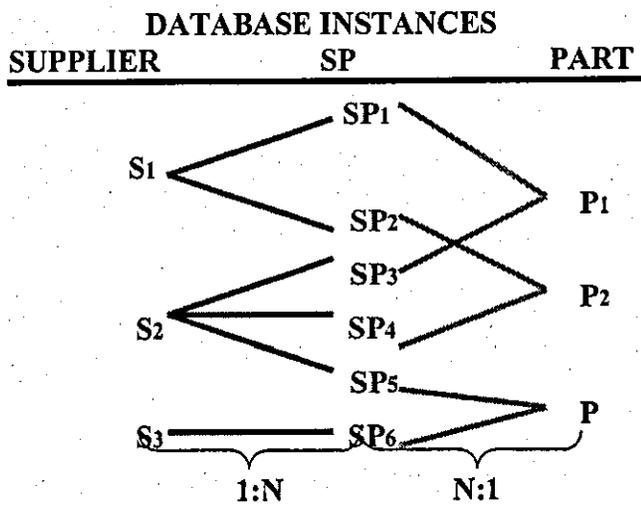
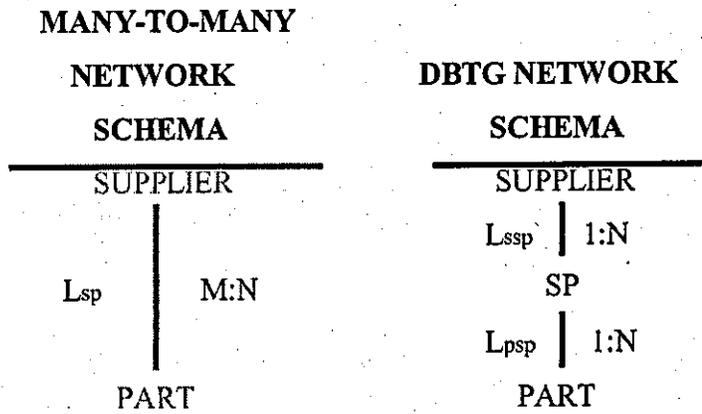
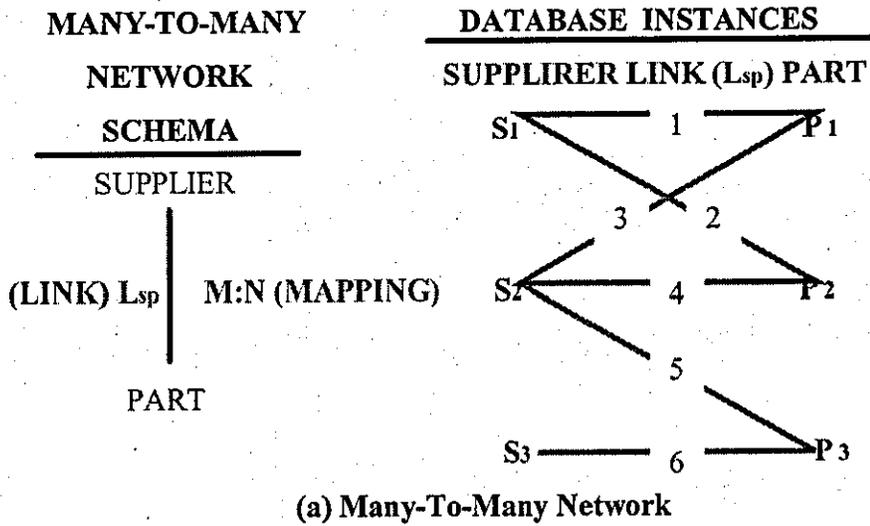
- there must be a one-to-many relationship between pairs of record types with respect to an owner-with-member relationship.
- a given owner must possess a unique set member.
- a given record type can only be the owner or member of the same set type.

The differences between hierarchical relationships and hierarchical databases are as follows:

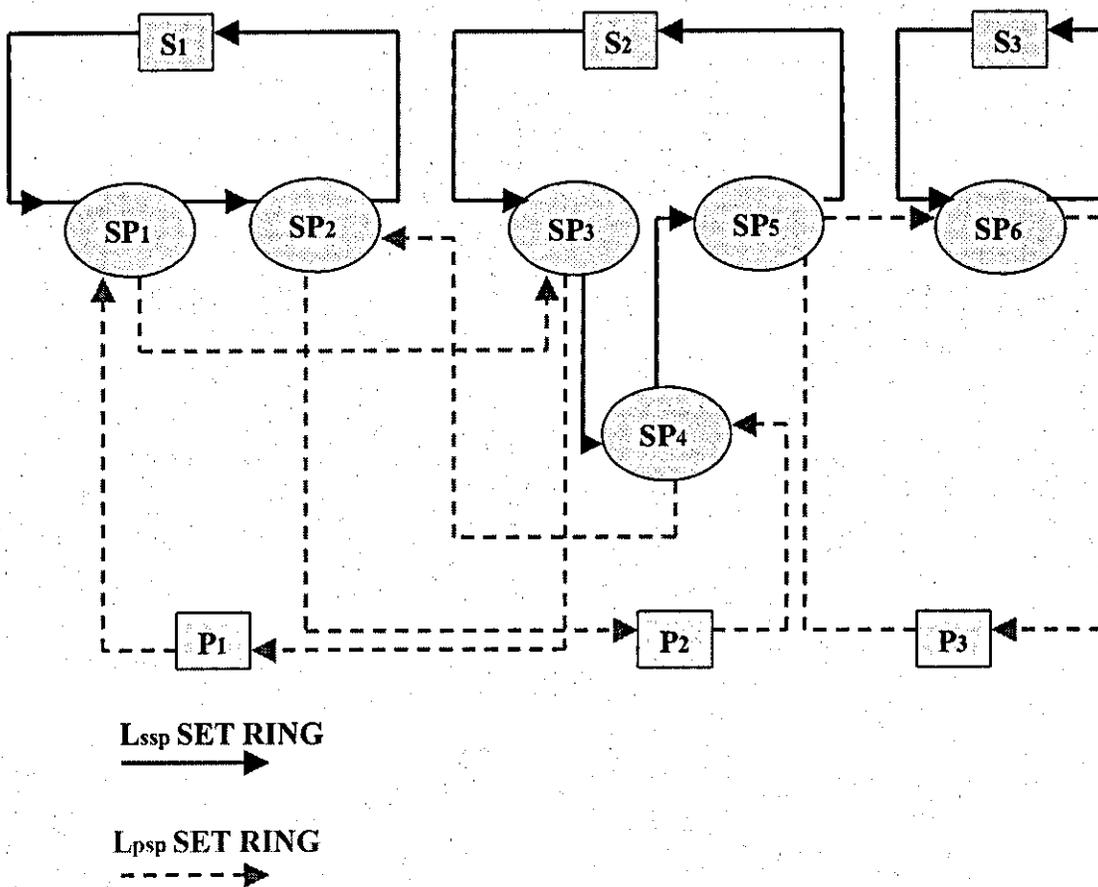
- the total functional mapping from children to parent is relaxed to partial functional mapping in DBTG. It is possible to have a member instance not currently attached to an owner (parent).
- there can be more than one relationship between pairs of record types, unlike the singular parent-child relationship in hierarchies. Each owner and member relationship defines a separate set type whose name is placed as a label on the arc representing the set type between owner and member record-type nodes.

In the hierarchical database, it has been demonstrated how to represent a "many-to-many" map in terms of a hierarchical database. Now it is possible to do a similar thing by constructing a "many-to-many" map to show a DBTG network schema. It is assumed that SUPPLIER and PART record types are related in a "many-to-many" manner, and the "many-to-many" network schema is shown by link  $L_{sp}$  in Figure 1.13(a). On the right side of the figure, the corresponding database extension is shown. In Figure 1.13(b), it can be a DBTG equivalent of the "many-to-many" network schema. To obtain a "many-to-one" map between owners and members, a link record type is introduced between SUPPLIER and PART. Therefore it is possible to convert the  $L_{sp}$  link into two DBTG set types,  $L_{ssp}$  and  $L_{psp}$ , each of which is on the 1's side, and member SP for both, on the n's side.

As can be seen in Figure 1.13(b), the DBTG rule (b) is also satisfied since no owner of a set shares a SP instance with the others. Linked lists between owner and members usually implement DBTG networks. In this way, each DBTG set occurrence forms a ring structure, as shown in Figure 1.13(c), for set types  $L_{ssp}$  and  $L_{psp}$ . In the implementation of the ring, the key of the owner is embedded in all the members in the set instance.



(b) DBTG Network



(c) Ring Structure

Figure 1.13 Conversion into a DBTG Network Database

#### 1.1.3.2.4 Client/Server Databases

A client/server database works like this: a database server is left running 24 hours a day, and 7 days a week. Thus, the server can handle database requests at any hour. Database requests come in from "clients" who access the database through its command line interface or by connecting to a database socket. Requests are handled as they come in and multiple requests can be handled at any one time. For Web applications, which must be available for worldwide time zone usage, it is essential to build upon a client/server database, which can run continuously.

### 1.2 Review of Distance Learning

#### 1.2.1 Definition of "Distance Learning"

"Distance" learning is one type of "open" learning and has a lot of definitions and interpretations. It consists of a variety of forms of learning at all levels. Distance learning

is regarded as non-contiguous learning, in which the teaching and learning occur separately, in contrast to contiguous classrooms learning where teaching and learning occur simultaneously. [9] In contiguous learning, teachers and students are present in the lecture rooms. In this teaching system students benefit from this teaching system's planning, guidance and tutoring, and instantaneous motivation.

In distance learning students spend a lot of their time alone working on materials alone. Teachers do not necessarily know personally for whom they have prepared these materials. Students choose their desired studying programs, and study when and where they wish and at a pace to suit their circumstances. Learners and teachers mostly communicate through written, mechanical or electronic means.

The most notable characteristic of distance education is that normal communication between learners and teachers is through an artificial medium. Originally, the medium was print or writing, followed by broadcasts and audio or video recording, then cable, satellite, or microwave "narrowcasts," and, most recently, interactive teleconferences via computer, audio, or video networks. A second significant characteristic of distance education arises from the first. Effective use of media requires a new approach to instruction, with the process of teaching being broken into its constituent parts. Some or all of these parts are prepared away from the learner and communicated through a range of media; exactly which parts will depend on the nature of the subject matter, the location of the learners, and the resources of the providing agency. [10]

### **1.2.2 Distance Learning and Open Learning**

Although the terms are often used interchangeably, there are important differences. Open learning is an umbrella term for any scheme of education or training that seeks systematically to remove barriers to learning, whether they are concerned with age, time, place or space. With open learning, individuals take responsibility for what they learn, how they learn, where they learn, how quickly they learn, who helps them, and when they have their learning assessed.

Distance learning, on the other hand, is one particular form of open learning in which tutors and learners are separated by geographical distance. This is sometimes called a home study or correspondence course. But many modes of communication are used for

distance learning, not just postal correspondence. Most of people use distance-learning techniques in some form in their daily lives: reading books and newspapers, watching programs on television and requesting information over the telephone. These are all learning experiences, which 'educate' in the broadest sense.

### **1.2.3 Types of Distance Learning**

Distance learning systems are many and various. It is possible to regard distance learning as encompassing a range of possible teaching-learning arrangements, within which there are: correspondence study, educational broadcasting, individualised instruction, face-to-face tuition, self-help study groups, online distance learning. Here, *distance* can be regarded as a variable simply in teaching-learning systems, which show real distance in terms of teacher-student interaction, student-student dialogue, and the geographical separation of institution and learner.

A variety of instructional techniques and settings are available to teachers and students in distance learning systems. In the earlier years, the most common were: students working at home on centrally produced correspondence courses; and students combining correspondence course work with periods of face-to-face tuition. Then broadcasting and study discussion groups were widely accepted. Now the most popular is online distance learning, with which most of this thesis is concerned. Before examining online distance learning in detail, it is possible to consider the educative potential of other modes of learning "at a distance".

#### **1.2.3.1 Broadcasting**

Broadcasting was, and is, valuable in several ways. The greatest virtue is its accessibility, which is one of the chief criteria used to judge the quality of any distance learning system. Because of this uniquely favourable aspect, a lot of open universities use it, combined with face-to-face tuition.

#### **1.2.3.2 Study Discussion Groups**

Study discussion groups are one consequence of broadcasting and face-to-face tuition. Usually, it is linked to a particular broadcast or series and is composed of self-help learning groups. In Sweden and North America, these groups are associated with radio listening-groups formed among scattered rural populations. The earliest self-help groups occurred in Britain in 1927 to encourage the local wireless listening groups in

conjunction with some special radio programs, such as "Modern Britain in the Making", "Mind and Body" and "The Changing World".

### **1.2.3.3 Informal independent learning**

Outside formal education classes and courses, there is informal independent learning. Learners associate with fellow learners and enthusiasts and form themselves into a variety of learning groups, some of which take the form of hobbyists' and enthusiasts' societies. Sometimes, these learning groups develop both range and depth. They use libraries and broadcasting as resources and aids to learning. Fellow learners, intimates, and work colleagues, are consistently cited as being the most important resources. Another feature of this kind learning is that independent learners request and seek more help than they are actually able to get. So such people are unlikely to remain isolated.

### **1.2.3.4 Online Distance learning**

In recent years, there have been major technological advances offering new opportunities and approaches in the use of a wide range of technology to support learning and knowledge transfer more generally. With the growing trend toward geographical dispersion in today's global society, an explosion has occurred in the use of both the Internet and Intranet to facilitate computer-based learning. Online learning has been set up with using World Wide Web and other compatible technologies. It serves a widely distributed community of students and researchers who are engaged in study and for those who need college credits, but cannot either attend regularly scheduled classes or who could not register for a class at their home campus. It can out-reach to those who cannot be resident at a university and institute, enabling them to register as students or scholars to get an equivalent opportunity to follow university courses.

Online distance learning uses this currently most popular communication technology to support learning and knowledge exchange, communication between practitioners in laboratories, and training and educational divisions. Practitioners include researchers in a wide range of disciplines and all kinds of students. It's also a rich source of material for research students in areas such as collaborative learning, artificial intelligence and research themes requiring detailed evaluations.

Online distance learning is also a method of learning that is both enjoyable and flexible for students. Only a multimedia capable computer system is required to participate.

Classes can be offered exclusively online and use a variety of technologies to deliver instructional materials. Typically students can register for classes at any time during the year by selecting the online registration option and filling out all of the necessary information.

The Online Campus (associated with online distance learning) facilitates communication between students, tutors and the academic administration. It is an uncomplicated environment that makes studying online possible. While pioneering the convenience of online studies, online distance learning has created a strong framework for student support and service. Online students also can receive support from a team of professional staff who provide a wide range of services including study consultation and counselling, technical advice and additional training.

#### **1.2.4 Early Developments of Distance Learning**

The concept of distance learning is not a new one. The first instance of pseudo structured distance learning correspondence courses came through letters created by St Paul. Similarly there were shorthand courses offered by the Pitman organisation at the end of the 19th century. By 1962, an estimated half a million adults in the UK were taking some forms of correspondence course. Many of these were courses led to professional qualifications, University of London external degrees, or GCE O- and A-levels. At that time, however, most of the providers of correspondence courses were private colleges, and many course providers seemed more concerned with profit paid than providing a comprehensive service.

#### **1.2.5 Current Growth Areas**

New providers have come onto the market as the demand for courses offering vocational and managerial skills, many of them leading to professional qualifications, has snowballed. One of the most prolific areas is for courses leading to a Master's Degree in Business Administration (MBA). Another trend is the increasing interest in providing on-the-job training through distance learning. In the UK, companies like Coca-Cola Schweppes, Ford and IBM are taking distance learning very seriously. No longer limited to a few specialist institutions, open and distance learning provision is becoming part of mainstream delivery.

More further education colleges and universities now offer mixed-mode delivery of courses, which enable people to learning at their own pace and in their own time. Ten years ago, few people would have understood the terms 'distance learning' or 'open learning'; now they are part of the educational vocabulary.

Distance learning has changed form being the last choice for people who couldn't attend college or university to being the first choice for people who want flexibility and guaranteed quality. It has also pioneered the concept of learner-centred education. The future is one where learning boundaries will disappear, and distance learning opportunities continue to expand.

### **1.2.6 Benefits from distance learning**

Eight possible aspects of distance learning have been identified by students.

- Flexibility generated by self-pacing.
- Distance learning in professional and in-service training courses permits students to make direct connections with their own work experience.
- Distance learning helps the development of transferable study skills.
- The accessibility stimulates participation for inexperienced people, and encourages contact with other students from around the world.
- Online distance learning lets students visit different parts of a virtual campus for information and search advice.
- Online distance learning can link to other important sites.
- Online distance learning allows the download of freeware and shareware or links to other sites for additional programming applications.
- Browsing the hyper-linked shelves of an electronic library.

## Chapter 2 IT Aspects of Database

### 2.1 Some Background

#### 2.1.1 Internet

The Internet is a vast network of interconnected computers. It is like local telephone network, countrywide telephone network and international telephone network, which are joined together to form a global telephone network. Hundreds and thousands of computers network make up the Internet and are joined together to a universal scale, so they can communicate each other.

#### 2.1.2 World Wide Web

##### 2.1.2.1 Simple use of the Web

As an illustration of simplification, the author is able to read from the UK the daily news in ShenZhen, a famous city in China thousands of miles away. It is available on <http://www.szonline.net> as a series of Web "pages" on the Internet. This can be initiated using a World Wide Web browser, which is a piece of software that allows the display certain kinds of information from the Internet.

A network card, or modem, allows connection of a computer to the telephone line, and access to the 'net'. Via the interface provided by the Web browser, it is possible to enter the Internet address, otherwise known as the URL, or Uniform Resource Locator, of the file containing the front page of szonline.

HTTP (HyperText Transfer Protocol) is the name of the Web's own transmission protocol. Web pages are sent through the Internet to computers under HTTP.

##### 2.1.2.2 What is the World Wide Web?

The World Wide Web is a means of online publishing, a way of accessing, storing and retrieving information, as well as a means of sending, acquiring and querying data across the Internet. [11] Most importantly, the Web allows the use of hypertext links that can channel to any computer on the Internet. All these functions work by using appropriate hardware: the wires, the cables, the computers, and the satellite links that are used to send information from computer to computer using Internet protocols.

### **2.1.2.3 How Did the World Wide Web Begin?**

The World Wide Web began life in a place named CERN, the European Laboratory for Particle Physics in Geneva, Switzerland. CERN is a meeting place for physicists from all over the world. It was Tim Berners-Lee who invented the Web. In 1989, Tim was working in a computing service section of CERN. He got the idea of enabling researchers from remote sites in the world to do collaboration. But far from simply making available a large number of research documents as files that could be downloaded to individual computers, he suggested to actually link the text in the files themselves. In other words, there could be cross-references from one research paper to another. This could mean that while one research paper was being read, another paper holding directly relevant text or diagrams could be displayed quickly. Documentation of a scientific and mathematical nature would thus be represented as a 'web' of information held in electronic form on computers across the world. This, Tim thought, could be done by using some form of hypertext, some way of linking text clicked on to jump from one paper to another.

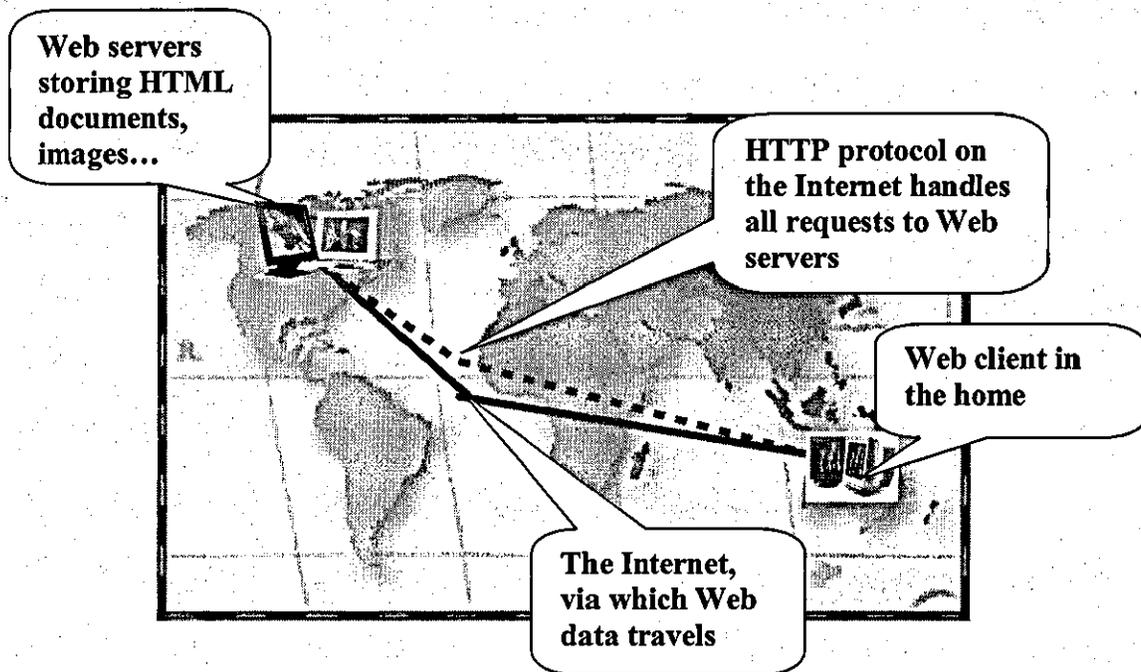
### **2.1.3 The difference between the World Wide Web and the Internet**

There is a common mistake that the Web and Internet are the same thing. The Internet simply provides the medium for the Web to run on, just as a telephone line provides the medium for telephone conversations. What the Web does is provide the technology for publishing, sending and obtaining information over the expanse of the Internet. How the Internet actually works may be a matter of interest, but the Web user does not need to know about it in any detail.

### **2.1.4 Basic components of the World Wide Web**

The basic components of the Web are:

- a) **Web servers** (computers that hold information for distribution over the Internet)
- b) **Servers** (all kinds of computers, like PCs, Macintosh systems or Unix workstations, which are installed with special software and connection)
- c) **Web clients** (computers, which are connected to the Internet and can retrieve information from Web servers)
- d) **HTTP protocol** (used to transmit files between servers and client)
- e) **Browser** (software that is needed by the client to display messages)



**Figure 2.1 Basic Components of World Wide Web**

## **2.2 Interface Design**

An application interface is a means of providing access to the use of a product. It defines the nature and experience of the product and limits its use. A major task is that of maximising this experience for the learner; that is, of describing and creating an interface that is intrinsically motivating, interactive, intuitive and correspondingly, impose a minimum cognitive load on the user.

Essentially, an interface must be designed to provide the user with a functional (if incomplete) cognitive model of the learning task, the content or domain material and the procedures or processes that can be explored and tested to realise the task(s). Elements such as interactivity, functionality, and learner control and cognitive load are central considerations in designing an interface, and all potentially cross-arbitrary boundaries, which are often drawn between an instructional and an interface design. An interface to instruction is more than a link between learners and learning materials, it creates and embodies the form, functions and processes of learning.

## 2.3 User Interface Domain

User Interface Domain is the technologies that allow users to effectively perceive and express information.

The User Interface Domain seeks to improve all user/computer communications on the Web. In particular, the Domain works on formats and languages in way that will present information to users with more accuracy and a higher level of control. [12]

### Domain Activities [12]

- **Hypertext Markup Language (HTML)**

Hypertext Markup Language -- known as HTML -- is the *lingua franca* for publishing on the Web. Following the success of HTML 3.2 and HTML 4.0, the Consortium is designing the next generation of the Markup language. The new HTML, called XHTML, is re-cast in XML and is being designed so that it can be used in combination with other XML applications.

- **Style Sheets**

Style sheets offer precise control over the presentation of Web pages. Not only can Web designers specify the visual effects they want, but also oral style sheets give control over voice, pitch and other aspects of how the text will sound when rendered into speech. After the publication of two recommendations, CSS1 and CSS2, the Cascading Style Sheets (CSS) language continues to be evolved to provide even richer stylistic control, while emphasising the importance of the thorough implementation of CSS on browsers.

For more complex publishing tasks, such as automatically producing a table of contents, and for converting documents written in XML into HTML for publication, the Extensible Style Sheets Language (XSL) is being developed, and builds upon experience of CSS and DSSSL.

- **Document Object Model (DOM)**

The Document Object Model is a platform-neutral and language-neutral interface that allows programs and scripts to be dynamically accessed and updates the content, structure and style of documents. The document can be further processed and the results of that processing can be incorporated back into the presented page.

- **Synchronised Multimedia**

Synchronised Multimedia Activity focuses on the design of a language for scheduling multimedia presentations where audio, video, text and graphics are combined in real-time. The language, the Synchronised Multimedia Integration Language (SMIL) is written as an XML application. Simply put, it enables authors to specify what should be presented and when.

- **Math**

Communicating mathematical and other technical notation is a challenging and important task. The demand is high for an effective means of electronic scientific communication. To address the needs of the scientific community, a core specification for embedding mathematical expressions in HTML and XML documents has been developed. In April 1998, a Recommendation entitled Mathematical Markup Language (MathML) was published, which provides a way of encoding both mathematical content and visual presentation for mathematics at all levels, from elementary school to scientific research.

- **Graphics**

Graphics are the most visible part of the modern Web and arguably one of the primary reasons for its popularity and explosive growth. Successful use of graphics on the Web depends on interoperability across platforms, output resolutions, color spaces, and software products.

In October 1996, a format for bitmapped images Portable Network Graphics (PNG) was recommended. Then interoperable methods of integrating CGM vector graphics were developed and constitute the WebCGM Profile Recommendation. Now Scalable Vector Graphics (SVG) are being developed, an open vector graphics format written in XML, and designed to work across platforms, output resolutions, colour spaces, and a range of available bandwidths.

- **Voice Browser**

A lot of work has been done now to expand access to the Web to allow people to interact with Web sites via spoken commands, and listen to pre-recorded speech, music and synthetic speech. This will allow any telephone to be used to access Web-based

services, and will be a boon to people with visual impairments or needing Web access while keeping their hands & eyes free for other things.

- **Internationalisation**

The Web was originally developed to enable people throughout the world to communicate with one another. Having a single system that can deal with all languages and cultures has many advantages: when the same protocols are used everywhere, the same software can be used likewise.

The role of Unicode, the basis for identifying characters in documents, has been stressed. Work is continuing on providing Markup and style components for international needs.

- **Mobile Access**

Mobile access technology has gained a lot of attention recently. There are strong interests in mobile Web access among a wide range of people and organisations involved in mobile access technology, such as hardware manufacturers, software providers, communication service providers, content providers, and end user organisations.

- **Open Source Code**

Amaya is a highly advanced and powerful Web client, which acts as both a browser and an authoring tool. It has been designed with the primary purpose of being a test-bed for experimenting with, testing and demonstrating new specifications and extensions of Web protocols and formats.

### **2.3.1 Review of other available Software and Difference between Them**

Besides HTML, there are many programs to build Web pages. They are a collection of HTML commands. It is not necessary to write every HTML code by hand. Everything is carried out behind the screen and makes the creation of Web pages easier and more interesting. It is also an easy-way and fast-way to build Web pages. People can choose a suitable program to create their Web page. There are six top programs: Allaire HomeSite, Adobe PageMill, FileMaker HomePage, HotDog Professional, HotMeta Pro, Netscape Composer and Microsoft FrontPage Express.

**Allaire HomeSite:** makes it easy for beginners to create impressive Web pages. It also gives a lot of control over the look of pages, and because the HTML is always in view, it helps in putting the site together. HomeSite comes with a number of colour palettes, and

where it is possible to click a menu to select the right shade. Toolbars can be customised and new ones added, while the extended search-and-replace function allows replacements across entire subdirectories and folders.

**Adobe PageMill:** is a powerful yet easy-to-use tool for creating Web pages. There's no need to learn HTML or master complex applications. With its drag-and-drop simplicity, PageMill integrates seamlessly with current office applications. Once the site is built, delivery to the Web is easy using the built-in Uploader.

**FileMaker HomePage:** Makes it easy to create and manage great looking Web pages. Easy-to-use 'Assistants' step users through the entire process in minutes, handling all the complex HTML work behind the scenes. And, with the new FileMaker Pro 4.0 connection built into Home Page 3.0, it is possible to dynamically publish data over the Internet by linking web pages to FileMaker Pro 4.0 database. New management tools easily track all files, pages and links. For posting pages to the Web, Home Page 3.0 automates consolidating the files and uploading them to designated Web server.

**HotDog Professional:** is a good package for all aspiring Web designers. It takes into account all Web browsers when creating a page and so allows for greater browser compatibility with a huge archive of animated images, plus hi-resolution movie files and sound files for really improving page.

**HotMetal Pro 5:** is the most powerful version yet of SoftQuad's award-winning HTML development tool. Aimed at both professional Web developer, and new HTML users, it now offers more features and an integrated suite of authoring and site-management tools in one application. The program offers three editing views: a WYSIWYG (what you see is what you get) view for quickly prototyping pages, a source code view for control over a page's HTML, and 'Tags On' view for precision source editing with the convenience of WYSIWYG. Version 5.0's advanced site-management includes powerful link-checking and management, site-wide search and "replace" for text and an FTP program for getting sites online.

**Netscape Composer:** is a relatively small Web-authoring program built into the Netscape Communication suite, along with Netscape's Navigator Web browser. Composer has a very straightforward interface, similar to a word processor. Composer

can easily get a Web site online by simply clicking the 'Publish' icon and entering a few details.

**Microsoft FrontPage Express:** is another fully featured Web authoring package, given away as part of the Microsoft Internet Explorer suite. It's a cut-down version of the powerful FrontPage authoring package, and contains all the functions that needed to create a good starter site. Users can then upgrade to FrontPage if they decide their need all that extra power.

## **2.4 Review of Related Tools for User Interface Design**

### **2.4.1 DHTML**

Dynamic HTML gives a creative control to manipulate any page element and change styles, positioning, and content at any time. It provides a richer, more dynamic experience on web pages, making them more like dynamic applications and less like static content. [13] Dynamic HTML presents richly formatted pages and lets the user interact with the content on those pages without having to download additional content from the server. This means that a page can respond immediately to user actions, such as a mouse click, without having to retrieve an entire new page from the server.

### **2.4.2 VRML**

VRML is an acronym for "Virtual Reality Modeling Language". It is the International Standard (ISO/IEC 14772) file format for describing interactive 3D multimedia on the Internet. [14] The VRML was created by Silicon Graphics, Inc. and based on the Open Inventor file format. In December 1997, VRML97 replaced VRML 2.0 and was formally released as International Standard ISO/IEC 14772.

### **2.4.3 XML**

Extensible Markup Language (XML) is a human-readable, machine-understandable, general syntax for describing hierarchical data, applicable to a wide range of applications (databases, e-commerce, Java, web development, searching, etc.). [15] The purpose of XML is to provide an easy to use subset of SGML that allows custom tags to be processed. Custom tags will enable the definition, transmission and interpretation of data structures between organisations.

#### 2.4.4 CGI

The Common Gateway Interface, or CGI, permits interactivity between a client and a host operating system through the World Wide Web via the HyperText Transfer Protocol (HTTP). [16] It's a standard for external gateway programs to interface with information servers, such as HTTP or Web servers. A plain HTML document that the Web server delivers is static, which means it doesn't change. A CGI program, on the other hand, is executed in real-time, so that it can output dynamic information - perhaps weather reading, or the latest results from a database query. CGI allows someone visiting a Web site to run a program on that site machine that performs a specified task.

Gateways are programs, which handle information requests and return the appropriate document or generate a document on the fly. The server can serve information, which is not in a form readable by the client (e.g. an SQL database), and act as a mediator between the two to produce something, which clients can use.

Gateways can be used for a variety of purposes, the most common being the handling of FORM requests for HTTP. An HTTP server is often used as a gateway to a legacy information system; for example, an existing body of documents or an existing database application. The Common Gateway Interface is a convention between HTTP server implementers about how to integrate such gateway scripts and programs.

Gateway programs, or scripts, are executable programs, which can be run by themselves. They have been made external programs in order to allow them to run under various (possibly very different) information servers interchangeably.

#### 2.4.5 Java

Java is an object-oriented programming language that resembles a simplified form of C++. Java code displays graphics, accesses the network, and interfaces with users via a set of capabilities--known as classes--that define similar states and common methods for an object's behaviour. [17] Unlike other programming languages, though, Java programs are not compiled into machine code; instead, they are converted into an architecture-neutral bytecode format. This collection of bytes represents the code for an abstract Java virtual machine (VM). In order for these bytes to execute on a physical machine, a Java interpreter running on that physical machine must translate those bytes into local actions, such as printing a string or drawing a button.

#### **2.4.6 JavaScript**

JavaScript is a compact, object-based scripting language for developing client and server Internet applications. [18] JavaScript statements can be embedded directly in an HTML page. These statements can recognise and respond to user events such as mouse clicks, form input, and page navigation. JavaScript is a programmable API that allows cross-platform scripting of events, objects, and actions.

#### **2.4.7 Perl**

Web developers most frequently use Perl in the context of CGI. Perl can "speak" CGI fluently and happens to be well suited to manipulating data, which is exactly why Perl is the most common language used in developing CGI interactions. [19]

#### **2.4.8 Active Server Page**

Active Server Page is a language-independent framework designed by Microsoft for efficient coding of server-side script that are designed to be executed by a Web server in response to a user's request for a URL. [20] Active Server Page is currently available for the following Web server:

- Microsoft Internet Information Server (IIS) 3.0
- Microsoft Internet Information Server (IIS) 4.0
- O'Reilly WebSite Pro

#### **2.4.9 SQL**

SQL is a data sub-language used to organize, manage, and retrieve data from a relational database, which is managed by a relational database management system (RDBMS). [21]

## **Chapter 3 Distance Learning Aspects of Database**

### **3.1 Background**

In the last decade, the World Wide Web has enjoyed remarkable growth and made a vast impact on learning technology and higher education teaching. The network of HTML, which makes up the Web, allows a high degree of cross-platform compatibility opening up many new opportunities for teaching and learning. [22] The new developments in the Web make it possible to have many types of learning technology available online, including simulations, assessment and computer-based communication. [22]

The educational use of Web grants new development of distance learning and change the role of academic from being a deliverer of knowledge to being a facilitator of learning. The new flourishing of powerful software brings richer content to the learning process and forms a completely integrated learning and teaching environment.

### **3.2 The Use of WWW in Distance Learning**

#### **3.2.1 Resource-based Learning (RBL)**

##### **3.2.1.1 What is Resource-Based Learning**

One main way of using WWW in teaching and learning is Resource-based learning. The term 'resource-based learning' is a broad one, encompassing a wide range of means by which students are able to learn in ways and on a scale from those that are mediated by tutors, and to where the students are learning independently. [23] Resource-based learning has been used increasingly within higher education to produce more quality education and training. It focuses on the students' needs, so everything in learning resources is specified clearly. In this learning mode, it is up to the student to demonstrate learning, not the teaching team to show what has been delivered. Distance learning is a particular mode of RBL where there is a physical distance between the instructor and the student. Distance learners receive these learning materials via some means of delivery at a remote location. When doing this via WWW, the learner can access the learning materials through the Internet. This requires IT development to support RBL.

##### **3.2.1.2 Current Development of RBL in UK Higher Education**

Higher education providers in the UK are increasingly turning to RBL as a means of coping with the conflicting demands to produce ever higher standards of curriculum delivery when, at the same time, the conditions of work for both students and staff are

declining, for well-rehearsed reasons. [23] The Higher Education Funding Council funded the 'Course design for resource-based learning' project, which focused on collecting examples of best practice in course design to use new resources in ways that overcame a range of problems associated with increased student numbers, declining resources and strained library facilities. [24] It defined a range of different types of RBL and accompanying course designs and sought examples of each for each subject area.

Institutions in the UK are implementing RBL in a variety of ways: [24]

- The University of Luton set a target of 20% of all courses being delivered through RBL by 1995/6. It used little control or central support to make implementation.
- The University of North London is integrating a range of learner support services in a new 'Learning Center'. It helps users while course design and delivery may be mostly unchanged.
- Norfolk College and Wirral Metropolitan College have combined small classrooms into a large resource center, obliging lecturers to change their teaching methods. It may force staff to develop teaching materials to cope with the change.
- Oxford Brookes University has succeeded in developing a great deal of RBL without normal institutional support requirements. However, there may be little clear direction and the infrastructure may be unsupportive or even obstructive and as a consequence change may be slow and patchy.
- Many universities such as Sunderland and De Montfort are developing students as independent learners with extending induction programs, special study skills courses or packages providing learning skills. These have little productive impact and generalized learning skills development transfers poorly onto specific courses within varied disciplines.
- Some institutions are pushing single solution or technology such as open learning or computer-assisted learning. These include major investment in specialists of open learning and team of experts using sophisticated technology.

### **3.2.1.3 RBL with WWW**

Over last ten years Information Technology has been developed dramatically. The new development of IT brings new development of RBL. It gives RBL the ability and potential to cross campus and gain access to local and remote library, networked CD-

ROMs, Internet and so on. Web-based RBL and electronic RBL are going to replace print-based RBL. To keep trace of students' progress and get feedback of resource, effective contact between students and staff is useful. This has led to computer-based assessment and online assessment in some RBL. It may also require security systems to protect the resource. Typically a student would use a username and password to login for an assessment or access a resource. Although RBL gives students autonomous learning, it doesn't mean that students can learn effectively and better. In formal class learning, students can go to staff or other students when problems arise. In Web-based RBL, there may be an absence of formal contact with staff and other students. Correspondence and Email-based communication are common in some Web-base RBL. However, despite IT having been developed so dramatically over the last decade, basic IT tools such as word-process, desktop publishing database and email, are still seldom exploited fully. Learning material delivery is still often via conventionally printed hard copy even where facilities exist.

On the other hand, since there is an enormous amount of information existing on the Web; it is also meaningful to know how to use such information as a library resource. The Web provides various-starting points for locating subject-specific material including search engines and subject-specific indices and gateways. [22] These search activities bring out results according to the relevance of the site to the topic or how far these contain information on the content and quality of catalogued sites. When doing these search activities, many sites need to be recovered and evaluated thoroughly before including them in a reference list. It is effective to use electronic "bookmarks" to record all relevant and quality sites. In addition, it is a good idea to include additional notes with the reference list to relate the sites to the context of courses, enabling students to make informed choices on the sites they visit.

### **3.2.2 Online Distance Learning**

As mentioned before, distance learning is a particular mode of RBL where a physical distance exists between tutors and learners. To overcome this physical obstacle, direct correspondence was used in the past. Now correspondence is still a main communication tool in many distance-learning programs. New IT developments have brought Internet and WWW to distance learning. With Internet and WWW, learning resources can be

easily published and delivered to remote learners via Internet. It can serve a widely distributed community of students and researchers who are engaged in study and for those who need college credits, but cannot either attend regularly scheduled classes or who could not register for a class at their home campus. It can out-reach to those who cannot be resident at a university or institute, enabling them to register as students or scholars to get an equivalent opportunity to follow university courses.

### **3.2.3 Distance Learning/Education Associations and Projects**

A considerable number of associations and projects have been founded and funded to improve distance learning/education technologies and universities' awareness and use of technological innovations in teaching, learning and assessment. ALT [25] (Association for Learning Technology) aims to promote good practice in the use and development of learning technologies in higher and further education; facilitate interchange between practitioners, developers, researchers and policy makers in education and industry; and represent the membership in areas of policy such as infrastructure provision and resource allocation. COL [26] (Commonwealth of Learning) was founded by Commonwealth Heads of Government at their meeting in Vancouver in 1987. It has a mandate to encourage the development and sharing of open learning/distance education materials, expertise and technologies, and other resources for learners throughout the Commonwealth and other countries. The purpose of The Commonwealth of Learning is to create and widen access to education and to improve its quality, utilising distance education techniques and associated communications technologies to meet the particular requirements of member countries. The agency's programs and activities aim to strengthen member countries' capacities to develop the human resources required for their economic and social advancement and are carried out in collaboration with Governments, relevant agencies, universities, colleges and other educational and training establishments among whom it also seeks to promote co-operative endeavours. CTI [27] (Computer in Teaching Initiative) comprises 24 subject-Centres working to support the use of communication and informal technologies in UK higher education. Each Centre is based within a department or specialist unit of a UK university. CTI Centre has been developed by subject specialists whose teaching experience is combined with expertise in computer based learning, to support academics and departments through the process of change, and

to help ensure that each subject area exploits to the full the opportunities offered by communication and information technology. The ETS (<http://www.warwick.ac.uk/ETS/resource/>) provides extensive dissemination of relevant information via the ETS web site. There is an Educational Technology User Group forum for exchanging ideas and experiences. The Web-based journal of the ETS advises and supports technology-based teaching and learning initiatives throughout Universities. It provides resources to assist staff in producing computer-assisted learning materials more efficiently and effectively. ICDL [28] (International Centre for Distance Learning) is an international centre for research, teaching, consultancy, information and publishing activities based in the Institute of Educational Technology, and which has received a world class rating in England. ICDL promotes international research and collaboration by providing information from its library and databases. ITTI [29] (the Information Technology Training Initiative) was founded by the University Funding Councils in 1991 to improve the availability of training materials for the use of IT in UK higher education Institutions. LTDI [30] (Learning Technology Dissemination Initiative) was a project funded by the Scottish Higher Education Funding Council from August 1994 until August 1999 to promote the use of learning technology and computer based learning materials in SHEFC funded Higher Education Institutes. The emphasis was on educational issues and pedagogy, and the implementation and integration of learning technology rather than technical and programming aspects. TLTP [31] (Teaching and Learning Technology Program) was launched in 1992 by the Universities Funding Council (UFL) and then continued by its four successor funding bodies in 1993, the Higher Education Funding Council for England (HEFCE), the Scottish Higher Education Funding Council (SHEFC), the Higher Education Funding Council for Wales (HEFCW) and the Department for Education Northern Ireland (DENI). The program was launched to encourage the higher education sector to work collaboratively and explore how new technologies could be exploited to improve and maintain quality within teaching and learning. TLTSN [32] (Teaching and Learning Technology Support Network) was made up of nine support centres, funded by the four UK higher education funding bodies, HEFCE, SHEFC, HEFCW and DENI. There are many other sources of expertise in the field of learning technology, and relevant workshops and conferences. The four UK

higher education funding bodies promote and fund high-quality, cost-effective teaching and research in universities and colleges in UK. The Pennsylvania State University [33], American Centre for the Study of Distance Education provides a practical foundation for planning, developing, and implementing effective distance education programs. It also offers suggestions, advice, and encouragement for those using distance education as a form of instructional delivery. WWW Services discipline index [34] is a good place to start and WWW Virtual Library entry for Educational Technology [35] and Disciplines index to national support centres [36] offers lots of resources.

It should also be noted that many universities and colleges have developed their own distance learning centres. Centre for Advanced Instructional Media in Yale University, Centre for Digital Multimedia Projects in New York University, Communications Technology Centre in Washington Community & Technical Colleges, Centre for Instructional Technology Development in University of Toronto, Educational Technologies Assistance Group in University of Illinois, IT Learning Systems Group in Washington State University, Institute for Learning Technologies in Columbia University and so on are promoting and supporting educational products.

### **3.2.4 Distance Learning Programs**

With the efforts of the institutes and associations, more and more distance learning programs have been produced.

#### **3.2.4.1 The Open University, UK**

There are five single-mode institutions in European Union, which have 500,000 enrolled students. [37] The UK Open University is the biggest one with 257,000 students. However, there are only 12 courses of most popular subjects available from most of countries in the world making use of the Internet, email and electronic conference. Tutor guidance on many aspects of the course and marking and commenting on written work is given throughout whole program. The learner is taught and assessed through printed materials and a combination of media, including e-mail, computer conferencing and the World Wide Web. Contact between learners and tutors is via e-mail or WWW forms.

Some courses still ask learners to report to a Regional Central to discuss their progress and future study plans with their tutors and other options with advisory staff.

#### **3.2.4.2 The University of Catalonia (UOC)**

UOC (<http://www.uoc.es>) is a Web-based institution and regionally focused institution, based in Barcelona. It is supported by regional bodies and industry, offering courses in Catalan. A number of programs are being developed with the support of members of other universities.

#### **3.2.4.3 The University Licensing Program (TULIP)**

The University Licensing Program (TULIP), [38] which started in early 1991 and concluded at the end of 1995, was a collaborative project of Elsevier Science and nine teaching universities, namely Carnegie Mellon University, Cornell University, Georgia Institute of Technology, Massachusetts Institute of Technology, University of California (all campuses), University of Michigan, University of Tennessee, University of Washington and Virginia Polytechnic Institute and State University (all in the USA). The goal of the project was to jointly test systems for networked delivery to, and use of journals, at the user's desktop. It has an important impact on the implementation of the digital library. However, both the universities and Elsevier Science were not able to resolve one critical issue, how to make the transition to digital libraries work economically.

#### **3.2.4.4 University of Phoenix Online**

University of Phoenix, [39] the world's leading university for adult students, offers continuing education and degree programs to working adults around the world through multiple campuses and the Online Degree Program. University of Phoenix Online was formed in 1989 and currently enrolls degree-seeking adult students from all over the U.S. and the world. It is a group-based learning environment uses the power of the Internet to deliver online learning. The communication is many-to-many rather than one-to-one. Each class shares its own group mailbox, which serves as an "electronic classroom." While communication between individuals is common, each class uses a group forum where students put their work and ideas before classmates for comment. This upgrades the quality of most work before its more formal, academic review by the instructor. Students can access research material from the University's Electronic Library.

The Online program is designed to benefit working professionals only. Therefore classes are offered one at a time, in sequence and there are no semesters.

#### **3.2.4.5 UT TeleCampus**

UT TeleCampus (<http://www.telecampus.utsystem.edu/telecampus>) is a centre of distance education and provision of online degrees among University of Texas system and its fifteen component campuses. The online courses have involved some new features such as pre-test, post-test and hyper linked glossaries of course technology. The courses are divided into three groups: computer moderated courses with newsgroups, instruction moderated courses, and computer moderated courses to meet the different requirements of learners. Communication is via a conferencing system, which allows students to post questions to a public forum, instructors to post additional assignments or discussion topics, and students to share experiences with one another. Web-based and instructor led training takes place in Web-based training environment with a facilitator and students. Computer moderated courses allow learners to take the programs at their own pace at whatever time is most convenient. It obviously designed with the learner in mind. The course information is complete enough to allow the user to make informed decisions about which course to take, and links to the Web sites of course providers facilitate the registration process. [49]

UT TeleCampus demonstrate how to organize online distance learning courses and how to exploit new IT. The innovative features of the site highlight the attraction of distance learning and show future prospects, but it demands higher system and hardware requirements.

#### **3.2.4.6 World Lecture Hall**

The World Lecture Hall (WLH) (<http://www.utexas.edu/world/lecture>) contains links to pages created by faculties worldwide who are using the Web to deliver university-level academic courses in various languages. There are 18 fields and 700 courses currently being delivered by higher educational institutions via the Web. The programs are presented with one or more hypertext pages for course components such the syllabus, assignments, exams, lecture notes, grades, or links to related materials. WLH is a good example of how to edit online courses and how to organize distance-learning materials. It's also a good resource for people wondering what distance learning is all about. However, almost all of the courses are implemented as static, text-based sites. The communication between lecturers and students is limited to correspondence and email.

Also the format and organization of lectures are unstructured and it is difficult to differentiate between features of subjects and courses. So it not particularly useful for people looking for a course that meets their needs. To attract more learners and to complete the studying process, more interactive contents should be exploited. Some providers have realized this and use chat rooms, class bulletin boards and mailing lists, QuickTime movies, and Internet course-management software. Brent Iverson's "Organic Chemistry" site (<http://www.cm.utexas.edu/courses/Spring98/CH610B/iverson/Spring98>) is one of them.

### 3.2.5 Overview of Distance Learning

In Africa, the open university of Tanzania is one of the most recently established in a long line of autonomous, degree-granting distance-teaching universities across the world. [40] The oldest established open university of all is the university of South Africa, which current finds itself only one of a number of dynamic single- and dual-mode distance teaching institutions in South Africa. [41] In general, distance education has been widely developed widespread. At present, many international agencies are involved in the development of distance education in Africa.

In America, distance education also has a long history. The West Indies Distance Education Experiment uses teleconference technology for facilitating contact between students and university tutors. [42] In Latin America, two open universities have been established and other similar institutions. [43] Distance education in Canada offers degree programs at all levels and many universities offer distance -taught courses. In the United States, distance education has extensive and disparate nature. Many universities have their own distance education systems and provide distance-taught courses as in Canada. It is characterized by extensive usage of audio- and videoconferencing, cable and satellite television and computer applications of many different kinds. [44]

During the 1970s and 1980s, Asia has featured the largest growth area of single-mode open universities. The global trend towards the emergence of dual-mode institutions can also be observed in many countries. [45] The demands on education are so great that more and more institutions are developing distance education programs.

In Europe, there are five regional open universities based in Germany, the Netherlands, Portugal, Spain and the United Kingdom are well established. Europe is one

of the world's regions where the trend towards dual-mode provision is most pronounced.  
[37] This applies across Western and Central and Eastern Europe.

Distance education and open learning in Australia are widely available from a high proportion of higher education institutions. The term 'external studies' has traditionally been widely used in Australia and neighboring countries, but one of the symptoms of change has been in the emergence and use of additional terms such as 'open learning', 'flexible learning' and 'flexible delivery' which reflect not only a general conceptual move towards more student-centered provision, but also a demand for institutions to produce course materials very quickly utilizing the whole available range of technologies.  
[46] It is similar in New Zealand.

### **3.3 Distance Learning Database**

The World Lecture Hall (<http://www.utexas.edu/world/lecture/>) grew from hundreds of course links to thousands of other. The old publishing method became too cumbersome for WLH editors, leaving them insufficient time to maintain the collection while reviewing and adding new sites. WLH chose database technology to solve this problem. The data in the WLH index files was imported into Microsoft Access, and a prototype Web site was developed on local machines running Windows 95, Cold Fusion Server, Cold Fusion Studio, and Personal Web Server. The future publishing scheme will involve database services, upgrading the Windows NT and Cold Fusion servers, and converting the MS Access database to a MS SQL database.

As with the WLH example, the integration of databases into distance learning would be an effective approach for reviewing and adding new materials. These databases are accessible databases that include detailed descriptions of materials offered at a distance. The information contained in the WLH database comes from a collection of learning-specific data offered at accredited institutions or education organisations or edited by staff worldwide, and provides information on high qualities accredited distance-learning materials. Search engines help to explore the databases.

The Open University's website (<http://www.open.ac.uk/frames.html>) is currently changing. A new structure has recently put in place. Initially there is a gateway to the collection of Open University websites. To support this gateway, a powerful search engine and a database of catalogued OU websites have been built.

In recent years, a number of such distance learning databases have been developed and made available on the World Wide Web. These online databases are intended to both provide a central repository of up-to-date information on the many courses and programs that are available remotely and to make it easy for users to locate information about courses meeting their specific needs. [49] TeleEducation NB in Canada did a final report of an evaluation of 20 distance education databases that are currently available online (<http://teleeducation.nb.ca/media/03.2000/dbreport/index.html>). This report ranks these 20 distance education databases by using a standard set of criteria, which are User-Friendliness, Search Capabilities, Reliability, Course Offerings, Course Information and Connectivity. Within each criterion, there are several sub-criteria. The satisfactory for each of criterion of 20 databases rated from 80% (highest) to 15% (lowest). Five highest scored databases are the Canadian TeleCampus Online Course Database (44) [50]; California Virtual Campus (33) [51]; Internet University (32) [52]; CURSUS (a database of courses primarily in French) (31) [53]; eCollege (<http://www.ecollege.com>), America's Learning Exchange (<http://www.alx.org/learnersite.html>), Hungry Minds (<http://www.hungryminds.com>) (28). The lowest scored databases are Pangaea Network (<http://www.pangaeanetwork.com>) (3), Canadian Association for University Continuing Education (<http://cauce-aepuc.ca/english/>) and CISAER Catalogue of Web Courses (<http://home.nettaskolen.nki.no/~morten/cisaer>) (6), GetEducated.com (<http://www.geteducated.com>) and World Lecture Hall (<http://www.utexas.edu/world/lecture/>) (9).

According to the report, it is possible to conclude what is a good distance-learning database. A good distance-learning database should to user-friendliness, including easy of use, clarity of display, familiarity of terminology, online help, information storing and distance learning information. Next this database should offer search capabilities, such as keyword search, advanced search and browse. Then it should provide reliability to system, information and accuracy to search. It also should contain course offerings and course information. Finally this database should provide connectivity to potential learners, which can be accessibility, links to other database, conferencing and information sharing.

More and more universities and educational organizations are thinking about their future development and have realised that distance learning is unavoidable. For this reason, they have started to develop their own distance programs and databases to support it. They also provide access to open and distance learning literature for planning, decision-making and learning, both for students and adults. As a further consequential databases encourage practitioners to become better informed in open and distance learning theory and practice across the world.

### **3.4 Distance Learning Aspects of Materials Database**

#### **3.4.1 Materials Databases**

Databases are probably among the most exciting innovations in the computer world because they enable users to easily store volumes of data on computers. The combination of Internet and World Wide Web databases make them even more useful. The world of Materials Science and Engineering is a good example. The use of databases can expand horizons especially in support of research.

For example, Cambridge Scientific Abstract Internet Database Service [55] is widely accepted in the scientific field. It provides comprehensive coverage of all aspects of materials science and contents include: international literature on ferrous and non-ferrous metals, polymers, ceramics, plastics and composite materials; the practices of materials science and engineering as they relate to these substances; technical and commercial developments in materials science. Databases are also available which focus on: processes and process development; products and manufacturing; fuel energy; usage and raw materials; engineering applications; management and economics; environmental issues and world industry news.

There are several "Materials Science Collection" titles covering chosen areas. Aluminum Industry Abstracts [56] provides comprehensive coverage of the world's technical literature on aluminum, production processes, products, applications, and business developments. Engineered Materials Abstracts [57] provides in depth coverage of polymers, ceramics, and composites in a variety of structural and other advanced applications. Materials Business File [58] focuses on industry news, international trade data, government regulations and management issues related to the metals and materials industries. Mechanical Engineering Abstracts [59] surveys and summarizes the worldwide

literature in mechanical engineering, engineering management, and production engineering. Metadex [60] is a source for information on metals and alloys: their properties; manufacturing; applications; and development. WELDASEARCH [61] is a database covering the areas of joining metals, plastics and ceramics, metal and ceramic spraying, thermal cutting, brazing, soldering and related topics. World Ceramics Abstracts [62] provides in depth coverage on the ceramics and other materials-based industries including traditional and advanced ceramics, metals, composites, and cements. Database-Japanese Materials Science and Engineering [63] presents the databases that are in partly experimental. DemoBase- Materials Science Demonstration Database [64] consists of three main divisions and several sub-divisions, providing details on a wide range of chosen materials. The IDS Database List [65] available through the Internet Database Service includes current abstracts combined with five years of back-volume data. The Materials Science and Technology database, an archive file containing more extensive back-volume data is available as a subscription option. Instructional Materials Database for Materials Science and Technology [66] provides a primary site for people to find current information on available materials. It consists of a database in a structural form that allows searches/links to existing databases and/or sources of educational materials. The forgoing are going are given as examples and not intended as an exhausting list of available Materials Science Databases.

### **3.4.2 Distance Learning Aspects of Materials Database**

Distance learning aspects of materials database could be a materials database which can also provide a central repository of up-to-date information on the materials courses and programs that are available remotely and can make it easy for users to locate information about courses meeting their specific needs. This materials database could be a any subject database with distance learning package, or a specific distance learning materials database. As a distance learning materials database or a materials database with distance learning feature, they should satisfy the criteria: User-Friendliness, Search Capability, Reliability, Course Offerings, Course Information and Connectivity. Before evaluating these distance-learning materials databases or materials databases offering distance learning information, a collective table of 84 examples is presented in Appendix

A to describe current situation. The table can provide answers to critical queries. The query criteria are:

- how many databases are for an academic purpose? (30)
- how many academic databases are providing courses? (6)
- how many databases are providing information of courses, publications, projects, and institutions? (3)
- how many databases are providing degree programs? (0)
- how many databases are for general purpose? (36)
- how many general subject databases are serving courses? (3)
- how many general subject databases are serving information of courses, publications, projects and institutions? (3)
- how many databases are for commercial purpose? (18)
- how many databases are specified as distance learning databases? (0)

Eight query results (see Appendix A) are produced according to the criteria above. Among the 84 databases, 30 are for academic purposes. Six academic databases have courses or training programs and three of them provide information of publications, projects and institutions. In 36 general subject databases, only three offer course information. They also offer publication, project and institution information. Apart from academic and general databases, there are 18 commercial databases. None of 84 databases is specified as distance learning database.

The table and queries associated with it illustrates how hard it is to find specific materials databases which would be directly relevant to distance learning. Those, which are available, focus on course information and have very limited options on courses. It is also very hard to find any degree level programs linked them. Based on this current study, a satisfied "distance learning materials database" would greatly benefit both students and professionals in this area. Clearly it would be very useful to develop such a site with structured links to other materials related sites. Even more useful would be materials databases linked together as a distance-learning package.

### **3.5 A New Distance Learning Materials Database**

A new database is proposed in this research to provide support for students who are distance learners in the area of materials science and engineering. The development of

this database is intended to focus on user-friendliness, search capability and connectivity. Since distance learning materials database is developed as a tool for potential users, it should stand to reason that it will be developed with the needs and abilities of the user in mind [49]. User's needs and particularly the needs of the user who is relatively new to the online world should be appeared to the layout and functionality of the content. These needs would be addressed and visualized through use of hypertext, graphics and animation. Learner would then interpret the interface's actions and structure. This interface would be an important part of the distance education transaction, and the learner who cannot interact successfully with the interface would be inhibited regardless of his proficiency in other domain [75]. Accordingly all options should be clearly identified and easily accessed; user would usually have a clear sense of "where they are" in the directory and could navigate easily through it [49]. In addition, display should be clarity and terminology should be familiar to most users.

No matter how extensive the distance-learning database, it is ultimately only as good as its search engine [49]. The database should allow users to perform a full text keyword search or narrow down their search according to other criteria. Besides, many existing researches are intended to intelligent the search engine so that it could locate information more precisely.

In traditional university study, students attend lectures and teachers present materials step by step. After the lecture, the teacher assigns coursework and organizes the tutorials. When a suitable stage of learning is completed, students take exams and teachers get the feedback on their learning outcomes. Physical contact can happen (in theory) at any time the students feel the need. They can approach lecturers individually and ask them in a lecture or tutorial. There is also discussion and conversation among students. These all are very common aspects of face-to-face learning. But in distance learning, students work generally in isolated and don't know each other. They can't attend lectures, tutorials, exams and experiments because of the physical distance and for other reasons. Online distance learning provides an alternative approach to the traditional method by supplying all course materials from a single location and furnishing the flexibility for students to attend courses from wherever and whenever they like. Thus all that the student needs is an online browser to view lectures, read assignments, attend tutorials, present

experiments and take quizzes. The proposed new database would have ability to connect users with course providers and each other. It would not simply provide course and contact information but make it easy for users to register for or access a course, or request more information via hypertext links [49]. It would also offer links to other related resource. This new database should cater tools for users to ask questions or share information with other users.

## Chapter 4 The Experimental Development of a DL Materials Database

Following the conclusions drawn in section 3.3, 3.4 and 3.5, it is proposed here to explore the possibility of developing an innovative distance learning materials database.

The Web is not a unified source of information; there is no coherence in the form in which the information is offered, in its quality, substance or usability. It is possible to consider the Web as a set of 'independent pages', each of which constitutes a specific source of information. This is the criterion associated with *bookmarks* managed by browsers and search engines, which select links to single pages. The design of this new Web site would have to concentrate on using a system dedicated to the specific application needs and under the control of various coordinated subjects objectively sharing the same design goals.

The primary purpose of the site would be to deliver relevant (and possible large) amounts of information to a wide variety of users, ideally with a very regular and user-friendly structure. Given this requirement, it would be convenient to design portions of the site with techniques similar to those used to design databases.

### 4.1 Online Distance Learning Components

The online distance learning components would consist of HTML Web pages, the SQL Server database and an Internet Information Server (IIS) application.

Although almost all Web pages would be Active Server Pages (ASP), many applications would start out as HTML. Some Web pages would contain forms that post their inputted and hidden data fields to other forms or to themselves. Other pages use the "Get" method to provide a dynamic link to specific content. No frames would be used in the application, but tables would be used extensively, which would help space items in an exact location on the Web page.

The database for this application would be SQL based. With minor modification the database could be ported to Access or any other ODBC-compliant database server.

All of the pages within this application would be Active Server Pages (ASP) supplying the dynamic content from the SQL Server database. The Active Server Pages would be

placed on the server in a common directory structure and together installed as an application within IIS.

#### 4.2 General Process

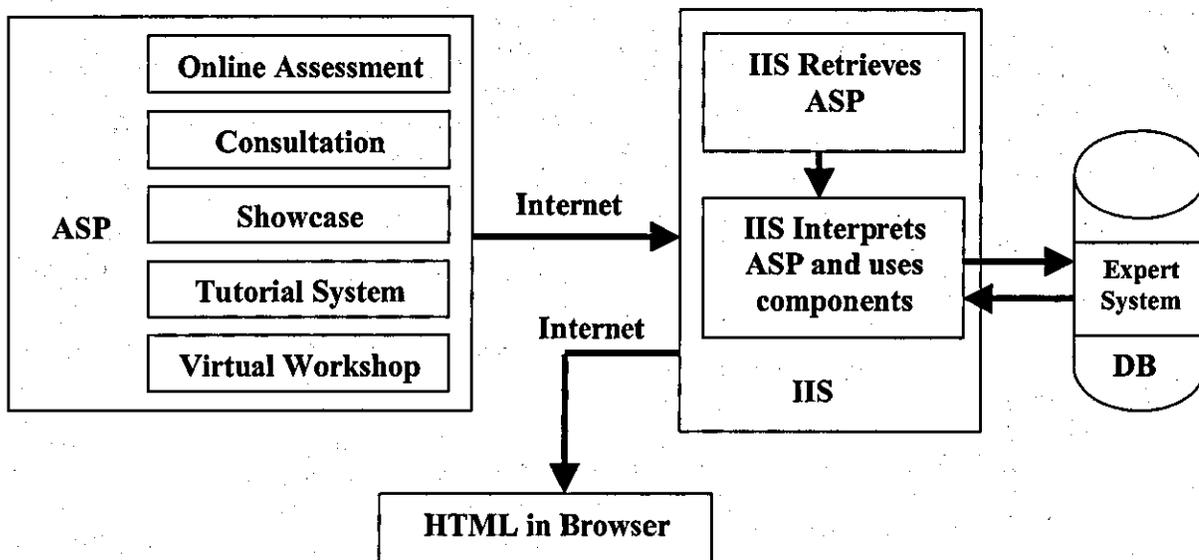


Figure 4.1 A General Process

The current proposed Web site is designed for both students and the professionals and would cover all aspects of materials research. This new site could be launched as a platform to bring together the basic principles of materials and research studies from around the world. It would provide a medium for all kinds of students in educational institutes, researchers in laboratories and for practitioners who are the users of research data in a wide range of areas. To meet these requirements, interactive multimedia and specific telematics applications are proposed to develop programs and the methods and tools and to support the pedagogic process. Some of these would also be based on some of the principles of 'object-oriented design' as it is known in the field of software engineering.

Several sections are proposed in order to develop and specify this Web site. They can be summarized into five basic modules: **Courses, Tutorial System, Online Assessment, Showcase and Virtual Workshop.** Each module has interconnection with the others. A

search engine working with each of them would allow exchange with most commercially available databases. They could be "access prescribed content" or allow response to a keyword search using any of the popular WWW browser applications. There would be a common interface to make all the modules look and "feel" the same. The result of the current research suggests the following specific format. The interface would be language-independent, an important consideration for online distance learning. Each module would be constructed with an opening motivation page to introduce the topic and engage the users' interest. The next page would list the module's learning objectives, any prerequisite modules the user should study first, any subsequent modules that follow on, and a list of the module's contents. The following pages would contain the teaching material, whilst the final page would contain a summary of the material, drawing out the salient points of the topic. Users would navigate through the modules by "clicking" to progress page-by-page, forward or backward. The learning environment would be supported by a glossary and keyword index, enabling the user to find easily those modules that contain material covering a term selected from the index. Communication facilities need to be included, such as email to subject experts, discussion group and chatting area.

### **4.3 HTML Site Hierarchy**

Figure 4.2 displays the Online Distance Learning Web page hierarchy. Each box in the site hierarchy contains the name of the page and name of the file. All the pages except the Index page are in a subdirectory called HTML. The boxes with heavy border are the placeholders for the Contents. The Tutorial Router page has no HTML in it and is used to record in the database that the student has been to that specific tutor.

Once a quiz is completed, the answers are submitted to the Quiz Results page. That page displays the quiz results.

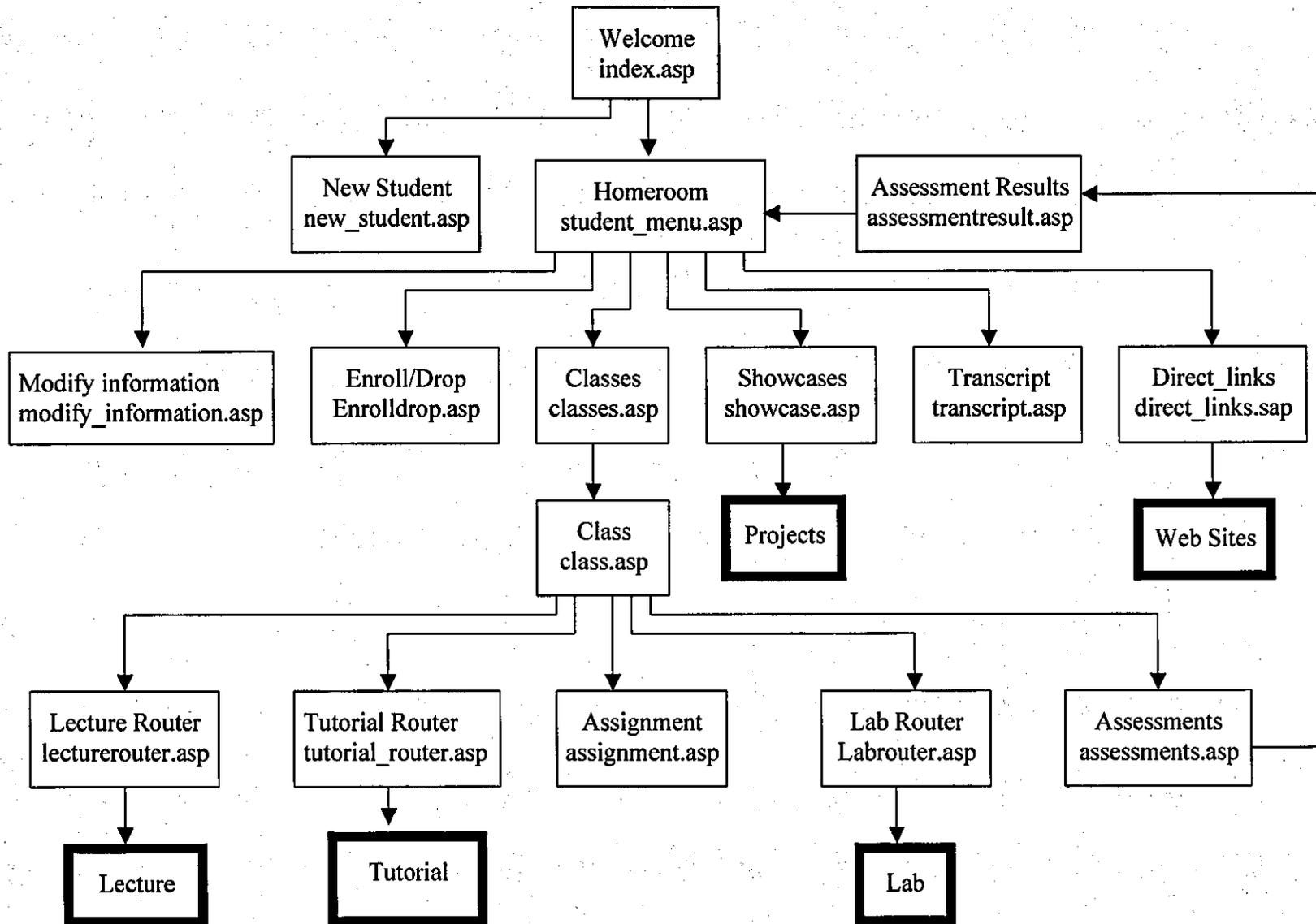


Figure 4.2 HTML Sites Hierarchy

## **4.4 The Content of Web Site**

### **4.4.1 Courses**

After signing up for a course the students can attend lectures, which involve text and instruction, in materials science and engineering. The course is designed to transfer existing teaching material to web-based format. In traditional methods, teaching is based on the assumption that knowledge in the teacher's mind is linked to some 'correct' structure, and the objective of the teaching is to place facts and relationships between them into the minds of students with minimal distortion. [67] In this new approach, the objectives and the means of instruction, the decisions about the level of interaction, the management of time, and evaluation of the student's activity and performance will be done by computers and delivered by Internet. So in this human-computer dialogue, which simulates the dialogue between a teacher and a student, the student is mainly a passive partner and the computer is an active, leading partner. [67]

The design of the computer-based course will involve some teaching strategies derived from the learning styles and translated into teaching methods in a CBLE. [68] The basic pedagogical method used in the design are:

- 1) setting goals: the knowledge or skills the learner is expected to acquire during the lesson;
- 2) providing instructions: uninterrupted presentations of any type of knowledge through text;
- 3) providing demonstrations: illustration of a particular task, a worked example;
- 4) providing explanations: the rationale behind a particular action;
- 5) presenting tasks: activities presented through text or graphical representations;
- 6) asking questions: questions requiring specific answers are presented;
- 7) providing examples: a learner's daily experience related to the present learning;
- 8) providing reminders: key words, such as commands, or key concepts, that a learner needs during the performance of a task, presented.

### **4.4.2 Tutorial System**

#### **4.4.2.1 What is the Tutorial System?**

"Tutorial systems" are specially designed to connect tutors with students and focuses on areas in which tutorials can reinforce the students' learning derived from Web

materials or in class. In addition, the online tutorial system provides a more stimulating and less stressful environment for learning. It can link users into a network of experts who can assist when a problem arises. It can also encourage students to discuss with each other. Thus this is a system that can provide online support to students who needed extra help in the learning process. It is also a good way to stimulate learning motivation through one-to-one communication with the tutor.

#### **4.4.2.2 The Use of Microsoft NetMeeting in Tutorial Systems**

The use of Internet resources "MS NetMeeting" can offer and enhance learning and understanding, modify the learning environment, reduce the barriers which time, space and social difference may create, be a source of motivation, and redefine the role of teachers and learners. It enables communication between tutors and students over the Internet or local Intranet. There are several features provided that can be very useful to distance learning. These features are Video and Audio Conferencing, Whiteboard, Chat, Internet Directory, File Transfer, Program Sharing, Remote Desktop Sharing, Security and Advance Calling. With Video and Audio Conferencing, tutors can send and receive real-time video images, and can also send video to students who don't have video hardware. Sometimes students can use a video camera to instantly view items, such as experimental devices and hardware, that are displayed in front of the lens. Tutors also can talk with students and share ideas and conversations. The Whiteboard lets tutors collaborate in real time with students using graphical information. With the Whiteboard, tutors and students can review, create and update graphical information. The contents can be copied, pasted and cut from any Windows-based application into the Whiteboard. The use of different-coloured pointers can differentiate between participants' contents. The use of "Chat" allows real-time conversations using text with many people. Tutors and students who have had the experience of using ICQ can more easily be involved in this type of "text chat". The contents of the chat can be saved to a file for future reference. The Internet Directory helps tutors locate students connected to the Internet. Tutors can view the Internet Directory from a web page, and review a list of students currently attending tutorials. It also helps tutors connect to more of the listed students or select another student by typing in his or her location information. File Transfer lets tutors and students send files to each other during a tutorial. When using NetMeeting's Program

Sharing, a shared program frame is shown, which makes it easy to distinguish between shared and local applications on users' desktops. The tutors can choose students and allow them to work in the shared program one at a time. It can also approve conference students; and requests to work in the program which the tutor has introduced. Remote Desktop Sharing lets tutors and students call a remote computer to access its shared desktop and applications. NetMeeting's advance calling feature gives tutors the flexibility to send a mail message to a NetMeeting student or to initiate a call directly from the mail address book.

#### 4.4.2.3 Hosting a Tutorial

It is very easy to host a tutorial with NetMeeting. The tutors only need to arrange a timetable about the tutorial and ask the students to call them at a specific time. The tutors also can use Outlook and an Exchange Server to schedule the tutorial. The details of tutors are provided in the web page. Students can access each tutor's web page and find out who they want to contact.

#### 4.4.2.4 Embedding the NetMeeting into a Web Page

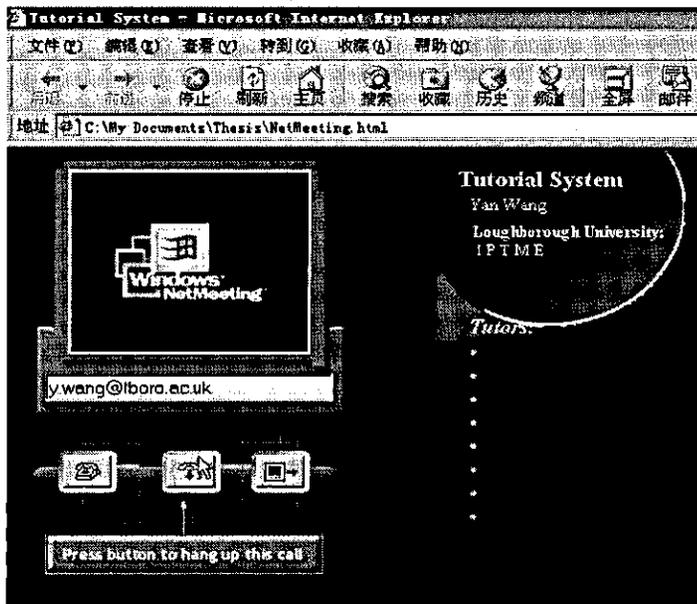


Figure 4.3 A Web Page with Embedded NetMeeting

It is useful to embed NetMeeting into a Web page that can be used by each student. In the page, there are names of tutors and hyperlinks to their web pages. Students can access

their web pages and find out useful information about the tutor and tutorials. There are also timetables of each tutorial. It is thus helpful to students in terms of arranging their time.

#### **4.4.3 Online Assessment**

##### **4.4.3.1 What is Online Assessment?**

Online assessment is a computer-based test, which is associated with evaluating skills, which can be operated on the World Wide Web through standard browsers such as Netscape. It can be used to deliver both summative and formative assessments in a wide range of subjects. Using online assessments a student can be assessed on his or her ability to meet a required level of skill, competence or understanding.

Summative assessment is an assessment in which tests and examinations are used to formally assess a student's level of knowledge, skill or understanding. [69] Formative assessment is where tests are used to simply gauge student understanding. The information obtained from formative assessments can be used to help students overcome weaknesses and improve the quality of teaching. [69]

Online assessment enables feedback and highlights how effective the training and teaching is. The ability to access the Internet/intranet means that everyone is connected. Any computer that can access the Internet or Intranet is a possible contender for use in assessment or testing. Moreover everyone can be connected in the same way. They don't need special software to login in, but can use standard software designed for that particular Internet or Intranet system. In distance learning, an assessment or paper can be put on the Web site, perhaps protected by a password, and anyone connected to the Web can take it. No special computer skills or connection are needed. When using online assessment and testing, anyone can take a test at a place and time of their choice. The results are stored on the server and available for collation and reporting instantaneously.

##### **4.4.3.2 Reason for Online Assessment**

The traditional method of assessment is using pen and paper. The process of testing and marking assessed coursework is very time-consuming and can be unreliable sometimes, with results being returned days or weeks later.

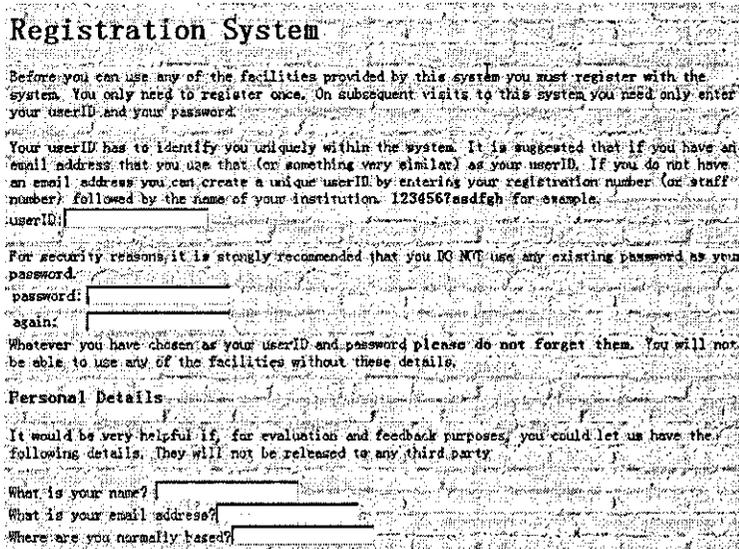
Fortunately, much of the testing and marking process has the potential to be automated. Online assessment involves using computers for delivering assessments rather

than by pen and paper. The participants sit before a computer screen and use a keyboard or mouse to answer questions. The result can be returned instantly and accurately.

The greatest advantage of online assessment is that feedback is automatic and immediate. Online assessment can be designed to allow learners to control the selection of assessment items they wish to use as a means of individualising their learning. The big disadvantage is that answers to the questions have to be simple, either straightforward choices or unambiguous character strings. [69]

#### 4.4.3.3 Identification Problem:

Identification is an important issue in all assessment. It is necessary to have a reliable way of identifying a person, and checking who they really are. For example, it is important to stop someone from getting a friend to do their test for them. Although this isn't as common a problem in real life as some imagine, it is important to identify people in order to give credibility to an assessment.



The image shows a screenshot of a registration system interface. At the top, the title "Registration System" is displayed. Below the title, there is a paragraph of text explaining the registration process: "Before you can use any of the facilities provided by this system you must register with the system. You only need to register once. On subsequent visits to this system you need only enter your userID and your password." This is followed by instructions on how to create a unique userID, suggesting the use of an email address or a combination of a registration number and institution name. A text input field for "userID:" is provided. Next, there is a warning about password security: "For security reasons, it is strongly recommended that you DO NOT use any existing password as your password." Below this, there is a "password:" label and a text input field. A "confirm password:" label and another text input field are also present. A note says "again:" followed by a text input field. A final paragraph states: "Whatever you have chosen as your userID and password please do not forget them. You will not be able to use any of the facilities without these details." Under the heading "Personal Details", there is a request for user information for evaluation purposes: "It would be very helpful if, for evaluation and feedback purposes, you could let us have the following details. They will not be released to any third party." Three text input fields are provided for "What is your name?", "What is your email address?", and "Where are you normally based?".

Figure 4.4 Registration System

Although it is possible for computers to identify individual people (by eye characteristics, for example), for the moment the only reliable way of easily identifying someone is to have careful invigilation or proctoring of the test. This is the same whether the test is on paper or on computer.

When the testing is for high stakes, a person needs to be checked individually. When the stakes are lower, system checks can be used.

#### **4.4.3.4 The Use of "Question Mark" in Assessment**

The commercial software company "Question Mark" has been involved in the design of online assessment databases. With the use of QM, it is possible to create tests, surveys, questionnaires, and assessments for use via the web or an Intranet. There are two Windows applications, Question Manager and Session Manager. Question Manager can be used to create questions and organise these within a hierarchical item bank. Session Manager can be used to construct tests and surveys around these questions. As questions and tests/surveys are created, they are saved within databases and published to the master server database. The QM server then accesses this database and serves out the tests and surveys to authorised individuals over the web or Intranet. The QM server also allows online security management and real-time analysis of respondents' answers to the surveys and tests.

#### **4.4.3.5 Creating Question Database with QM**

When starting to run Question Manager of Question Mark, A **Welcome to Question Manager** dialog can be seen, which offers three options. When first launching Question Manager, it is necessary to create a new database. By choosing the appropriate option from the dialog, the new question database is located. Questions can be stored in MS Access or SQL databases, although the **.question** file suffix is used for all question databases created by QM.

Question Mark's author tool allows the creation and design of questions in a number of different formats, which are called question types. All questions can include question-specific graphics and styles. See Figure 4.5.

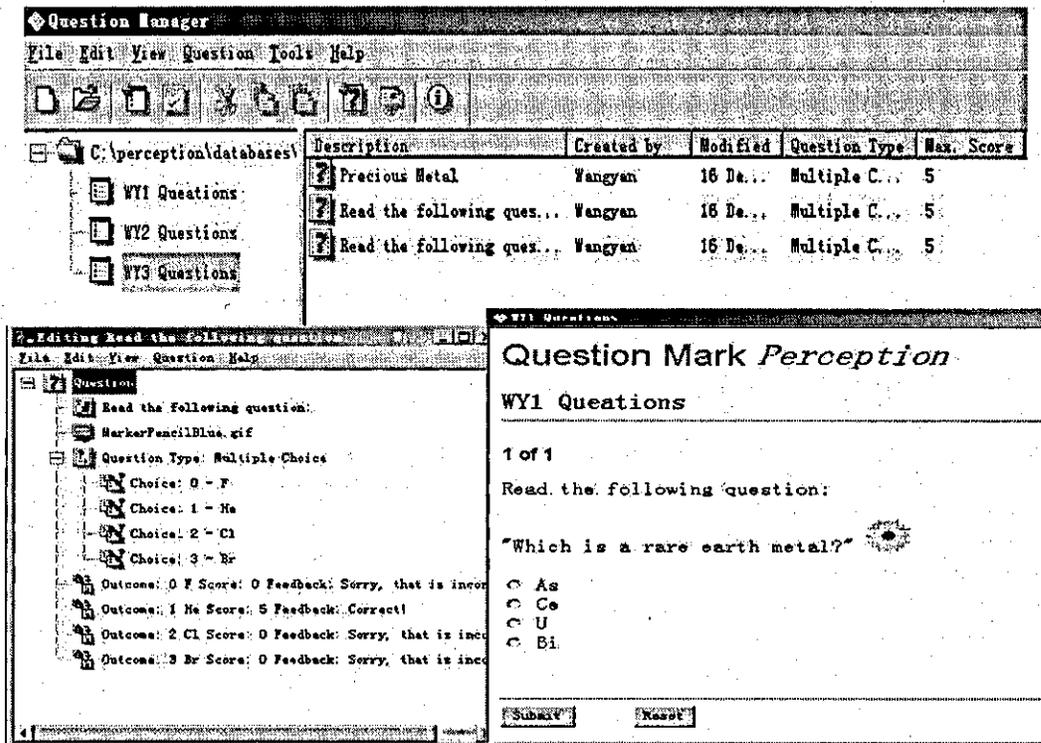


Figure 4.5 A Design of Question Database

#### 4.4.3.6 Assembling Questions into Tests, Exams and Quizzes

There is another Window application of Question Mark called Session Manager, which can be used to create sessions. The sessions can encompass tests, quizzes and exams. When questions are created within Question Manager, sessions are created within Session Manager. The questions can be organised into topics and sub-topics, and it is possible to shuffle questions and answers for each participant. Then it is possible to grab questions from various topics, individually, all within a topic, or randomly. But only questions held within one question database can be referenced by a session. All sessions are saved in a MS database, although with a special .session file suffix.

Sessions are stored individually within the .session database, and are displayed as separate items within Session Manager. Before creating a session, a new .session database needs to be created, in which to house the session. At the start of Session Manager and selecting File | New Database, the resulting dialog will be shown and one is

asked to enter the name of this database (e.g. "WY"), then click Create to create a .session database, which will draw questions from the defined .question database. Since this is a new .session database a new session will be immediately created. When creating a new session, it is possible to do this using "Wizard" or from scratch or by copying an existing session.

The name of the session must be defined (and an optional message,) which will be displayed whenever the session is first run. At the same time, the feedback needs to be chosen in order to display to the session, record answers, or display questions randomly.

The next step of the "Wizard" is to add a question. This can be done by clicking the Add... button to produce a dialog which enables interrogation of the question database selected via the Tool | Options... menu.

The final screen allows the score bands to be defined. Once different messages (depending on pass/fail) have been selected, two score bands are produced. This is the end of session creation. See Figure 4.6.

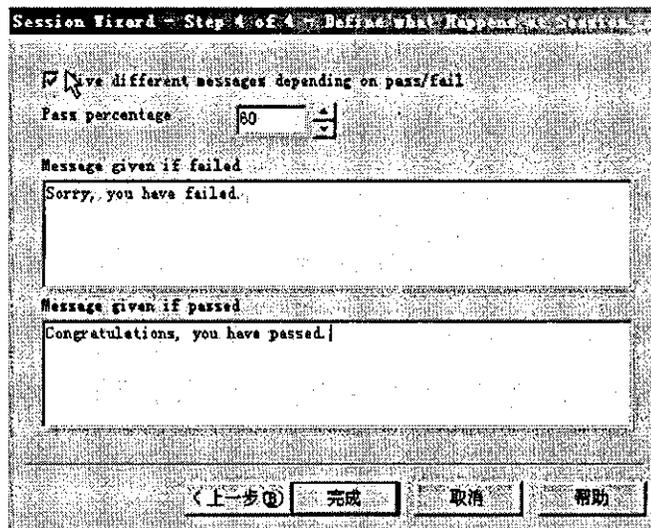


Figure 4.6 A Score Band

When finishing session creation, it is possible to add questions later to the same session. Question blocks must be built to house the question references. These question blocks are able to override the feedback setting defined within the session Control Block

and shuffle the order that the questions are displayed and to define an introductory message when the question block is run.

Generally, a simple session will contain only one question block, and maybe one or two question reference blocks within it. However, multiple question blocks are useful when separating text is supplied between groups of questions, or to branch (i.e. “jump”) to another question block depending on the results of another block.

Controlling the flow of a session between question blocks is accomplished via the jump block. To create a jump block, it is first necessary to create two separate question blocks within the session. Then the jump block is placed in-between these two question blocks.

Score bands are referred to as “end block” and are a means by which the conclusion of the session can be controlled. It is possible to use a score band to define unique feedback messages, or jump to another session or even to a Web or Intranet address.

The final step is to publish sessions to the Web-server. The Perception Server has to be used. There are server databases: **master.session** and **library.question**. All sessions must be made available to these databases in order to be deliverable across the Internet or Intranet. This can be done by choosing **File | Publish Session... | to Access...** command. The publishing process copies the selected sessions to the server database. Sessions previously published remain in the database.

When the publishing process is finished, a message similar to figure 4.7 received:

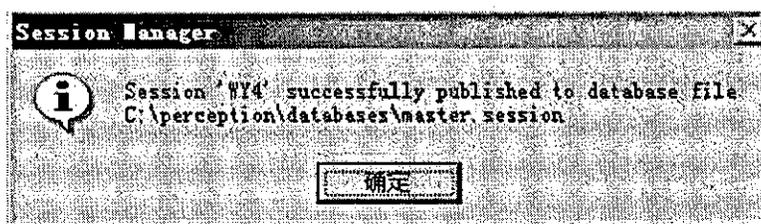


Figure 4.7 A Session Publishing Message

#### 4.4.3.7 Delivery of Sessions

Once the sessions have been published to the server area, it is necessary to prepare them for delivery to participants via an Intranet or the Web. To do this, it is necessary to access the Security Manager on <http://www.questionmark.com/qm/security.dll>.

In Security Manager, the participants' access rights can be assigned by following the screen. After registering the required participants, it is important to schedule them for the appropriate sessions. From the participant listing one needs to select those participants to schedule and then click the **Assign** button. Each schedule created is identified by a unique chosen name. So the particular session name has to be specified as defining a schedule. The number of attempts and time period in which the server software can administer the session also has to be limited. After clicking the **Add** button, these setting can be defined and the selected participants are immediately included within the schedule. Now the participants can take a session via the Perception Server by entering their names and passwords. Once they have answered all of the presented questions and clicked **Submit** button, the answers can be saved to the Perception Server's **qmpanswer.mdb** database file. At this time, any feedback text and/or score band branches are generated. See Appendix B for examples of simple questions and answers.

#### **4.4.3.8 Reporting**

There is a reporting module, which called "Enterprise Reporter", installed as part of the Perception Server. To view a session's results it is necessary to launch the Web browser and point it to Enterprise Reporter, located within the server's ENTERPRISE subdirectory. It can display detailed information on a single session, including the answers and scores for each question. It also can report statistics of difficulty, discrimination, standard deviation and the frequency rates for choices within questions. The general statistics of all sessions on the server can be listed as well, such as the number of sessions started and finished, low and high scores, mean score of all completed sessions, and the standard deviation. It is possible to give an analysis of answers to questions, typically a frequency analysis for multiple choice and similar questions and a listing of answers for text questions. In addition, it is possible to display a list of which participant has taken which session in score order, or other lists of information about each attempt at a session.

#### **4.4.4 Showcase Window**

The "Showcase Window" is proposed to first present and highlight exemplary projects in Materials Science and Engineering within the author's department, and then extend it to external institutes and educational organisations. Online application forms could be

compiled and published on the Internet. The teachers and students then complete the application forms online at the web site. This gives the teachers and students the opportunity to describe their specific technology projects when filling out the forms. It is possible that these projects would be reviewed and compiled into a database. This could be published on the Web for a specific period. Users can find Showcase and review projects submitted in the past. The showcase could be arranged into three categories: "Winner", "Previous" and "Searchable". The Winner Showcase would hold award-winning projects by a particular technological organisation and be shared across the Web site.

Several field names need to be set for "search". These would be project name, contact person, school name, city, participating teachers, curricular areas, technologies, and short description. The projects compiled into these fields and would be stored into a relational database, and would support the showcase Web pages. Showcase would ask for this information on each project. The information would be typed into the database exactly as received by the application. Users can simply fill out related messages, then click on "Find" to view a list of projects that match their selection. Figure 4.8 is an example of a simple showcase Web page.

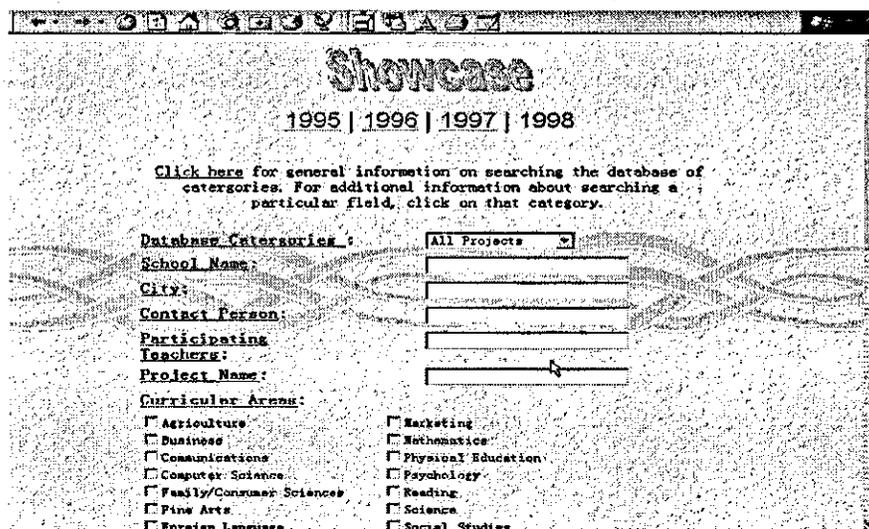


Figure 4.8 A Showcase Web Page

The sample application forms is below (Figure 4.9):

The image shows a screenshot of a web-based application form titled "Showcase Project Application Form". At the top, there is a navigation bar with icons for home, back, forward, and search. The main heading is "Showcase" in a stylized font, followed by "Showcase Project Application Form". Below the heading, there is a paragraph of instructions: "Please complete ONE application for EACH exemplary technology project at your school. Feel free to use this form as many times as needed. The projects may be completed projects or work-in-progress." Below this, it says "Application deadline is xxxx." and "Indicate required field". The form contains several input fields: "Higher Education Institution:", "School Name:", "School Address:", "Contact Person: (list one name only)", "E-Mail Address:", "Participating Teachers: (Includes Contact Person if also a participating teacher)", "Project Name/Title:", "Phone:", "Fax:", "Phone: (if different from above)", and "Fax: (if different from above)".

Figure 4.9 A Sample Application Form

#### 4.4.5 Virtual Workshop

This provides links to those areas where it is possible to get ongoing support for the work the users wish to do in implementing a technology component of their course

- **Virtual Laboratories** would be a place to let users to "attend" experiments.
- **Direct Link** would enable access to useful Web sites.

##### 4.4.5.1 Virtual Laboratories

It is accepted that materials studies are generally accompanied by experimentation and great importance is attached to laboratory work, where students have the opportunity to develop their creative skills in a practical environment. Even a small mistake made in an experiment can potentially cause ultimate failure. Students cannot be prepared sufficiently for this activity by simple attendance at lectures in which basic principles are expounded to large classes. Before an experiment, a lot of preparation must be done. For students and researchers studying or working in a conventional education institute, it is possible to do this preparation and perform these experiments, leading to an

understanding of the whole process of experimentation. Unfortunately, for various reasons, very often it is not possible for the "distance learner" to attend an educational institute although it is possible to read related textbooks. However, extracting and understanding text, tables and graphics are not a substitute for practical experience. Although figures can be used to show the static process of an experiment, it is not sufficient in itself.

The use of "Microsoft NetMeeting" or "Microsoft Media Player" can be a way to solve this problem. It enables communication between tutors and students over the Internet or local Intranet. The Video and Audio Conferencing feature could be used to transfer real-time video images, and also send video materials to the students who don't have video hardware (other than a computer with appropriate software).

#### **4.4.5.2 Direct Links**

A vast amount of Materials Science and Engineering data already exists on the Web; therefore there is great potential for using the information to support studies and research. Subject-specific searches on the Web have become more and more popular in this area. Many search engines return results ranked according to the relevance of the site to the search topic. The user needs to recover many sites to evaluate thoroughly before including them in the reference list. It is a good idea to build up bookmarks and make sure only relevant and quality sites have been included. After some time there can be hundreds of bookmarks recorded. This could be a burden to the computer memory and hard disk. "Direct Links" performs as a bookmark and gives additional notes with the reference list to relate the sites to the context of fields of Materials Science and Engineering, enabling users to make informed choices on the sites they visit. The reference sites would be checked periodically to ensure that the address is still valid, as Web pages may be frequently removed or change location. Users can access required Web sites directly from the "Direct Links" and can repeat at any time. They don't need to keep hundreds of bookmarks in their computers, but only this one.

#### **4.5 The Distance Learning Database**

The distance-learning database is effectively an integration of two "child" databases: learning database and assessment database that has been compiled with Question Mark and sent to Perception Servers.

#### 4.6 Conceptual Design of the Learning Database

The conceptual design of a database requires the construction of an Entity-Relationship schema, providing an optimal description of the user requirements. The Entity-Relationship (E-R) model is a conceptual model and as such provides a series of constructs capable of describing the data requirements of an application in a way that is easy to understand and is independent of the criteria for the management and organization of data on the system. [6]

The purpose of this is to represent the informal requirements of the application in terms of a formal and complete description, but independent of the criteria for the representation used in database management systems. The conceptual model allows the description of the organization of data at a high level of abstraction without taking into account the implementation aspects. It is necessary to represent the information content of the database in this phase, without considering either the means by which this information will be implemented in the actual system, or the efficiency of the programs that make use of this information.

After the analysis of requirements of this database, it is possible to construct a glossary of terms. The database will consist of a course part and a student part. The Courses part provides assignments, lectures, assessments, labs and tutorials and students read assignments, view lectures, take assessments, present tutorials and attend labs. The skeleton schema can be presented as below (Figure 4.10)

It is possible to repeat the steps for all the schemas until every specification is presented. It is necessary to carry out refinements and add new concepts to the schema to describe them and any new parts not yet represented.

An integration step is carried out to make a general schema with reference to the skeleton schema. After all the steps, a quality analysis is required. It is very important to verify the correctness, completeness, minimality and readability of the schema and carry out any necessary restructuring.

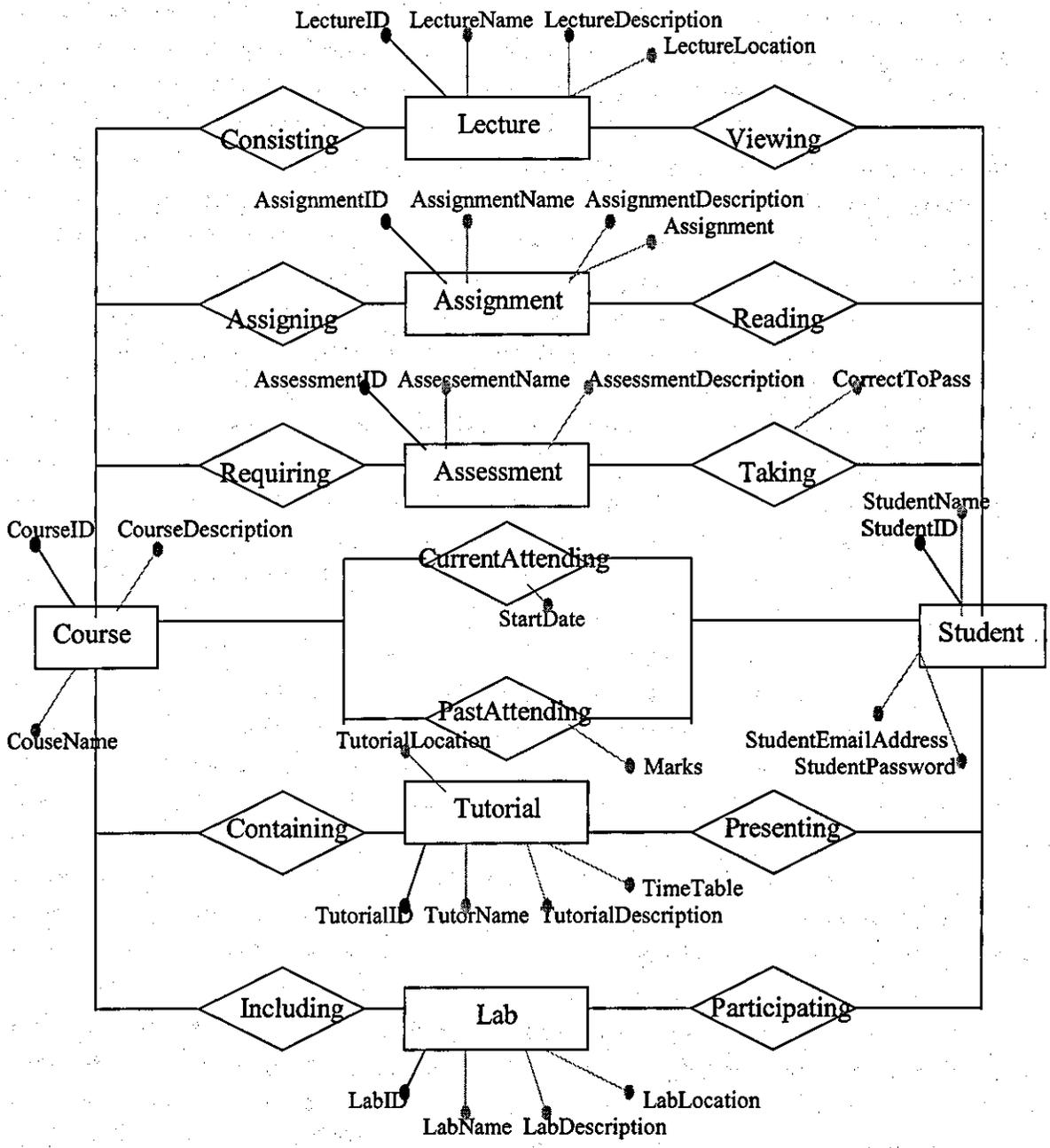


Figure 4.10 The Skeleton Schema

#### 4.7 Logical Design of the Consultation Database

The aim of logical design is to construct a logical schema that correctly and efficiently represents all of the information described by an Entity-Relationship schema produced during the conceptual design phase. [6] Logical schema can be made by assigning details to each part. Then it is necessary to find the data for each part. The volume of data and the general characteristics of the operations can be described by using tables (see table 4.1).

**Table of volumes**

<b>Concept</b>	<b>Type</b>	<b>Volume</b>
Student	E	5000
Course	E	200
Assignment	E	8000
Lecture	E	8000
Assessment	E	8000
Tutorial	E	1000
Lab	E	500
Current Attending	R	7000
Past Attending	R	200
Consisting	R	4000
Viewing	R	8000
Reading	R	8000
Presenting	R	8000
Taking	R	8000
Including	R	4000
Assigning	R	4000
Requiring	R	4000

**Table 4.1 Table of Volumes**

The following operations were planned using the data described by the schema:

- Operation 1: insert a new student indicating all his or her data;
- Operation 2: assign a student to a course;
- Operation 3: display all the information of all courses;
- Operation 4: display all the information of all assignments in a course;
- Operation 5: display all the information of all lectures in a course;
- Operation 6: display all the information of all tutorials in a course;
- Operation 7: display all the information of all assessments in a course;
- Operation 8: display all the information of all labs in a course;
- Operation 9: carry out a statistical analysis of all information.

**Table of operations**

Operation	Type	Frequency
Op1	I	40 per day
Op2	I	40 per day
Op3	I	100 per day
Op4	I	100 per day
Op5	I	100 per day
Op6	I	100 per day
Op7	I	100 per day
Op8	I	100 per day
Op9	B	10 per month

**Table 4.2 Table of Operations**

In the *table of volumes*, all the concepts of the schema are listed (entities and relationships) with their estimated volumes. In the *table of operations* are the expected frequencies and symbols that indicate whether the operation is interactive (I) or batch (B). The number of occurrences of the relationship depends on two parameters: the volume of the entities involved in the relationship and the number of times an occurrence of these entities

participates (on average) in an occurrence of the relationship.

Moreover, it is possible to describe the data involved by means of a *navigation schema* that consists of the fragment of the E-R schema relevant to the operation. On this schema, it is useful to draw the 'logical path' that must be followed to access the required information. All paths can be summed up in a *table of accesses* as shown below.

**Table of accesses (for operation 3).**

Concept	Type	Accesses	Type
Course	Entity	1	R
Consisting	Relation	10	R
Assignment	Entity	2	R
Assessment	Entity	2	R
Lecture	Entity	2	R
Tutorial	Entity	2	R
Lab	Entity	2	R
Current Attending	Relation	2	R
Past Attending	Relation	10	R
Student	Entity	1	R

**Table 4.3 Table of Accesses**

Next it is necessary to carry out the various restructuring tasks. The various transformations are carried out and the redundancy is presented. Then it is possible to find disadvantages both in terms of storage and access time. Lastly, it is necessary to remove and merge concepts and reconstruct a new E-R schema.

By following the techniques, the new E-R schema can be translated into the following relational schema.

Course (CourseID CourseName CourseDescription)

Assignment (AssignmentID AssignmentName AssignmentDescription Assignment)

Lecture (LectureID LectureName LectureDescription LectureLocation)

Assessment (AssessmentID AssessmentName AssessmentDescription CorrectToPass)

Tutorial (TutorialID TutorName TutorialDescription TutorialLocation TutorialTime)

Lab (LabID LabName LabDescription LabLocation)

Student (StudentID StudentName StudentEmailAddress StudentPassword)

#### 4.8 Normalization

Next it is necessary to discuss some properties, known as *normal forms*, which can be used to evaluate the quality of a relational database. For example, it can be found that a relation does not satisfy a normal form, and it presents redundancies and produces undesirable behavior during update operations. This principle can be used to carry out quality analysis on schemas that do not satisfy a normal form and it can be applied as *normalization*. [6] Normalization allows the non-normalized schemas to be transformed into new schemas for which the requirements of a normal form are guaranteed.

There are two important points to be clarified. First, design techniques allow schemas to be obtained that satisfy a normal form. In this, normalisation theory can constitute a useful verification tool indicating amendments, but can't constitute for the wider range of analysis and design techniques. Second, normalization theory has been developed in the context of the relational model and for this reason, can provide means and techniques for the analysis of outcomes of logical design.

Following conceptual and logical design, it is possible to produce the relational databases. These allow the representation of information with a detailed structure.

#### 4.9 The Table Definition

##### DLCourses

The DLCourses table is a main linking table across many other tables. The CourseName and description fields are used on the Enrol/Drop form. The CourseName field is also used on many of the other pages in the DL program to indicate which course the student is currently working with.

Field Name	Field Type	Notes
CourseID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseName	varchar	Length=100
CourseDescription	text	

**Table 4.4 DLCourse Field Specification**

### **DLEAssignments**

The DLEAssignments table contains information about assignments in each of the courses. The AssignmentName and AssignmentDescription fields are used in the Course Outline table. The AssignmentDescription contains the HTML displayed on the assignment page itself.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
AssignmentID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseID	int	Foreign Key
AssignmentName	varchar	Length=100
AssignmentDescription	text	

**Table 4.5 DLEAssignments Field Specification**

### **DLELectures**

The DLELectures table has fields identifying the lectures for each of the courses. The LectureName and LectureDescription are used on the Course Outline page. The LectureLocation is a fully qualified or relative path to the location of the lecture file.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
LectureID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseID	int	Foreign Key
LectureName	varchar	Length=100
LectureDescription	text	
LectureLocation	text	

**Table 4.6 DLELectures Field Specification**

### **DLEAssessments**

The DLEAssessments table contains information about Assessments in each of the courses. The AssessmentName and AssessmentDescription fields are used on the Course Outline table.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
AssessmentID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseID	int	Foreign Key
AssessmentName	varchar	Length=100
AssessmentDescription	text	
CorrectToPass	int	Score needed to pass

**Table 4.7 DLEAssessments Field Specification**

### **DLLabs**

The DLLabs table has fields identifying the Labs for each of the courses. The LabName and LabDescription are used on the Course Outline page. The LabLocation is a fully qualified or relative path to the location of the Lab file.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
LabID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseID	int	Foreign Key
LabName	varchar	Length=100
LabDescription	text	
LabLocation	text	

**Table 4.8 DLLabs Field Specification**

### **DLTutorials**

The DLTutorials table has fields identifying the Tutorials for each of the courses. The TutorialName and TutorialDescription are used on the Course Outline page. The TutorialLocation is a fully qualified or relative path to the location of the Tutorial file.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
TutorialID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseID	int	Foreign Key
TutorName	varchar	Length=100
TutorialDescription	text	
TutorialLocation	text	

**Table 4.9 DLTutorials Field Specification**

### **DLStudents**

The DLStudents table is the main table for the student information part of the database. This table contains the personal information about the student and is linked to many other tables.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
StudentID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentName	varchar	Length=100
StudentEmailAddress	varchar	Length=100
StudentPassword	varchar	Length=100

**Table 4.10 DLStudents Field Specification**

### **DLStudentCourses**

Contained in the DLStudentCourses is a list of all courses that the student is actively taking and all courses that are completed. Note that courses that were dropped do not appear in this table. If the status of the courses is InProgress, then the StatusDate field contains the date the student signed up for the course. If the status is complete then the completion date is contained in the StatusDate field.

Field Name	Field Type	Notes
CourseID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
CourseName	varchar	Length=100
CourseDescription	text	

**Table 4.11 DLStudentCourses Field Specification**

### **DLStudentAssignments**

The DLStudentAssignments table keeps track of the Assignments that a student has viewed. The presence of a record is determined on the Course Outline page.

Field Name	Field Type	Notes
StudentAssignmentID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentID	int	Foreign Key
AssignmentID	Int	Foreign Key

**Table 4.12 DLStudentAssignments Field Specification**

### **DLStudentLectures**

The DLStudentLectures table keeps track of the Lectures that a student has viewed. The LectureRouter.asp file adds records to this table.

Field Name	Field Type	Notes
StudentLectureID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentID	int	Foreign Key
LectureID	Int	Foreign Key

**Table 4.13 DLStudentLectures Field Specification**

### **DLStudentLabs**

The DLStudentLabs table keeps track of the Labs that a student has viewed. The LabRouter.asp file adds records to this table.

Field Name	Field Type	Notes
StudentLabID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentID	int	Foreign Key
LabID	Int	Foreign Key

**Table 4.14 DLStudentLabs Field Specification**

### **DLStudentTutorials**

The DLStudentTutorials table keeps track of the Tutorials that a student has viewed. The TutorialRouter.asp file adds records to this table.

Field Name	Field Type	Notes
StudentTutorialID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentID	int	Foreign Key
TutorialID	Int	Foreign Key

**Table 4.15 DLStudentTutorials Field Specification**

### **DLStudentAssessments**

The DLStudentAssessments table tracks the quizzes that the student has taken. The table also store whether the student passed or failed the assessment. The pass/fail, as well as the presence of a record are determined on the Course Outline page.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
StudentAssessmentID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
StudentID	int	Foreign Key
QuizID	Int	Foreign Key
Status	varchar	Length=20

**Table 4.16 DLStudentAssessments Field Specification**

### **DLShowcases**

The DLShowcases table contains projects related to study and research. The Showcases are categorized into two groups: Winner, Previous.

<b>Field Name</b>	<b>Field Type</b>	<b>Notes</b>
ProjectID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
ProjectName	varchar	Length=100
ProjectDescription	varchar	Length=100
ParticipatorName	varchar	Length=100
Institution	varchar	Length=100
Project	text	
Category	varchar	Length=100

**Table 4.17 DLShowcases Field Specification**

## DLDireckLinks

The DLDireckLinks table contains related Web sites.

Field Name	Field Type	Notes
WebSiteID	int	Identity column, seeded at 1 and incremented by 1 Provide resources.
WebSiteName	varchar	Length=100
WebSiteDescription	varchar	Length=100
URL	varchar	Length=100

**Table 4.18 DLDireckLinks Field Specification**

### 4.10 A Logical Model for Data-Intensive Hypertexts

After designing databases, it is necessary to describe how to adapt them to Web sites. The design has to concentrate on a system that is dedicated to database need and under the control of various co-ordinated subject areas sharing the same goal, i.e. *data-intensive* Web sites. That is, sites whose primary purpose is to deliver potentially large amounts of relevant information to a variety of users. These needs are best served by sites with very regular structures. The organization for this site is specified as below.

- “Welcome page” shows the entrance into the DL program. This is the first page that will be seen by anyone entering the DL program. A student who attempts to go straight to another page in DL program without first logging in is automatically redirected to this page. A student who has never been to the DL program before clicks on the class entrance, which brings up the sign-up form. A student who is a return visitor just supplies name and password and clicks to enter. The name and password are validated in the database before entry is allowed.
- “New-Student page” shows the form used to add a new student. Here students supply information about themselves. Most fields are required and their email address and names are verified to confirm that they haven’t already been here before. Also their passwords are checked to make sure both entries match.

- “Home page” is the main menu for the DL program. Once the students successfully submit this form or once they successfully log in from the Welcome page, they are routed to the Home page. From here the student can change personal information, enrol or drop a course, go to class, showcase, direct links, or check a transcript. This page is also linked to pages throughout the application to provide a way to escape the current page.
- “Enrol/Drop page” displays the Enrol/Drop form. On this form students are presented first with a list of courses with course description available. Clicking on course signs a student up for the course. This is accomplished by using the “Get” method of Form object and submitting the form back to itself. On this page, students also see a list of classes that they are currently active in, which excludes courses that they have completed. When they select a course from the list and select Drop, the course is removed from the active list. Either of the above actions returns a student to the Home page, or the student can click on the Home icon to return there.
- “Transcript page” displays the status of all courses the student has been or is involved in. The status column indicates whether the course is InProgress or Completed. The date column states the date that the students entered the course for InProgress, or the completion date for the completed courses. The Home icon returns the student to the Home page.
- When student selects the “Go To A Class” from Home page, the Course Selection page is presented. The Course Selection page lists all the courses for which the student is listed as InProgress.
- When student selects the “Go To Showcase” from Home page, the Showcase Selection page is presented.
- When student selects the “Go To Direct Links” from Home page, the Direct Links Selection page is presented.
- The student will see the “Course Outline page” after clicking on course. This page displays all the lectures, assignments, assessments, tutorials and labs associated with the course. Clicking on each item will take the student to that particular page.
- “Lecture page” shows a lecture, which is stored within database. It can be any type of presentation file.

- “Assignment page” provides details about what additional material is needed to complete this part of course. Here would be information about reading assignments, exercises and possible items that need to be emailed to an instructor.
- “Lab page” provides the details about experimentation needed to complete this part of course. Here would be pre-record video and transferred by computer conferencing.
- “Tutorial page” provides the details about tutorials and names of tutors.
- “Questions and answers in Assessment page” are edited by using QM. A student who has passed all the quizzes for his/her class is given a different message, one stating that the student has completed the course, and the course is marked as completed in the student’s transcript.
- “The Lecture Router, Tutorial Router and Lab Router pages” have no HTML in them and are used to record in the database that the student has been to the specific lecture, tutorial and lab. The pages redirect the student to the lecture, the tutorial and the experiment.

#### **4.11 Setting Up the ASP Application**

As a student traverses the site and takes quizzes, it is necessary to keep track of who that student is, otherwise the student would be required to log in on every page. So keeping track of a student from page to page needs to be maintained. This can be done by creating an ASP application within the Internet information Server. For an ASP application to work correctly, all pages must be within the same directory structure.

The ASP code in the Welcome page is responsible for validation that the user exists and for logging the user in. The code in the New Student page is responsible for adding new students to the database. It validates the field data and checks for an existing entry before adding the student. The Home page is a very important navigational page. The code in the Modify Information Active Server Page allows students to change their personal information. Before saving changes, the code validates a student’s input. Since the student may want to change only part of the information, the existing record is placed in each field by default. The code in the Enrol/Drop page displays a list of all the courses available and a list of courses that the student is active in. The code also registers the student in a course and drops the student from a course. The code in the Transcript page

displays all Completed and InProgress courses for the student. The Class page displays all the lectures, assignments, assessments, tutorials and labs for the course requested. It also displays which items have been viewed and not viewed by the student. The code in the Lecture Router, Tutorial Router and Lab Router pages are responsible for adding a record to the DLStudentLectures, DLStudentTutorials and DLstudentLabs indicating that the student has viewed or attend them. They then route the student to the location of the lecture, tutorial or experiment. The code in Showcase page is responsible for creating an HTML table of all projects. The project page displays all the projects and related information. The Assignment Page is responsible for adding data to the database indicating that the student has visited this assignment and then displays the requested assignment. The Direct Links displays all related Web sites.

## **4.12 Search Engines**

### **4.12.1 Searching Functions**

This section is for finding desired materials and properties in the most efficient manner. There would be two kinds of search engines. One responds to data, which can be structured as a small table and can be retrieved according to one or two field values. Another deals with data requiring complex interrelations, and so a relational database is needed.

Some Basic Searchers could be involved, which allow users to search by keyword, publication, topic, or subject. Each of these methods provides direct access to specific information. Drop-down menus give users search options and make it easy to find specific information from this particular term of electronic database.

The Quick Search option allows searching of all databases. In addition to specifying keywords, it is possible to restrict the search in other ways such as specifying the fields keywords must appear in, requiring the words to be near each other, and asking for words that sound like the specified keyword.

To narrow down a search, it is necessary to search specific databases. It is also possible to search for Full Text Reports and documents. It is proposed that this new database would consist of many documents, and the full text of the documents would be available online. Another useful search option is the Subject Categories engine. Keywords are not specified: rather, they are selected from a drop-down menu of categories and produce a

list of documents. For example, selecting "courses" from courses menu would bring up lectures menu.

#### 4.12.2 Searching Principles

One of most useful CGI applications is a web server search/index gateway. This allows a user to search all of the files on the server for particular information. (Figure 4.11)

### Search with *Abstract* Field

1. Type the word you want to use with the Abstract field.

PDN(>08/26/1999 AND <09/26/1999) AND ABS()

2. Click Add to continue.



Figure 4.11 Search with Abstract Field

The source file is:

```
<html>
<head>
<title>Search with ABSTRACT Field</title>
<body>
<h1>Search with <i>Abstract</i> Field</h1>
<form action="cgi-bin/search.pl" method="post">
<ol>
<li>Type the word you want to use with the Abstract field.<br>
PDN(>08/26/1999 AND <09/26/1999) AND ABS(<input type="text" name="query" size=40>)
<li>Click add to continue.<br>
<input type="Submit" value="Add">
</ol>
</form>
</body>
</html>
```

I

Figure 4.12 HTML Source File of Abstract Field Search

The form contains one field to hold the search query. The following is a typical program.

```

#! /usr/local/bin/perl

$webmaster = "wangyan (wangyan\@bu\edu)";
$fgrep = "/usr/local/bin/fgrep";
$document_root = $ENV { 'DOCUMENT_ROOT' };
&parse_form_data (*SEARCH);
$query = $SEARCH { 'query' };
if ($query eq "") {
    &return_error (500, "Search Error", "Please enter a search query.");
} elsif ($query !~/^(w+)$/){
    &return_error (500, "Search Error", "Invalid characters in query.");
} else {print "Content-type: text/html", "\n\n";
    print "<html>", "\n";
    print "<head><title>Search Result</title></head>";
    print "<body>", "\n";
    print "<h1>Result of searching for:" , $query, "</h1>";
    print "<hr>"; }
open (SEARCH, "$fgrep -A2 -B2 -1 -n -s $query $document_root/*");
/abc/cde/filename.abc-57-Previous, previous line
/abc/cde/filename.abc-58-Previous, previous line
/abc/cde/filename.abc-59 : Matched line
/abc/cde/filename.abc-60-Following line
/abc/cde/filename.abc-60-Following, following line
$count = 0;
$matches = 0;
$accesssed_files = ();
while (<SEARCH>) {
    if ( ($file, $type, $line) = m|^(\w+) ([\:-]\d+\2(.*)|) {
        unless ($count) {
            if (define 0$accesssed_files{$file})) {
                next;
            } else { $accesssed_files{$file} = 1;
            }
            $file =~ s/^$document_root\/(.*)/$1/;
            $matches++;
            print qq|<a href="?$file">$file</a><br><br>|;

            $count++;
            $line =~ s/<([[^>]]\n)*>&lt;$1&gt;/g;
            if ($line =~ /^[^A-Za-z0-9]*$/){
                next }
            print $line, "<br>";
        } else { if($count) { print "<br>";
            $count = 0;
        } } }
    print "<p>", "<hr>";
    print "Total number of files searched: ", $matches, "<br>";
    print "<hr>";
    print "</body></html>", "\n";
    close (SEARCH);
}
exit(0);

```

Figure 4.13 Source Code

## **Chapter 5 Expert Systems**

### **5.1 What is Artificial Intelligence (AI)?**

Artificial intelligence can be viewed from a variety of perspectives. From the perspective of intelligence, artificial intelligence is making machines "intelligent" and acting as one would expect people to act. The inability to distinguish computer responses from human responses is the Turing Effect. From a research perspective, artificial intelligence is the study of how to make computers do things, which are currently better done by people. From a business perspective, artificial intelligence is a set of very powerful tools, and methodologies for using those tools to solve business problems. From a programming perspective, artificial intelligence includes the study of symbolic programming, problem solving and searching. [77]

### **5.2 What is an Expert System (ES)?**

An expert system is a computer system, which emulates the decision-making ability of a human expert. [70] Expert systems can be defined narrowly or broadly. Narrowly, expert systems techniques make computer programming easier and more effective. Broadly, they represent the first step in a process that will transform computing by moving programming technology beyond numerical programming into the realm of logical, symbolic programming. [71] They can solve problems efficiently and effectively in a narrow problem area. They have the ability to perform at the level of an expert and match a competent level of human expertise in a particular field. They can offer intelligent advice or make an intelligent decision about a processing function. They also can address the problem normally thought to require human specialists for their solution.

### **5.3 Basic concepts of an Expert System Function**

The expert system is composed of two main components: the knowledge base (or rule-base) and the inference engine. The knowledge base is the source of facts that the inference engine uses to draw conclusions or expertise about the user's query. In developing an expert system, an IF THEN rule-base is formulated initially from the knowledge of a human expert. After the knowledge base is created, the inference engine is programmed to select the appropriate IF THEN rules from its knowledge base, depending on the facts (or symptoms) provided by the user. Finally, the inference engine formulates advice and returns it to the user.

It is important to remember that the knowledge domain is a complete subset of the problem domain. [72] So in this light, the design of an expert system is very different than that of a conventional computer program. Since inference engines rely on inferences to solve problems, it is important for expert systems to have an explanation facility, which explains the engine's reasoning.

#### 5.4 Basic Elements of Rule-Based Expert System

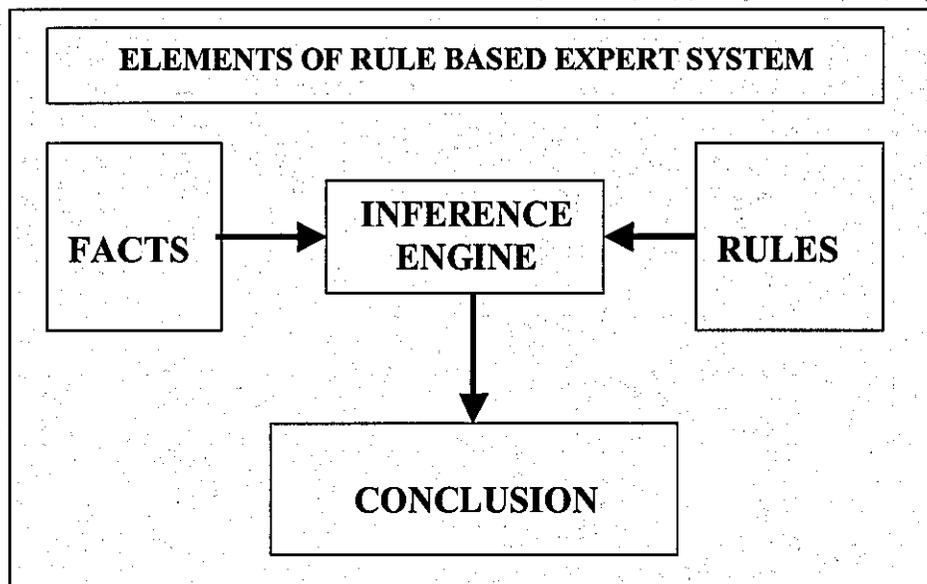


Figure 5.1 Basic Elements of Rule-Based Expert System

**RULED BASED EXPERT SYSTEM:** contains a set of problem specific information (facts) in the working memory, as shown by the box (FACTS) and a set of rules in the knowledge base, as shown by the box (RULES). The inference engine is used to derive new knowledge or make a conclusion.

**FACT:** are a type of declarative knowledge, which describes what is known about a given problem. They are statements, which are asserted into the working memory, as shown by the FACTS box, with either a true or false value. Therefore, the memory contains the facts about the problem during the consultation. For example, snow is white.

**RULES:** contains the domain knowledge, which is represented by a set of IF-THEN rules. For example, IF condition  $\rightarrow$  THEN action, or IF premise  $\rightarrow$  THEN conclusion.

**Rule 1:**

IF information\_is\_materials = true AND  
information\_is\_ceramics = true  
THEN information = needed

**Rule 2:**

IF information\_is\_materials = true AND  
information\_is\_ceramics = true  
THEN information = needed (confidence=90)

**INFERENCE ENGINE:** makes inference by deciding which rules are satisfied by facts, and fires the rules. Two inferencing methods are commonly used:

- **Forward Chaining:** reasoning from the facts to the conclusion. The medical diagnosis system is an example of the reasoning model. It makes diagnosis (conclusion) about the patient, based on the syndromes (facts) supplied by patients and its medical knowledge (rules).
- **Backward Chaining:** reasoning in reverse from a hypothesis, a potential conclusion to be proved, to gather the facts, which support the hypothesis. For example, if the doctor thought that the patient had a certain disease (hypothesis), then he tried to make some tests to prove his hypothesis.

**CONCLUSION:** is the response of the expert system to the user's queries for expertise. It derives new knowledge or information. For example, the medical expert system gives diagnosis of a particular disease.

### 5.5 Creating Expert System

This expert system is a rule-based system, which comprises of many definitional rules and a few heuristic rules. All rules in this expert system are placed together in one set and then examined as a whole. The goal is to get necessary knowledge from a current "expert" and put it into a system so that others can access that knowledge when they want to solve similar problems. There are four phases to the procedure of developing this expert system: 1. define the problem;

2. develop an initial set of rules;
3. enhance the rules;
4. customise inference and control.

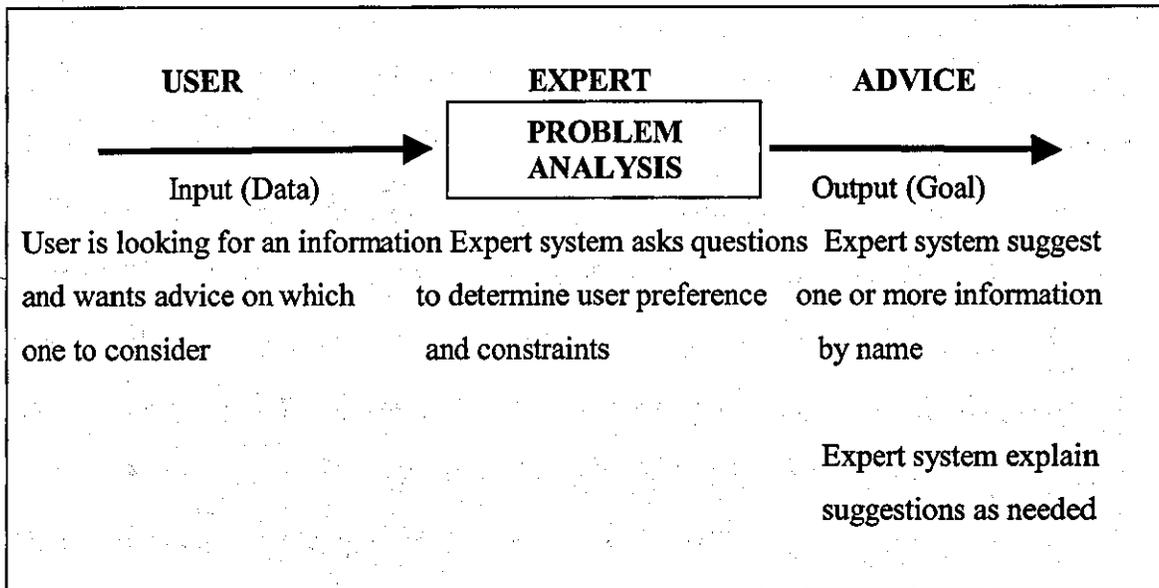
### Phase 1. Define the Problem

The expert system is developed to help users to select needed materials information. Users can access the system, which performs the task by asking users about their preferences and making recommendations. The system will need to automate the consultation process that a user would normally go through. It is necessary to observe the consulting between users and expert system and see that the consultation begins with the user indicating what is wanted. The system asks a number of questions about needs and resources and makes a recommendation.

The figure below summarises the analysis of the task.

Next it is necessary to look at the factors that the expert system considers when it determines what information might be desirable or undesirable. Assume the discussions with the expert system lead to five main characteristics:

1. Their field (materials science, materials engineering)
2. Their type (ceramics, polymers, metals, composites, semiconductors)
3. Their subjects/audiences (general, academic, commercial)



**Figure 5.2 A Process of Defining A Problem**

4. Their producers (universities, companies, professional organizations)

5. Possible users (students, professionals, engineers, business men)

A diagram can be created to show a material as an object with attributes and potential values.

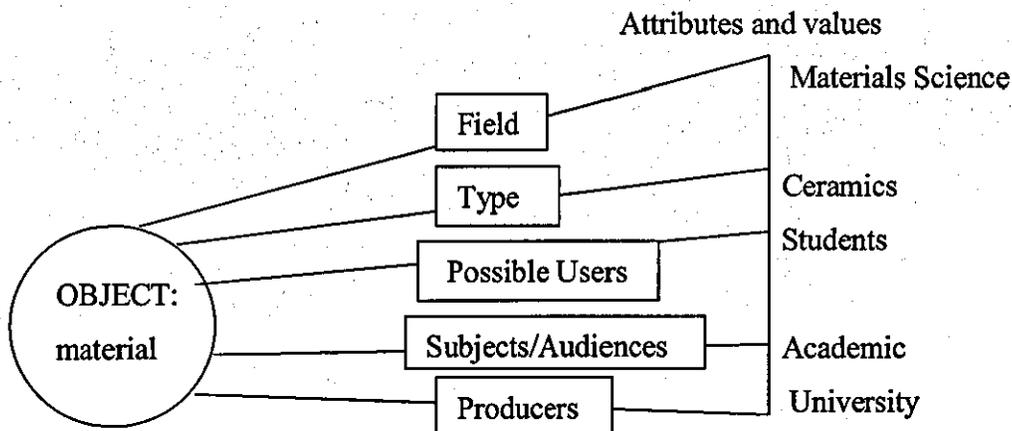


Figure 5.3 Factors of the Expert System

**Phase 2. Developing an Initial Set of Rules**

The first rule should apply directly to the goal.

**Rule 1:**

IF           Field = Materials Science AND  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = University AND  
              Possible Users = Students  
  
THEN        Recommendation = needed information

**Rule 2:**

IF           Subjects/Audiences = important  
  
THEN        Rule 3, Rule 4, Rule 5, Rule 6, Rule 7, Rule 8, Rule 9, Rule 10,  
              Rule 11, Rule 12, Rule 13

**Rule 3:**

IF           Field = Materials Science AND  
              Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Companies AND

Possible Users = Students

THEN Recommendation = needed information

**Rule 4:**

IF Field = Materials Science AND

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Companies AND

Possible Users = Professionals

THEN Recommendation = needed information

**Rule 5:**

IF Field = Materials Science AND

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = University AND

Possible Users = Professionals

THEN Recommendation = needed information

**Rule 6:**

IF Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = University AND

Possible Users = Business Men

THEN Recommendation = needed information

**Rule 7:**

IF Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = University AND

Possible Users = Engineers

THEN Recommendation = needed information

**Rule 8:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Students

THEN Recommendation = needed information

**Rule 9:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Professionals

THEN Recommendation = needed information

**Rule 10:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Engineers

THEN Recommendation = needed information

**Rule 11:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Business Men

THEN Recommendation = needed information

**Rule 12:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Companies AND  
              Possible Users = Engineers  
THEN        Recommendation = needed information

**Rule 13:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Companies AND  
              Possible Users = Business Men  
THEN        Recommendation = needed information

**Rule 14:**

IF           Producers = important  
THEN        Rule 14, Rule 15, Rule 16, Rule 17, Rule 18, Rule 19, Rule 20, Rule 21,  
              Rule 22, Rule 23, Rule 24

**Rule 14:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = University AND  
              Possible Users = Professionals  
THEN        Recommendation = needed information

**Rule 15:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = University AND  
              Possible Users = Engineers  
THEN        Recommendation = needed information

**Rule 16:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND  
                      Possible Users = Business Men  
  
THEN                Recommendation = needed information

**Rule 17:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Students  
  
THEN                Recommendation = needed information

**Rule 18:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Professionals  
  
THEN                Recommendation = needed information

**Rule 19:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Engineers  
  
THEN                Recommendation = needed information

**Rule 20:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND

Subjects/Audiences = Academic AND  
Producers = Companies AND  
Possible Users = Business Men  
THEN Recommendation = needed information

**Rule 21:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Students  
THEN Recommendation = needed information

**Rule 22:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Professionals  
THEN Recommendation = needed information

**Rule 23:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Engineers  
THEN Recommendation = needed information

**Rule 24:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Business Men

**THEN** Recommendation = needed information

**Rule 25:**

**IF** Possible Users = important

**Then** Rule 26, Rule 27, Rule 28, Rule 29, Rule 30, Rule 31, Rule 32, Rule 33

**Rule 26:**

**IF** Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Students

**THEN** Recommendation = needed information

**Rule 27:**

**IF** Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Companies AND  
Possible Users = Students

**THEN** Recommendation = needed information

**Rule 28:**

**IF** Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = Professional Organization AND  
Possible Users = Students

**THEN** Recommendation = needed information

**Rule 29:**

**IF** Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = University AND  
Possible Users = Students

THEN Recommendation = needed information

**Rule 30:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = Companies AND  
Possible Users = Students

THEN Recommendation = needed information

**Rule 31:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = Professional Organization AND  
Possible Users = Students

THEN Recommendation = needed information

**Rule 32:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = University AND  
Possible Users = Students

THEN Recommendation = needed information

**Rule 33:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = Companies AND  
Possible Users = Students

THEN Recommendation = needed information

It is necessary to have a goal-attribute and list the goal-attribute, RECOMMENDATION. It is also necessary create the knowledge base as a text processor. In this case, the goal is listed like: **Goal = Recommendation.**

The consultation with the system using these rules would appear as follows:

### **Information Consultation**

**What is the value of Field?**

Materials Science Materials Engineering

**What is the value of Type?**

Ceramics Polymers Composites Metals Semiconductors

**What is the value of Subjects/Audiences?**

Academic Commercial General

**What is the value of Producers?**

University Companies Professional Organizations

**What is the value of Possible Users?**

Students Professionals Business Men Engineers

### **Phase 3. Enhancing the Rules**

The rules cover only a limited number of parameters. In fact, users may have needs that have not been considered. It is necessary to have enough rules to cover all of the different features that are available to develop this expert system. There are several ways to enhance the rule base system. The first is to ensure that the system makes a recommendation, then add text for questions the system presents to the user. After that it is necessary to provide situations in which system can make more than one recommendation. After this, certain factors need to be added to express confidence in relationships expressed by the various rules. The abstraction can be added to improve the rules. Finally the rules need to be consolidated.

In the design of this expert system, it is possible to add a rule when the system fails to reach any recommendation

#### **Rule 34:**

IF recommendation = UNKNOWN  
THEN DISPLAY "Sorry, but no recommendation is available."  
Recommendation = Not Available.

It is also necessary to provide specific question texts to the system and thus make much more sense to the user. The questions in Phase 2 are too crude for end users. When everything is ready, it is possible to arrange for the system to ask friendlier questions and to tailor questions simply ask the text for each question the system might want to ask.

### **Information Consultation**

**Which Field of information do you need?**

Materials Science **Materials Engineering**

**What kind of information do you need?**

Ceramics **Polymers Composites Metals Semiconductors**

**What is Subjects/Audiences of the information?**

Academic **Commercial General**

**Where does the information come from?**

University **Companies Professional Organizations**

**Who will use the information?**

Students **Professionals Business Men Engineers**

In this system, it is necessary to define the goal as *multivalued*. This causes the inference engine to continue trying rules until they run out, no matter how many passed. When the system finishes, attribute RECOMMENDATION will have the names of all the appropriate pieces of information. To get this, it is possible to add **MULTIVALUED: recommendation** to the knowledge base. This would guarantee that the system would continue to seek values for RECOMMENDATION until it had exhaustively examined all the rules that concluded with a value for it.

In the current form, the rules all have equal weight. In other words, every recommendation is made with the same amount of certainty. When making the recommendation, it is necessary to do so with varying degrees of confidence. By using certainty factors, the confidence the expert has can be codified in each recommendation. The number 0 ~ 100 can be added to the conclusion of each rule to indicate the expert's certainty. The certainty can be used by users as a measure of the strength of the system's recommendation. With multiple recommendations, certainty factors help users decide which one is the best. So the rule base can be modified to include a certainty factor with each rule.

**Rule 1:**

IF                   Field = Materials Science AND  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND  
                      Possible Users = Students  
  
THEN                Recommendation = needed information (CF = 40)

**Rule 2:**

IF                   Subjects/Audiences = important  
  
THEN                Rule 3, Rule 4, Rule 5, Rule 6, Rule 7, Rule 8, Rule 9, Rule 10,  
                      Rule 11, Rule 12, Rule 13

**Rule 3:**

IF                   Field = Materials Science AND  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Students  
  
THEN                Recommendation = needed information (CF = 80)

**Rule 4:**

IF                   Field = Materials Science AND  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Professionals  
  
THEN                Recommendation = needed information (CF = 80)

**Rule 5:**

IF                   Field = Materials Science AND  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND

Possible Users = Professionals

THEN Recommendation = needed information (CF = 80)

**Rule 6:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = University AND  
Possible Users = Business Men

THEN Recommendation = needed information (CF = 80)

**Rule 7:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = University AND  
Possible Users = Engineers

THEN Recommendation = needed information (CF = 80)

**Rule 8:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 80)

**Rule 9:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organizations AND  
Possible Users = Professionals

THEN Recommendation = needed information (CF = 80)

**Rule 10:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Professional Organizations AND  
              Possible Users = Engineers  
THEN        Recommendation = needed information (CF = 80)

**Rule 11:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Professional Organizations AND  
              Possible Users = Business Men  
THEN        Recommendation = needed information (CF = 80)

**Rule 12:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Companies AND  
              Possible Users = Engineers  
THEN        Recommendation = needed information (CF = 80)

**Rule 13:**

IF           Field = Materials Science And  
              Type = Ceramics AND  
              Subjects/Audiences = Academic AND  
              Producers = Companies AND  
              Possible Users = Business Men  
THEN        Recommendation = needed information (CF = 80)

**Rule 14:**

IF           Producers = important  
THEN        Rule 14, Rule 15, Rule 16, Rule 17, Rule 18, Rule 19, Rule 20, Rule 21,  
              Rule 22, Rule 23, Rule 24

**Rule 14:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND  
                      Possible Users = Professionals

THEN                Recommendation = needed information (CF = 65)

**Rule 15:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND  
                      Possible Users = Engineers

THEN                Recommendation = needed information (CF = 65)

**Rule 16:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = University AND  
                      Possible Users = Business Men

THEN                Recommendation = needed information (CF = 65)

**Rule 17:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND  
                      Subjects/Audiences = Academic AND  
                      Producers = Companies AND  
                      Possible Users = Students

THEN                Recommendation = needed information (CF = 65)

**Rule 18:**

IF                   Field = Materials Science And  
                      Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Companies AND

Possible Users = Professionals

THEN

Recommendation = needed information (CF = 65)

**Rule 19:**

IF

Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Companies AND

Possible Users = Engineers

THEN

Recommendation = needed information (CF = 65)

**Rule 20:**

IF

Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Companies AND

Possible Users = Business Men

THEN

Recommendation = needed information (CF = 65)

**Rule 21:**

IF

Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Professional Organization AND

Possible Users = Students

THEN

Recommendation = needed information (CF = 65)

**Rule 22:**

IF

Field = Materials Science And

Type = Ceramics AND

Subjects/Audiences = Academic AND

Producers = Professional Organization AND

Possible Users = Professionals

THEN Recommendation = needed information (CF = 65)

**Rule 23:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Engineers

THEN Recommendation = needed information (CF = 65)

**Rule 24:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Business Men

THEN Recommendation = needed information (CF = 65)

**Rule 25:**

IF Possible Users = important

Then Rule 26, Rule 27, Rule 28, Rule 29, Rule 30, Rule 31, Rule 32, Rule 33

**Rule 26:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Professional Organization AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 27:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Academic AND  
Producers = Companies AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 28:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = Professional Organization AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 29:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = University AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 30:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = Commercial AND  
Producers = Companies AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 31:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = Professional Organization AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 32:**

IF Field = Materials Science And

Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = University AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 33:**

IF Field = Materials Science And  
Type = Ceramics AND  
Subjects/Audiences = General AND  
Producers = Companies AND  
Possible Users = Students

THEN Recommendation = needed information (CF = 95)

**Rule 34:**

IF recommendation = UNKNOWN

THEN DISPLAY " Sorry, but no recommendation is available."

Recommendation = Not\_Available.

**ASK type: "Which Field of information do you need?"**

**CHOICE type: Materials\_Science Materials Engineering**

**ASK type: "What kind of information do you need?"**

**CHOICE type: Ceramics\_ Polymers Composites Metals Semiconductors**

**ASK type: "What is Subjects/Audiences of the information?"**

**CHOICE type: Academic Commercial General**

**ASK type: "Where does the information come from?"**

**CHOICE type: University Companies Professional Organizations**

**ASK type: "Who will use the information?"**

**CHOICE type: Students Professionals Business Men Engineers**

**MULTIVALUED: recommendation**

In addition to adding questions and certainty factors, it is possible to add rules to introduce more abstraction into the knowledge base to improve the rules themselves. The way to add abstraction to the knowledge base is to look for the rules that the users would not understand. This is why rule 2, rule 14 and rule 25 have been added to find more accurate information.

In this system, many rules have been created. Most of these rules share a similar attribute structure. It is possible to consolidate them all into a single, general rule that can access a database table to get different sets of values. A rule that accesses a database to obtain sets of different values is often called a database rule. [71] The database rule can make the knowledge base much more efficient.

**Rule DB:**

```

IF           Field = [ ]And
            Type = [ ] AND
            Subjects/Audiences = [ ] AND
            Producers = [ ] AND
            Possible Users = [ ]
THEN        Recommendation = [ ]
    
```

**Database Records**

Field	Type	Subjects/Audiences	Producer	Possible Users	Recommendation
Materials Science	Ceramics	Academic	University	Students	Needed info1.
Materials Science	Ceramics	Academic	Company	Students	Needed info2.
Materials Science	Ceramics	Commercial	University	Students	Needed info3.

**Table 5.1 Database Records of Rules**

This database rule can be linked to a table of specific values in a database file. When the expert system is running and the database rule comes up for consideration, the system goes to the database file and retrieves each set of values, one after the other. Each set of values is plugged into empty spaces in the database rule, and the resulting rule is tested. It

passes or fails, and then the system goes on to the next set of values. This continues until all the sets in the database file have been tested.

The built-in backward chaining inference engine that is the heart of this expert system and usually the expert system building tool is sufficient for modest applications. The built-in inference engine works well enough to assure that it is not necessary to worry about changing it.

## **5.6 Integrating Expert Systems and Database**

The process of evaluating the role of database and creating a linkage can be achieved with three steps.

### **Step 1. Deciding on the role of the Database**

The current expert system could be used as a front end for the database, asking questions and then initiating a database query. The consultation with the expert system proceeds in the usual way, with the system asking the user questions and using rules to reach a final conclusion. But once the system reaches its conclusion, it then takes an extra step by going out to the database to find an even more specific recommendation to give. This approach is specially useful in systems where the set of actual recommendations changes frequently, while the set of the underlying logic remains intact.

Adding the expert system front end to the existing database can be especially useful whenever users have trouble making effective database queries. In effect, the expert system asks databases for information they can more readily provide, applies rules to analyze the information, and then generates the actual database query.

The consultation begins with the expert system, although the user usually does not know that an expert system is actually involved. The system asks questions and uses rules to analyze the user's needs and to determine the final form of the database request that will obtain the information the user wants from the database. Once the expert system determines the correct form of the database query, it passes the query to the database program that then executes the command and produces a response. The response could be a single data item, but more commonly the response will be a report of some kind.

### **Step 2. Preparing for Data Access**

It is unlikely that database data will be immediately useful to the rules in the system. In general, there are five areas, which need to be addressed when building the expert system

that will use the database; file access, file format, data type, data abstraction, and data integrity.

Database files are not always immediately accessible from the expert system, they are existing on the network and need to be moved to a PC. The expert system needs to access the database file over the network. External data, especially created by other applications, usually is not stored in a form directly readable by the expert system. Sometimes, it is necessary to write a conventional program to convert external data from a format that is unsupported by expert system to a format that can be read. The knowledge base then calls this program every time that the system needs to read in new data. Once the establishment of the links between the expert system and database and the information can be read in, various low-level transformations are needed to convert the data into the format and type that the knowledge base can use. It is unlikely that external data will be expressed in a way that can be used by the rules preparing to expert system. Typically, the expert system does not think in terms of the fields of the database records, it is necessary to translate the data into the higher levels of abstraction that the expert system can accommodate. This is always a problem when the database has been developed independently of the knowledge base. When the expert system accesses a database, the desired data is copied from the database file into a knowledge base structure. Occasionally, duplication of data can cause problems.

### **Step 3. Making the Connection**

There are two basic ways to establish a database connection: by including database commands in a rule, or by attaching database *sourcing* to an attribute.

In this project, database commands have been used to make the connection. The tool, which has been used to develop the expert system, can program the database connection directly into the rules. A number of commands can be included to read the database file in "the conclusions of rules". When a rule is passed, the database commands (in its conclusion) are executed, causing the database to be accessed.

When the rule fires, the database command is executed. It causes the database file name to be opened, and searches for a record that has a field with a related name equal to the variable in the rule. If such a record is found, then the value is loaded into the

knowledge base. Using a different command, expert system can get the entire record, but it can get only one record per call.

## **Chapter 6 Innovative Feature**

### **6.1 A New Model of Designing Distance Learning Programs**

The distance learning aspects of a materials database model presented in this thesis could be used as a basis for designing a wide range of database-learning systems. The model is adaptable and is possible, for instance, to change table contents, (and study areas) whilst maintaining the same logical scheme. It is also possible to achieve different objectives by changing learning materials and instructions. The database-driven format would provide more flexibility to designer to review, edit, and upgrade. Thus the model could be used to produce and re-produce learning materials to users of different levels. In addition, it is easy to add new materials in existing learning materials to follow new development and new technologies.

### **6.2 An Expert System**

The proliferation of databases has led to a growing demand for skills in navigating and manipulation of them. These skills are important not just in order to study and research in Higher Education, but as an important transferable skill likely to be expected of all graduates by industry and commerce. Online databases can be said to embody and require considerable expertise just by themselves. They contain substantial knowledge related to many fields. "Browsing", which has been used in a very restricted and precise manner by information scientists, is a very useful and effective way to find information. It also is used to describe all search activities that involve a level of imprecision about the desired outcome of the search. These search activities start to locate subject-specific material on the Web by means of search engines and subject-specific indices and gateways. Many search engines return results ranked according to the relevance of the site to the search topic. In contrast to Web indices, subject gateways contain information on the content and quality of the catalogued sites. A critical feature is that users refine their requirements over time as more information becomes available and set subgoals to satisfy them. Researchers have stressed the importance of "serendipity" and its effective exploitation in the browsing process. But it also seems that expertise is more useful.

When users are searching databases and they may decide that they are not making the progress they would like. In a physical library, they might go to a help desk and talk to a librarian. When surfing on the Internet, they may wish to communicate with an expert by

telephone or email. The expert calls up a representation of the users' searching history and composes suitable advice. This advice can be specific, general or remedial. It can help to solve the current task, explain a generic browsing technique or correct any apparent misconceptions. As part of the explanation, the expert passes on an annotated searching procedure, which the users can view and even use on their own terminals.

In present case it would seem appropriate to establish how to make that knowledge much more accessible, as if one were consulting an expert face to face. An expert system could be introduced, using small rule-based protocols. It could be developed to handle classification and selection problems and operate as a backward chaining system in which rules are used in order to determine appropriate values for the search goal. The rules could be grouped together in one set and then examine simultaneously. This approach would be best suited as a rule base to help a user find needed information.

### **6.3 Virtual Workshop**

The study and research of materials science and engineering covers many fields and often involves practising and developing laboratory techniques. By choosing distance learning, students have no opportunity to carry out these experiments. An understanding of these laboratory techniques has then to be deduced from texts and limited figures. But these cannot cover the full process of experimentation. A new web site is therefore proposed to attempt to mix video experimental representation with special electrical technologies and computing packages. The new web site is proposed to be a dynamic in nature. By accessing the virtual workshop, it is possible to follow a real experiments' process and get to know every detail. It can be used to teach users how to operate the experiment instruments, how to adjust experiment processes, how to test the working results, and so forth. It can also be a site to compare information in books and better understand theoretical examples.

"MS NetMeeting" could be used to transfer real-time video to students and who don't need to have video hardware. Students can get timetables of experiments and arrange their own virtual laboratory. The video and audio feature also allows students to ask questions during experiments. Technicians can pass their opinions to students simultaneously using the same software. The sources can be the pre-recorded videotapes, which can be re-played at the any time when students have questions.

#### **6.4 Direct Links**

A vast amount of Materials Science and Engineering databases already exists on the Web; therefore there is a great potential for using the database to support studies and researches. Subject-specific searches on the Web have become more and more popular in this area. Many search engines return results ranked according to the relevance of site to the search topic. The user needs to recover many sites to evaluate thoroughly before including them in the reference list. Therefore, it would be very useful to develop a site with structured links to other materials related sites. Even more useful would be materials databases linked together as a distance-learning package. It would enable users to make informed choices on the sites they visit and access required Web sites directly from the "Direct Links" at any time.

#### **6.5 The Routers**

There would be three routers in this model: Lecture Router, Tutorial Router and Lab Router. The router pages would have no HTML and would be used to record in the database that the student has been to the specific lecture, tutorial and lab. The pages redirect the student to the lecture, the tutorial and the experiment. They would keep trace of a student if he/she has attended a lecture, tutorial and lab. It would be important both to teacher and designer. Teachers could inspect and supervise students' studies, and know who are working hard and who not; hence teacher could know the reason causing some learners' failure. Furthermore, teacher could give special advices and warnings to those who seldom come to lecture, tutorial or lab and make them more active and working harder.

To designer, routers can give them feedback on which parts are popular, which not. Those, many students are working with or are like to work with, are desired designs; and those, with few students, are not. Designer would be aware of weakness and inadequacy of his design and what would be next step of his design.

#### **6.6 The Use of NetMeeting as a Tutorial System**

The tutorial system is supported by visual aids made available using MS NetMeeting to provide multi-point, shared applications. MS NetMeeting is a software tool for linking several Windows PCs in a conference session to enable communication and collaboration. Up to 32 participants in a 'NetMeeting' can join a common chat session

and share control of the built-in whiteboard. The tutor can deploy 31 students into one group with a timetable for the tutorial. The tutor and one student can speak to each other using the audio facility, and see each other if their machines have suitable video equipment. A very useful facility allows an application running on one of the machines in the tutorial to be 'shared' with all the others. This application can take up the whole screen, allowing the tutor to control the displays on all the other machines in the meeting. In 'collaborate' mode, control of this application can be passed to another participant at any remote site. The use of NetMeeting enables and enhances the communication between tutors and students over the Internet or local Intranet. Different style of tutorials can be accommodated to meet the requirements of all kinds of students. The tutorial system provides text, video, audio and other functions, which can solve the sorts of problems that would happen during the tutorials. On the other hand, NetMeeting has been shown to be a stable and effective platform for distributing multimedia material at a much higher resolution than is possible using the video signals common with most videoconferencing features.

#### **6.7 The Use of Question Mark as Online Assessment**

As mentioned earlier, the commercial software "Question Mark" can be used as an online assessment database. With the use of QM, it is possible to create tests, surveys, questionnaires, and assessments for use via the web or an Intranet. There are two Windows applications, Question Manager and Session Manager. Question Manager can be used to create questions and organise these within a hierarchical item bank. Session Manager can be used to construct tests and surveys around these questions. As questions and tests/surveys are created, they are saved within databases and published to the master server database. The QM server then accesses this database and serves out the tests and surveys to authorised individuals over the web or Intranet. The QM server also allows online security management and real-time analysis of respondents' answers to the surveys and tests.

## Chapter 7 Field Trial Web Site

### 7.1 Access - Easy of Use

The database proposed in this thesis has been designed for use by students and professionals worldwide. The design employs the Web pages as main carrier to accomplish communication between database and users. It is a relational database and data is kept in tables. These tables have similar style, and connect to each other using keys. This makes it an easy matter to establish a data-intensive Web site. The site processes many pages, designed to couple with the database. This can be a unified source of information. There is coherence with the form in which the information is offered, and in its quality, substance and usability. All of these are controlled by the database. Each page constitutes a specific source of information and gives users a straight view of the system. Links have to be made to pages. There is no need to key in a complicated syntax to access the database. Related items are "clicked" and users can access related pages to get the required information, see Figure 7.1.

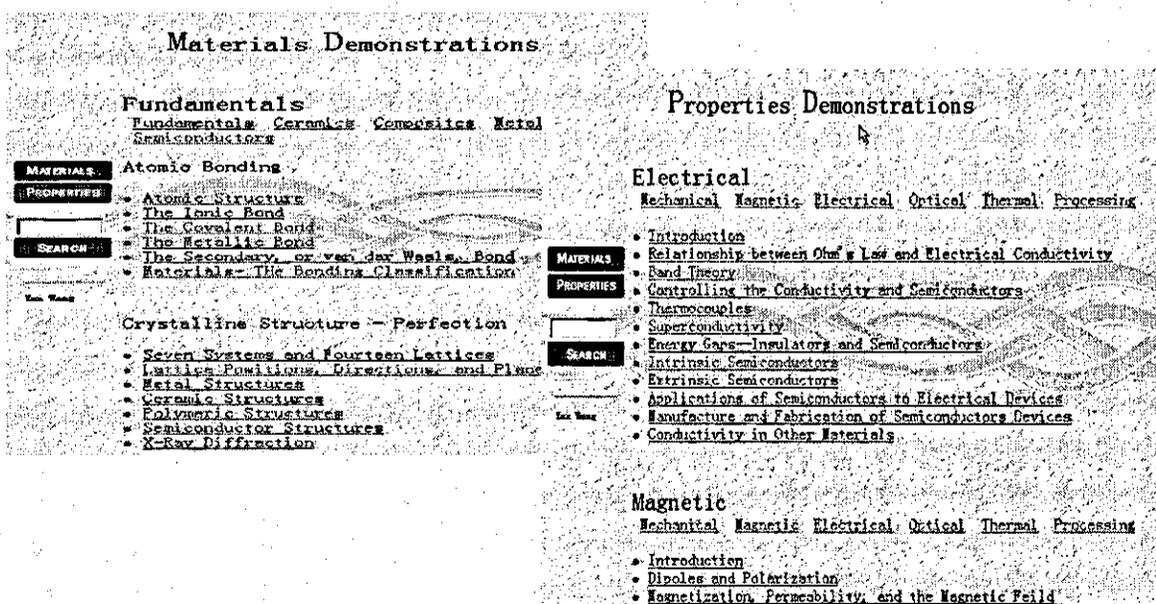


Figure 7.1 Demonstration

The data-intensive web pages can be published on Internet and it accessible 24 hours a day, and 7 days a week. It can handle database requests at any hour. Users can request

access to the database through its command line interface. Requests are handled in the sequence they come in and multiple requests can be handled at any one time.

The design of this new Web site has been predicated on a system dedicated to specific application needs and under the control of various co-ordinated subjects sharing the same design goals. The key feature of such a data-intensive Web site is the ability to deliver large amounts of information to a variety of users.

## 7.2 Access - Ease of Searching

One design feature of this data-intensive web site is the use of a CGI program. It is traditionally used to process online transactions and provide dynamic elements to static Web pages. With the working of PERL, CGI programs can exchange data with client Web browsers. The data exchange involves parsing text input and outputting formatted text (HTML code). The basic way CGI works is that the Web browser accepts input data from the HTML document in a similar way that searching engines operate. The browser encodes the data into text string, and passes this data string to the Web server, which in turn runs the CGI program. Users simply have to type in searching items in the correct place and "click" the related icon. The browser combines the input data into the query string to be passed to the server.

In this current data-intensive Web site, there are several choices of search protocol. Users can choose a desired searching method to get the needed information. Calling up "Help", figure 7.2, provides an introduction to search techniques.



Figure 7.2 Search Help

It is very easy to make a successful search using an appropriate key word to meet the searching requirement, figure 7.2. The CGI program and PERL program behind the Web site completes the process.

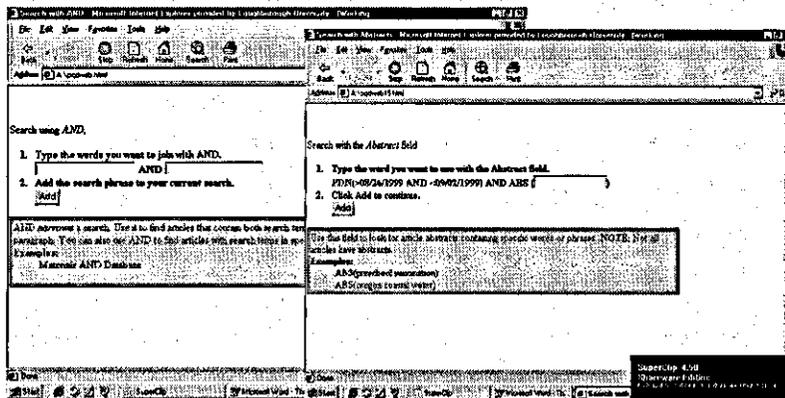


Figure 7.3 Search Field

### 7.3 Access - Ease of Assessment

Students access Perception Server via their web browser. After entering their correct access details, the entry can be gained and the server will display all sessions assigned to their account name. The students can execute a session by clicking on the symbol. When the session is run the student is presented with the first question block's questions. Once they have answered all of them the student only need to click the Submit button, then the answers will be saved to the Perception Server's database file. At the same time, the feedback text and/or score band branches are generated.

### 7.4 Expert System – Ease of Operation

The design of this database involves a variety of technological approaches. The expert system uses inference and emphasizes making explicit judgements. The system is used as a front end for the database, asking questions and then initiating a database query.

It is a small rule base system and is developed to handle classification and selection problems. Thus it is a backward chaining system in which rules are used in order to determine appropriate information for materials science and engineering studies and research. Because of the small rule base system, the AI techniques used in this design are fairly basic. Since the knowledge base is readable, maintenance and debugging is also much easier than a conventional programming language. The knowledge base is created

in a text processor and text is added for questions, which the expert system presents to the user. When the system starts, it finds the goal-attribute and then immediately backward chains to find the value of the attribute. The questions are automatically generated. It simply asks for the value (when it has exhausted its search for rules that can provide a needed value). In this expert system, a list of user-friendly questions is arranged. The question texts have been attached to an attribute, which means the questions are produced when the system needs to query the user for a value. The reserved word "ASK" is used to identify the attribute to be associated with the text. It also provides a list of choices that the user can respond to. This is done by using the reserved word "CHOICE", followed by the attribute and the possible value that the attribute could take. Because question text has been added, the consultation is very logical to the user.

The built-in backward chaining inference engine that is the heart of this expert system is sufficient for modest applications. It will look at rules during the consultation and solve the problem in a reasonably short time.

#### **7.5 Establish Limitations and Problems**

There are a number of limiting factors to be considered. Firstly the concept behind the establishment of this new database is to help solve problems which arise during distance learning. To make the database work well it is necessary to know how to control the demands of the database and the external relational database. It is also needed to know how to make the expert system work well with the database. One big limitation is the access to these databases. When preparing the access to a database, it is necessary to clear whether the database data is readable to a knowledge base. In general, there are five areas, which have to be addressed.

1. The expert system needs to be able to access the database over network to load the data into knowledge base.
2. The external data is created by different applications. They are stored in different forms and cannot be directly read by the expert system. Data type conversion is carried out by conventional programs.
3. The knowledge base then calls the program every time the system needs to read in new data.

4. Because the expert system and external database have been developed independently, it is unlikely that the external database will be expressed in a way that can be used by the rules in the knowledge base.
5. The expert system needs to translate the data into the form the expert system requires.

The above can potentially slow down the operation of expert system. If the database is modified immediately after the expert system accesses it, it could provide outdated information.

Secondly CGI programs have been used for accessing database within the Web. Because the use of such programs is relatively simple, it has some limitations. HTTP servers, system programs that offer their services to browsers via HTTP, operate the World Wide Web. HTTP consists of four phases: opening the connection, establishment of the connection, request and reply. But it is important to underline the fact that HTTP protocol has no memory. Thus, when a client issues several HTTP requests to the same server, the server is not able to maintain information about the operations already carried out on behalf of the same client and of their results.

The execution of a CGI program starts with "the request" and terminates with the return of "the results". It is necessary to have an operating system process that is created, carried out and terminated. This means that, at the time of creation, main memory space must be allocated for the process. Once initiated, the CGI program in turn requests a new connection with the DBMS; the session is then closed before the termination of the program. If there are many opening and closing sessions with DBMS, it can become overloaded.

Thirdly online assessments can be operated using "Question Mark". The new version of "Question Mark" involves a new feature, which can easily deliver questions via Internet or Intranet. To do this, the Perception Servers have to be involved in the Web site. Perception Servers are public servers that will work with all kinds of assessments (which have been edited by using Question Mark and which need the delivery of sessions and reporting). It is very easy for such servers to become overloaded. Hence, students may have to wait to access the Perception Servers in order to do the assessments.

Fourthly the use of "NetMeeting" as a tutorial tool can easily "group students up" and facilitate communication between them. At the moment, tutors only can do this with a limited number of students at a time. Old versions of "NetMeeting" only allow limited communication with each other. Limitations also occur when users are using different platforms. "NetMeeting" forces users to use Microsoft Windows. Students with Macintosh or Linux machines can't not plug in to the tutorial system at present.

## Chapter 8 Final Conclusions

1. Within the context of rapid technological change and shifting market conditions, the education system is challenged with providing increased educational opportunities without increased budgets. Many educational institutions are answering this challenge by developing distance-learning programs. In this field, a lot of progress has been made. The use of WWW for flexible learning is the most popular way. WWW and Web browsers have made the Internet a user-friendly environment. Many universities have their own professional groups working on distance learning via WWW. They are providing all kinds learning materials to all kinds of users. This is useful both for students (adding to what they have learnt in lectures) and also those who cannot attend universities and colleges because of other reasons. Students also can choose distance learning as a self-study mode and a commence Program at any time and from any location.
2. Increasingly good distance learning materials are being developed and put on to world web sites. Most work well and give users extended choice.
3. The integration of databases with distance learning programs can be an effective and practical way to promote study. They are one of the most exiting and useful IT applications for this purpose. Databases can be used to contain information on distance learning programs and courses, institutional teaching materials, abstracts of books, journal articles, research reports, conference papers, dissertations and other types of literature relating to all aspects of the theory and practice. They also offer links to worldwide searchable databases and basic support. There are numerous online mailing lists for teachers and database help lines.
4. Many universities and educational organizations are working in this area. They have developed databases which provide access to open and distance learning literature for planning, decision-making and learning, both for students and adults. They can encourage practitioners to become better informed about open and distance learning theory and its practice worldwide.
5. A review of educational web sites reveals that most them are working databases for learning programs. Some of these databases function as distance learning sites only in the broadest sense because their contents cover a wide range of

knowledge. Users can find almost anything on the World Wide Web, including learning materials. But they are not specific for distance learning. It takes time to access and re-access Web sites and collect related information. Typically in Materials Science, it is hard to find any specific database for distance learning. Thus the current work is fully justified.

6. The distance learning aspects of a materials database model presented in this thesis could be used as a basis for designing a wide range of database learning systems for a number of reasons.

Firstly, the model is adaptable. It is possible, for instance, to change table contents, (and study areas) whilst maintaining the same logical scheme. It is also possible to achieve different objectives by changing learning materials and instructions.

Secondly, the use of Web pages within the interface of the model provides user-friendly human-databased dialogue. The interface can be easily personalized by different designers without affecting the contents of databases.

Thirdly, the use of commercial software such as "Question Mark" allows designers to compile and deliver questions. Designers only need to think about content and type. It also allows fast and automatic feedback.

Fourthly, the inclusion in the model of "MS NetMeeting" facilities real-time communication between user and educator. Microsoft products have very wide PC market share. This means that the inclusion would be adaptable and suitable for most of users.

Fifthly, an expert system is proposed for development and integration into the model. This integration gives the model an allusion of human intelligence making it more user friendly.

Sixthly, the "Showcase" aspect allows users to acquire, assimilate and associate knowledge and ideas, by carrying out a number of case studies contained within it.

Seventhly, the model provides an opportunity for video experimentations and a "Virtual Laboratory", and a practical method of delivery.

Finally, the model highlights the need for adapting the environment to the learning needs of users in specific area of materials science and engineering. This adaptation is shown to be accomplishable using new IT technologies. These technologies will allow the instructional objective of the system to get close to the learning needs the user by adapting both contents and mode of delivery.

## **Appendix A: Table of 84 Materials Databases and Queries.**

Table1\_Lboro

14/11/2000

Title	URL	Hoder	Type of Activity	Subject/Audi	Info Public	Info Cou	Info Proj	Info Insti
Advanced Polymers Abstracts	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	technical information about the	General	Yes	No	Yes	No
Aluminium Industry Abstracts, UCL	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	coverage of the world's techni	Commercial	No	No	No	No
Aluminium Industry WWW Server	<a href="http://www.aluminium.net/">http://www.aluminium.net/</a>	Aluminium Industry	Aluminium Industry	Commercial	No	No	No	No
AMDIS	<a href="http://www-amdis.iaea.org">http://www-amdis.iaea.org</a>	International Atomic	stores and maintains recomm	Academic	Yes	No	Yes	No
Applied Science & Technology Abstracts	<a href="http://www.library.ualberta">http://www.library.ualberta</a>	University of Albert	acoustics, aeronautics and sp	General	Yes	No	Yes	Yes
Atomic and Plasma physics databases	<a href="http://plasma-gate.weizm">http://plasma-gate.weizm</a>	The Weizmann Inst	Databases for Atomic and Pla	Academic	Yes	No	Yes	Yes
Atomic Data for Astrophysics	Atomic Data for Astrophy	University of Kentuc	server provides links to basic	Academic	No	No	No	No
ATOMIC SPECTRA DATABASES	<a href="http://physics.nist.gov/Phy">http://physics.nist.gov/Phy</a>	NIST	This database contains criticall	Academic	No	No	No	No
Brad Hein's Nanotechnology Site	<a href="http://www.nanosite.net/re">http://www.nanosite.net/re</a>	Brad Hein	Nanotechnology	General	Yes	No	Yes	No
Cambridge Scientific Abstract	<a href="http://www.csa.com/">http://www.csa.com/</a>	Cambridge Scientifi	Mateirals databases	General	Yes	No	Yes	Yes
CAMPUS®, the Plastics Database	<a href="http://www.campusplastic">http://www.campusplastic</a>	CAMPUS	single-point data, multi-point d	Commercial	No	No	No	No
CebBASE/Materials on WWW	<a href="http://www.centor.com/">http://www.centor.com/</a>	CenTOR Corporati	Engineering material propertie	Commercial	No	No	No	No
CenBASE/Materials on WWW	<a href="http://www.centor.com/cb">http://www.centor.com/cb</a>	CenTOR Software	over 35,000 plastics, metals, c	Commercial	No	No	No	No
Ceramic Materials Database	<a href="http://art.sdsu.edu:591/m">http://art.sdsu.edu:591/m</a>	sdsu	Search for Ceramic Materials	General	No	No	No	No
CfA AMP Atomic and Molecular Databases	<a href="http://cfa-www.harvard.ed">http://cfa-www.harvard.ed</a>	Harvard-Smithsonia	Atomic and Molecular Databas	Academic	No	No	No	No
Chemdex	<a href="http://www.chemdex.org/">http://www.chemdex.org/</a>	Chemdex.org	a directory of chemistry resour	General	Yes	No	No	Yes
CIMC Materials Database	<a href="http://libweb.uncc.edu/cim">http://libweb.uncc.edu/cim</a>	Curriculum Material	indexes older materials which	General	No	No	No	No
Composite Materials - DTIC Database	<a href="http://composite.about.co">http://composite.about.co</a>	About.com	Business/Careers, Composite	Commercial	Yes	No	No	No
Composites Registry	<a href="http://www.compositesreg">http://www.compositesreg</a>	Durability, Inc	an easy method to locate man	General	Yes	No	No	Yes
Copper Data Center Database, UCL	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	bibliographic database of the	General	Yes	No	Yes	No
COREX Bibliography	<a href="http://xray.uu.se/hypertext">http://xray.uu.se/hypertext</a>	COREX	Core Edge Excitation Databas	Academic	Yes	No	No	No
Corrosion Abstracts, UCL	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	bibliographic information in the	General	Yes	No	Yes	No
CSA: Materials science collection	<a href="http://www.library.uq.edu">http://www.library.uq.edu</a>	Cambridge Scientifi	Engineering, Materials Scienc	Academic	Yes	No	No	No
DemoBase - Materials Science	<a href="http://ntwww.hcf.jhu.edu/">http://ntwww.hcf.jhu.edu/</a>	JHU	Hundreds of demonstrations a	General	No	No	No	No
Dept of Metals and Materials Engineering	<a href="http://www.mmat.ubc.ca/u">http://www.mmat.ubc.ca/u</a>	UBC	information on specific people,	Academic	Yes	No	Yes	No
Digitalfire Ceramic Materials Database	<a href="http://ceramicsearch.com/">http://ceramicsearch.com/</a>	Digitalfire Corporati	information on thousands of g	General	No	No	No	No
e-Ionization	<a href="http://physics.nist.gov/Phy">http://physics.nist.gov/Phy</a>	NIST	This is a database primarily of	Academic	No	No	No	No
Engineered Materials Abstracts	<a href="http://www.library.ualberta">http://www.library.ualberta</a>	University of Albert	covers the science and techno	General	Yes	No	Yes	Yes
Engineered Materials Abstracts, Ceramics	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	complete worldwide informatio	General	Yes	No	Yes	No
Engineered Materials Abstracts, UCL	<a href="http://norman.lib.uconn.edu">http://norman.lib.uconn.edu</a>	University of Conne	the research, manufacturing p	General	Yes	No	Yes	No
Engineering & Technology Databases	<a href="http://www.du.edu/~jokrau">http://www.du.edu/~jokrau</a>	Engineering & Tech	databases	General	Yes	No	No	Yes
ENGnetBASE	<a href="http://www.lib.mtu.edu/irv">http://www.lib.mtu.edu/irv</a>	ENGnetBASE	Engineering Database Online	Academic	No	No	No	No

Table1\_Lboro

14/11/2000

Title	URL	Hoder	Type of Activity	Subject/Audi	Info Public	Info Cou	Info Proj	Info Insti
GAPHYOR Database	<a href="http://gaphyor.lppg.u-psud">http://gaphyor.lppg.u-psud</a>	Centre de Données	A Database on the Properties	Academic	No	No	No	No
Instructional Materials Database for MST	<a href="http://www.pnl.gov/educat">http://www.pnl.gov/educat</a>	MST	Provide a primary site for peop	Academic	No	Yes	No	Yes
Interactive database of plastic	<a href="http://www.google.com/se">http://www.google.com/se</a>	polymerweb.com	hundreds of material suppliers	Commercial	No	No	No	No
InterCorr - Corrosion Material	<a href="http://www.corrosionsourc">http://www.corrosionsourc</a>	2000. Corrosionsou	designed to support the techni	Academic	Yes	Yes	Yes	Yes
Japanese Materials Science and Engineeri	<a href="http://www-japan.mit.edu/">http://www-japan.mit.edu/</a>	Massachusetts Insti	information related to Japanes	General	Yes	No	Yes	Yes
Materials Algorithms Project	<a href="http://www.msm.cam.ac.u">http://www.msm.cam.ac.u</a>	University of Cambr	serves as a centre for the "vali	Academic	Yes	Yes	Yes	Yes
Materials Business File	<a href="http://norman.lib.uconn.ed">http://norman.lib.uconn.ed</a>	University of Conne	focuses on industry news, inte	Commercial	No	No	No	No
MATERIALS DATA MODULE	<a href="http://www.granta.co.uk/pr">http://www.granta.co.uk/pr</a>	Cambridge Engine	contains data for 2760 engine	Academic	No	No	No	No
Materials Database	<a href="http://materials.npl.co.uk/">http://materials.npl.co.uk/</a>	The National Physic	Materials Database	General	No	No	No	No
Materials Database - Composite Materials	<a href="http://composite.about.co">http://composite.about.co</a>	about.com	composites materials	Commercial	No	No	No	No
Materials Education Library	<a href="http://msewww2.engin.um">http://msewww2.engin.um</a>	Univerisity of Michig	Materials Education Library	Academic	Yes	Yes	No	No
Materials Science (Numerous subfiles)	<a href="http://norman.lib.uconn.ed">http://norman.lib.uconn.ed</a>	University of Conne	Contains numerous subfiles; a	General	No	No	No	No
Materials Science Citation Index	<a href="http://www.isinet.com/pro">http://www.isinet.com/pro</a>	Institute for Scientifi	provides access to current bibl	General	Yes	No	No	No
Materials Sciences Databases	<a href="http://www.library.uq.edu">http://www.library.uq.edu</a>	The University of Q	Materials Science and Engine	General	Yes	Yes	Yes	Yes
MatWeb	<a href="http://www.matweb.com/">http://www.matweb.com/</a>	MatWeb	Online Materials Information R	Commercial	No	No	No	No
MatWeb Gains 100th Corporate Partner	<a href="http://www.matweb.com/p">http://www.matweb.com/p</a>	MatWeb	property data on Metals, Poly	General	No	No	No	No
MEMS Material Database	<a href="http://mems.isi.edu/mems">http://mems.isi.edu/mems</a>	MEMS Clearinghou	mechanical properties, electric	General	Yes	No	No	No
NIFS	<a href="http://amdata.nifs.ac.jp/">http://amdata.nifs.ac.jp/</a>	Data and planing ce	Numerical Databases for Ato	Academic	Yes	No	Yes	No
Particle-surface resources on the Web	<a href="http://chaos.fullerton.edu/">http://chaos.fullerton.edu/</a>	California State Uni	Web Sites	Academic	No	No	No	Yes
PartMaker's Materials Database	<a href="http://www.partmaker.co">http://www.partmaker.co</a>	PartMaker	stores materials data that is us	Commercial	No	No	No	No
Physical Sciences & Engineering Library	<a href="http://www.mclennan.libra">http://www.mclennan.libra</a>	McGill University	Electronic Databases	Academic	Yes	No	Yes	Yes
PLASPEC Materials Selection Database	<a href="http://www.library.upenn.e">http://www.library.upenn.e</a>	D&S Data Resourc	detailed engineering and desig	General	No	No	No	No
PLASPEC™ Materials Selection Database	<a href="http://library.dialog.com/bl">http://library.dialog.com/bl</a>	The Dialog Corpora	detailed engineering and desig	General	No	No	No	No
Polymer Chemistry Hypertext	<a href="http://www.umn.edu/~wif/">http://www.umn.edu/~wif/</a>	University of Misso	Polymer Chemistry Hypertext	Academic	No	No	No	No
Polymer Online	<a href="http://norman.lib.uconn.ed">http://norman.lib.uconn.ed</a>	University of Conne	Polymer Science and Enginee	Academic	No	No	Yes	No
Polymers and Composites	<a href="http://www.brinell.kth.se/p">http://www.brinell.kth.se/p</a>	Materials Sites	Materials Sites	General	No	No	No	No
PolySort	<a href="http://www.polysort.com/">http://www.polysort.com/</a>	PolySort	Plastics and Rubber Industry I	Commercial	No	No	No	No
R A P I D/CAST: Materials Database	<a href="http://www.ncemt.ctc.com">http://www.ncemt.ctc.com</a>	National Center for	The Materials Database modu	General	No	No	No	No
REMR Maintenance and Repair Materials	<a href="http://www.wes.army.mil/">http://www.wes.army.mil/</a>	Waterways Experi	identify products that may be a	Commercial	No	No	No	No
Smart Materials and Structures	<a href="http://www.usc.edu/isd/ele">http://www.usc.edu/isd/ele</a>	USC	this journal covers both basic	General	Yes	No	No	No
Table of Isotopes	<a href="http://isotopes.lbl.gov/isot">http://isotopes.lbl.gov/isot</a>	LBL	LBLN Isotopes Project	Academic	No	No	Yes	Yes
Technical Databases	<a href="http://www.vartm.com/dat">http://www.vartm.com/dat</a>	V System Composit	VSC has a wide breadth of co	Commercial	No	No	No	No

Table1\_Lboro

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Title	URL	Hoder	Type of Activity	Subject/Audi	Info_Public	Info_Cou	Info_Proj	Info_Insti
The Composite Corner	<a href="http://www.advmat.com/">http://www.advmat.com/</a>	THE COMPOSITE	Links to information about adv	General	Yes	No	No	Yes
The Copper Page	<a href="http://www.copper.org/">http://www.copper.org/</a>	International Coppe	information on copper and its	Commercial	Yes	No	No	No
The COREX Database	<a href="http://xray.uu.se/hypertext">http://xray.uu.se/hypertext</a>	COREX	Atomic and molecular core ed	Academic	No	No	No	No
The IRON Project	<a href="http://www.am.qub.ac.uk/">http://www.am.qub.ac.uk/</a>	The Queen's Unive	The Iron Project has the goal	Academic	Yes	No	Yes	Yes
The PLASPEC Materials Selection Databa	<a href="http://www.plaspec.com/">http://www.plaspec.com/</a>	Bill Communication	Materials selection database	General	No	No	No	No
The Semiconductor Subway	<a href="http://www-mtl.mit.edu/se">http://www-mtl.mit.edu/se</a>	MIT Microsystems	Links to all manner of semicon	Academic	Yes	Yes	Yes	Yes
The World's Source for Plastic Materials Inf	<a href="http://www.idesinc.com">http://www.idesinc.com</a>	IDES, Inc	plastic materials information or	Commercial	No	No	No	No
Thermal Protection Systems Expert and	<a href="http://asm.arc.nasa.gov/tp">http://asm.arc.nasa.gov/tp</a>	NASA Ames Resea	Thermal Protection Systems E	General	No	No	No	No
TOPbase	<a href="http://cdsweb.u-strasbg.fr/">http://cdsweb.u-strasbg.fr/</a>	Opacity Project	calculate the extensive atomic	Academic	No	No	No	No
Web Site for Instructional Materials Databa	<a href="http://depts.washington.e">http://depts.washington.e</a>	The University of W	Provide a primary site for peop	Academic	No	Yes	No	Yes
Web-Based Databases	<a href="http://www.library.cmu.ed">http://www.library.cmu.ed</a>	Science & Engineer	Web-based Databases	General	Yes	No	No	No
Weld Microstructure Development Modelin	<a href="http://engm01.ms.ornl.gov">http://engm01.ms.ornl.gov</a>	Oak Ridge National	Weld Microstructure Develop	Academic	No	No	No	No
Weldasearch - the materials joining databa	<a href="http://www.twi.co.uk/infser">http://www.twi.co.uk/infser</a>	Weldasearch Servi	apply a welding process, or de	Commercial	Yes	No	Yes	No
World Ceramic Abstract	<a href="http://www.csa.com/detail">http://www.csa.com/detail</a>	Cambridge Scientifi	a comprehensive database for	General	Yes	No	Yes	No
WWW links to Commercial sites	<a href="http://www.asm-intl.org/w">http://www.asm-intl.org/w</a>	ASM International,	Materials Commercial sites	General	Yes	No	Yes	Yes
WWW Virtual Library: Ceramics	<a href="http://www.ikts.fhg.de/vl/V">http://www.ikts.fhg.de/vl/V</a>	WWW Virtual Libra	Ceramics	General	Yes	Yes	Yes	Yes
XPS International	<a href="http://www.xpsdata.com/">http://www.xpsdata.com/</a>	XPS International, I	Digital XPS Database systems	Commercial	No	No	No	No
X-ray interactions with Matter page at LBL	<a href="http://www-cxro.lbl.gov/op">http://www-cxro.lbl.gov/op</a>	LBL	Database of atomic x-ray scatt	Academic	No	No	No	No
X-Ray WWW Server	<a href="http://xray.uu.se/">http://xray.uu.se/</a>	Uppsala University i	COREX bibliography and data	Academic	Yes	No	Yes	Yes
Yahoo's Materials Science site	<a href="http://dir.yahoo.com/scien">http://dir.yahoo.com/scien</a>	Yahoo	All aspects of materials scienc	General	Yes	Yes	Yes	Yes

Title	Subject/Audience	URL
Polymer Online	Academic	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/DatabasInfo.cfm?ID=816">http://norman.lib.uconn.edu/NewSpirit/Databases/DatabasInfo.cfm?ID=816</a>
Web Site for Instructional Materials Database	Academic	<a href="http://depts.washington.edu/mti/teaching_resources.html">http://depts.washington.edu/mti/teaching_resources.html</a>
Materials Algorithms Project	Academic	<a href="http://www.msm.cam.ac.uk/map/mapmain.html">http://www.msm.cam.ac.uk/map/mapmain.html</a>
COREX Bibliography	Academic	<a href="http://xray.uu.se/hypertext/corex.html">http://xray.uu.se/hypertext/corex.html</a>
AMDIS	Academic	<a href="http://www-amdis.iaea.org/databases.htm">http://www-amdis.iaea.org/databases.htm</a>
Atomic Data for Astrophysics	Academic	Atomic Data for Astrophysics
CfA AMP Atomic and Molecular Databases	Academic	<a href="http://cfa-www.harvard.edu/amdata/ampdata/ampdb.shtml">http://cfa-www.harvard.edu/amdata/ampdata/ampdb.shtml</a>
GAPHYOR Database	Academic	<a href="http://gaphyor.lpgp.u-psud.fr/">http://gaphyor.lpgp.u-psud.fr/</a>
NIFS	Academic	<a href="http://amdata.nifs.ac.jp/">http://amdata.nifs.ac.jp/</a>
ATOMIC SPECTRA DATABASES	Academic	<a href="http://physics.nist.gov/PhysRefData/ASD1/choice.html?nist_beta.html">http://physics.nist.gov/PhysRefData/ASD1/choice.html?nist_beta.html</a>
e-Ionization	Academic	<a href="http://physics.nist.gov/PhysRefData/Ionization/Xsection.html">http://physics.nist.gov/PhysRefData/Ionization/Xsection.html</a>
The IRON Project	Academic	<a href="http://www.am.qub.ac.uk/projects/iron/">http://www.am.qub.ac.uk/projects/iron/</a>
TOPbase	Academic	<a href="http://cdsweb.u-strasbg.fr/topbase.html">http://cdsweb.u-strasbg.fr/topbase.html</a>
Physical Sciences & Engineering Library	Academic	<a href="http://www.mclennan.library.mcgill.ca/psel/mining.htm">http://www.mclennan.library.mcgill.ca/psel/mining.htm</a>
CSA: Materials science collection	Academic	<a href="http://www.library.uq.edu.au/iad/journals/csascript.html">http://www.library.uq.edu.au/iad/journals/csascript.html</a>
InterCorr - Corrosion Material	Academic	<a href="http://www.corrosionsource.com/index.htm">http://www.corrosionsource.com/index.htm</a>
MATERIALS DATA MODULE	Academic	<a href="http://www.granta.co.uk/products.ces.components.datamodules.materials.html">http://www.granta.co.uk/products.ces.components.datamodules.materials.html</a>
Instructional Materials Database for MST	Academic	<a href="http://www.pnl.gov/education/mstdata.htm">http://www.pnl.gov/education/mstdata.htm</a>
Atomic and Plasma physics databases	Academic	<a href="http://plasma-gate.weizmann.ac.il/DBfAPP.html">http://plasma-gate.weizmann.ac.il/DBfAPP.html</a>
ENGnetBASE	Academic	<a href="http://www.lib.mtu.edu/jrvp/indexdata/moreinfo/ENGnetBASE">http://www.lib.mtu.edu/jrvp/indexdata/moreinfo/ENGnetBASE</a>
Particle-surface resources on the Web	Academic	<a href="http://chaos.fullerton.edu/mhslinks.html">http://chaos.fullerton.edu/mhslinks.html</a>
Table of Isotopes	Academic	<a href="http://isotopes.lbl.gov/isotopes/toi.html">http://isotopes.lbl.gov/isotopes/toi.html</a>
Weld Microstructure Development Modeling	Academic	<a href="http://engm01.ms.ornl.gov/">http://engm01.ms.ornl.gov/</a>
X-ray interactions with Matter page at LBL	Academic	<a href="http://www-cxro.lbl.gov/optical_constants/">http://www-cxro.lbl.gov/optical_constants/</a>
The Semiconductor Subway	Academic	<a href="http://www-mtl.mit.edu/semisubway.html">http://www-mtl.mit.edu/semisubway.html</a>
Dept of Metals and Materials Engineering	Academic	<a href="http://www.mmat.ubc.ca/units/mmat/default.asp">http://www.mmat.ubc.ca/units/mmat/default.asp</a>
Materials Education Library	Academic	<a href="http://msewww2.engin.umich.edu:591/menu.html">http://msewww2.engin.umich.edu:591/menu.html</a>
Polymer Chemistry Hypertext	Academic	<a href="http://www.umn.edu/~wlf/">http://www.umn.edu/~wlf/</a>
The COREX Database	Academic	<a href="http://xray.uu.se/hypertext/corexdb.html">http://xray.uu.se/hypertext/corexdb.html</a>
X-Ray WWW Server	Academic	<a href="http://xray.uu.se/">http://xray.uu.se/</a>

Title	Subject/Audience	Info Course	URL
Web Site for Instructional Materials Database	Academic	Yes	<a href="http://depts.washington.edu/mti/teaching_resources.html">http://depts.washington.edu/mti/teaching_resources.html</a>
Materials Algorithms Project	Academic	Yes	<a href="http://www.msm.cam.ac.uk/map/mapmain.html">http://www.msm.cam.ac.uk/map/mapmain.html</a>
InterCorr - Corrosion Material	Academic	Yes	<a href="http://www.corrosionsource.com/index.htm">http://www.corrosionsource.com/index.htm</a>
Instructional Materials Database for MST	Academic	Yes	<a href="http://www.pnl.gov/education/mstdata.htm">http://www.pnl.gov/education/mstdata.htm</a>
The Semiconductor Subway	Academic	Yes	<a href="http://www-mtl.mit.edu/semisubway.html">http://www-mtl.mit.edu/semisubway.html</a>
Materials Education Library	Academic	Yes	<a href="http://msewww2.engin.umich.edu:591/menu.html">http://msewww2.engin.umich.edu:591/menu.html</a>

Title	Subject/Audience	Info_Publication	Info_Course	Info_Project	Info_Institution
Materials Algorithms Project	Academic	Yes	Yes	Yes	Yes
InterCorr - Corrosion Material	Academic	Yes	Yes	Yes	Yes
The Semiconductor Subway	Academic	Yes	Yes	Yes	Yes

Title	Subject/Audience	URL
Advanced Polymers Abstracts	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=489">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=489</a>
Applied Science & Technology Abstracts	General	<a href="http://www.library.ualberta.ca/library_html/databases/asta/desc.html">http://www.library.ualberta.ca/library_html/databases/asta/desc.html</a>
Brad Hein's Nanotechnology Site	General	<a href="http://www.nanosite.net/resources/nanotechnology_resources.html">http://www.nanosite.net/resources/nanotechnology_resources.html</a>
Cambridge Scientific Abstract	General	<a href="http://www.csa.com/">http://www.csa.com/</a>
Ceramic Materials Database	General	<a href="http://art.sdsu.edu:591/materialbasearch.html">http://art.sdsu.edu:591/materialbasearch.html</a>
Chemdex	General	<a href="http://www.chemdex.org/">http://www.chemdex.org/</a>
CIMC Materials Database	General	<a href="http://libweb.uncc.edu/cimc/cimcdb.htm">http://libweb.uncc.edu/cimc/cimcdb.htm</a>
Composites Registry	General	<a href="http://www.compositesreg.com/">http://www.compositesreg.com/</a>
Copper Data Center Database, UCL	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=103">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=103</a>
Corrosion Abstracts, UCL	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=103">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=103</a>
DemoBase - Materials Science	General	<a href="http://ntwww.hcf.jhu.edu/matsci/">http://ntwww.hcf.jhu.edu/matsci/</a>
Digitalfire Ceramic Materials Database	General	<a href="http://ceramicsearch.com/material/">http://ceramicsearch.com/material/</a>
Engineered Materials Abstracts	General	<a href="http://www.library.ualberta.ca/library_html/databases/csaema.html">http://www.library.ualberta.ca/library_html/databases/csaema.html</a>
Engineered Materials Abstracts, Ceramics	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=648">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=648</a>
Engineered Materials Abstracts, UCL	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=647">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=647</a>
Engineering & Technology Databases	General	<a href="http://www.du.edu/~jokraus/NSME/tech-dbs.html">http://www.du.edu/~jokraus/NSME/tech-dbs.html</a>
Japanese Materials Science and Engineering Materials Database	General	<a href="http://www-japan.mit.edu/MatSciEng/">http://www-japan.mit.edu/MatSciEng/</a>
Materials Database	General	<a href="http://materials.npl.co.uk/NewIOP/MaterialDatabase.html">http://materials.npl.co.uk/NewIOP/MaterialDatabase.html</a>
Materials Science (Numerous subfiles)	General	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=759">http://norman.lib.uconn.edu/NewSpirit/Databases/Databaselnfo.cfm?ID=759</a>
Materials Science Citation Index	General	<a href="http://www.isinet.com/products/citation/citmsci.html">http://www.isinet.com/products/citation/citmsci.html</a>
Materials Sciences Databases	General	<a href="http://www.library.uq.edu.au/database/materialsdb.html">http://www.library.uq.edu.au/database/materialsdb.html</a>
MatWeb Gains 100th Corporate Partner	General	<a href="http://www.matweb.com/pr02.html">http://www.matweb.com/pr02.html</a>
MEMS Material Database	General	<a href="http://mems.isi.edu/mems/materials/">http://mems.isi.edu/mems/materials/</a>
PLASPEC Materials Selection Database	General	<a href="http://www.library.upenn.edu/dialog/fileinfo/dial321.html">http://www.library.upenn.edu/dialog/fileinfo/dial321.html</a>
PLASPEC™ Materials Selection Database	General	<a href="http://library.dialog.com/bluesheets/html/bl0321.html">http://library.dialog.com/bluesheets/html/bl0321.html</a>
Polymers and Composites	General	<a href="http://www.brinell.kth.se/part3.html">http://www.brinell.kth.se/part3.html</a>
R A P I D/CAST: Materials Database	General	<a href="http://www.ncemt.ctc.com/thrustAreas/casting/rapidCast/mat_db.html">http://www.ncemt.ctc.com/thrustAreas/casting/rapidCast/mat_db.html</a>
Smart Materials and Structures	General	<a href="http://www.usc.edu/isd/electresources/gateways/smart_materials.html">http://www.usc.edu/isd/electresources/gateways/smart_materials.html</a>
The Composite Corner	General	<a href="http://www.advmat.com/">http://www.advmat.com/</a>
The PLASPEC Materials Selection Database	General	<a href="http://www.plaspec.com/">http://www.plaspec.com/</a>
Thermal Protection Systems Expert and Web-Based Databases	General	<a href="http://asm.arc.nasa.gov/tps/tps-web.shtml">http://asm.arc.nasa.gov/tps/tps-web.shtml</a>
	General	<a href="http://www.library.cmu.edu/bySubject/Sciences/dbases.html">http://www.library.cmu.edu/bySubject/Sciences/dbases.html</a>

Title	Subject/Audience	URL
World Ceramic Abstract	General	<a href="http://www.csa.com/detailsV3/worldcer.html">http://www.csa.com/detailsV3/worldcer.html</a>
WWW links to Commercial sites	General	<a href="http://www.asm-intl.org/www-asm/othersit/commorgs.htm">http://www.asm-intl.org/www-asm/othersit/commorgs.htm</a>
WWW Virtual Library: Ceramics	General	<a href="http://www.ikts.fhg.de/vl/VL.ceramics.html">http://www.ikts.fhg.de/vl/VL.ceramics.html</a>
Yahoo's Materials Science site	General	<a href="http://dir.yahoo.com/science/engineering/material_science/">http://dir.yahoo.com/science/engineering/material_science/</a>

Title	Subject/Audience	Info Course	URL
Materials Sciences Databases	General	Yes	<a href="http://www.library.uq.edu.au/database/materialsdb.html">http://www.library.uq.edu.au/database/materialsdb.html</a>
Yahoo's Materials Science site	General	Yes	<a href="http://dir.yahoo.com/science/engineering/material_science/">http://dir.yahoo.com/science/engineering/material_science/</a>
WWW Virtual Library: Ceramics	General	Yes	<a href="http://www.ikts.fhg.de/VI/VL.ceramics.html">http://www.ikts.fhg.de/VI/VL.ceramics.html</a>

Title	Subject/Audience	Info_Course	Info_Publication	Info_Project	Info_Institution
Materials Sciences Databases	General	Yes	Yes	Yes	Yes
Yahoo's Materials Science site	General	Yes	Yes	Yes	Yes
WWW Virtual Library: Ceramics	General	Yes	Yes	Yes	Yes

Title	Subject/Audience	URL
Materials Business File	Commercial	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/DatabaseInfo.cfm?ID=758">http://norman.lib.uconn.edu/NewSpirit/Databases/DatabaseInfo.cfm?ID=758</a>
Weldasearch - the materials joining database	Commercial	<a href="http://www.twi.co.uk/infserv/weldas.html">http://www.twi.co.uk/infserv/weldas.html</a>
CenBASE/Materials on WWW	Commercial	<a href="http://www.centor.com/cbmat/">http://www.centor.com/cbmat/</a>
Aluminium Industry Abstracts, UCL	Commercial	<a href="http://norman.lib.uconn.edu/NewSpirit/Databases/DatabaseInfo.cfm?ID=505">http://norman.lib.uconn.edu/NewSpirit/Databases/DatabaseInfo.cfm?ID=505</a>
CAMPUS®, the Plastics Database	Commercial	<a href="http://www.campusplastics.com/">http://www.campusplastics.com/</a>
PartMaker's Materials Database	Commercial	<a href="http://www.partmaker.com/material.htm">http://www.partmaker.com/material.htm</a>
The World's Source for Plastic Materials Info	Commercial	<a href="http://www.idesinc.com">http://www.idesinc.com</a>
REMR Maintenance and Repair Materials	Commercial	<a href="http://www.wes.army.mil/REMR/repair/rprmatl_db.html">http://www.wes.army.mil/REMR/repair/rprmatl_db.html</a>
Materials Database - Composite Materials	Commercial	<a href="http://composite.about.com/business/composite/library/blmatweb.htm">http://composite.about.com/business/composite/library/blmatweb.htm</a>
Composite Materials - DTIC Database	Commercial	<a href="http://composite.about.com/industry/composite/library/weekly/aa110397.htm?once">http://composite.about.com/industry/composite/library/weekly/aa110397.htm?once</a>
Interactive database of plastic	Commercial	<a href="http://www.google.com/search?q=materials+database&amp;start=320&amp;sa=N">http://www.google.com/search?q=materials+database&amp;start=320&amp;sa=N</a>
Technical Databases	Commercial	<a href="http://www.vartm.com/database.html">http://www.vartm.com/database.html</a>
Aluminium Industry WWW Server	Commercial	<a href="http://www.aluminium.net/smelters/e_europe.html">http://www.aluminium.net/smelters/e_europe.html</a>
The Copper Page	Commercial	<a href="http://www.copper.org/">http://www.copper.org/</a>
MatWeb	Commercial	<a href="http://www.matweb.com/">http://www.matweb.com/</a>
PolySort	Commercial	<a href="http://www.polysort.com/">http://www.polysort.com/</a>
XPS International	Commercial	<a href="http://www.xpsdata.com/">http://www.xpsdata.com/</a>
CebBASE/Materials on WWW	Commercial	<a href="http://www.centor.com/">http://www.centor.com/</a>

Title	Subject/Audience	Info_Publication	Info_Course	Info_Project	Info_Institution
Materials Business File	Commercial	No	No	No	No
CenBASE/Materials on WWW	Commercial	No	No	No	No
Aluminium Industry Abstracts, UCL	Commercial	No	No	No	No
CAMPUS®, the Plastics Database	Commercial	No	No	No	No
PartMaker's Materials Database	Commercial	No	No	No	No
The World's Source for Plastic Materials Info	Commercial	No	No	No	No
REMR Maintenance and Repair Materials	Commercial	No	No	No	No
Materials Database - Composite Materials	Commercial	No	No	No	No
Interactive database of plastic	Commercial	No	No	No	No
Technical Databases	Commercial	No	No	No	No
Aluminium Industry WWW Server	Commercial	No	No	No	No
MatWeb	Commercial	No	No	No	No
PolySort	Commercial	No	No	No	No
XPS International	Commercial	No	No	No	No
CebBASE/Materials on WWW	Commercial	No	No	No	No

## **Appendix B: Simple Questions**

# WangYanSample

Monday, November 13, 2000 17:01

---

Block 1, 20 question(s), maximum score 100

Question block

Welcome to my online assessment!

---

1 of 20



Which industry is associated with Port Talbot?

- a. steel
- b. aluminium
- c. tin
- d. copper

---

IF choice a. is selected

Set score to 5

Correct!

---

2 of 20



Which of the following is NOT commercially viable for energy storage?

- a. fermented methanol
- b. geothermal rocks
- c. tidal barrage
- d. nichel-cadmium batteries

---

IF choice b. is selected

Set score to 5

---

3 of 20



In the sequence Li Na K, which is next?

- a. Ca
- b. Ba
- c. Sr
- d. Rb

---

IF choice d. is selected

Set score to 5

Correct!

---

4 of 20



Which of the following is irreversibly processed?

- a. moulded fireclay
- b. polyethylene bottles
- c. vulcanized rubber tyres
- d. extruded aluminium

---

IF choice c. is selected

Set score to 5

Correct!

---

5 of 20



Quartz is a mineral of?

- a. Si
- b. Ca

- c. Cr
- d. Al

---

IF choice a. is selected  
Set score to 5

Correct!

---

6 of 20



In energy conversion where does the greatest inefficiency lie?

- a. combustion of coal to fuel ash
- b. conversion of steam to mechanical energy of rotation
- c. conversion of coal to steam
- d. conversion of mechanical energy to electrical energy

---

IF choice a. is selected  
Set score to 5

Correct!

---

7 of 20



Kaolinite is commonlu called?

- a. limestone
- b. clay
- c. sand
- d. gravel

---

IF choice b. is selected  
Set score to 5

Correct!

---

8 of 20



Hematite is a mineral of?

- a. Co
- b. Ni
- c. Pb
- d. Fe

---

IF choice d. is selected  
Set score to 5

---

9 of 20



Galena is a mineral of?

- a. Pb
- b. Mo
- c. Sn
- d. Mn

---

IF choice a. is selected  
Set score to 5

Correct!

---

10 of 20



Bauxite is a mineral of?

- a. Al
- b. Sn

- c. Sn
- d. Mo

---

IF choice b. is selected  
Set score to 5

Correct!

---

11 of 20



Which is NOT an halogen?

- a. F
- b. Br
- c. He
- d. Cl

---

IF choice c. is selected  
Set score to 5

Correct!

---

12 of 20



Which of the following is NOT commercially viable for energy storage?

- a. fermented methanol
- b. nichel-cadmium batteries
- c. geothermal rocks
- d. tidal barrage

---

IF choice c. is selected  
Set score to 5

---

13 of 20



Kaolinite is commonly called?

- a. clay
- b. sand
- c. gravel
- d. limestone

---

IF choice a. is selected

Set score to 5

Correct!

---

14 of 20



Quartz is a mineral of?

- a. Cr
- b. Ca
- c. Al
- d. Si

---

IF choice d. is selected

Set score to 5

Correct!

---

15 of 20



Bauxite is a mineral of?

- a. Sn
- b. Si

- c. copper
- d. aluminium

---

IF choice d. is selected  
Set score to 5

Correct!

---

16 of 20



Which is NOT an halogen?

- a. F
- b. Cl
- c. Br
- d. He

---

IF choice d. is selected  
Set score to 5

Correct!

---

17 of 20



North sea gas is composed mainly of?

- a. ethane
- b. methane
- c. butane
- d. propane

---

IF choice b. is selected  
Set score to 5

Correct!

---

18 of 20



Kaolinite is commonly called?

- a. clay
- b. gravel
- c. sand
- d. limestone

---

IF choice a. is selected  
Set score to 5

Correct!

---

19 of 20



Bauxite is a mineral of?

- a. Al
- b. Sn
- c. Fe
- d. Si

---

IF choice a. is selected  
Set score to 5

Correct!

---

20 of 20



Hematite is a mineral of?

- a. Pb
- b. Co

- c. As
- d. Bi

---

IF choice a. is selected  
Set score to 5

Correct!

---

Score band 1  
0% to 59%  
Sorry, you have failed!

---

Score band 2  
60% to 100%  
Congradulation, you have passed!

---

## Standard Bibliography

Askeland, Donald R. (1996)

The Science and Engineering of Materials. Third S.I. Edition - London: Chapman & Hall. ISBN: 0412539101.

Adiba, Michel and Lopez, Mauricio (1987)

Data Bases for Office Automation, in Databases edited by J. Paradaens - London: Academic, 1987 - (International lecture series in computer science). Page 1. ISBN: 0125449623.

Alessi, Stephen M. and Trollip, Stanlery R. (1991)

Computer-Based Instruction: Methods and Development. Second Edition - N.J.: Englewood Cliffs; London: Prentice-Hall. Page 17-90. ISBN: 0131641611.

Atzeni, Paolo, Ceri, Stefano, Parboschi, Stefano and Torlone, Riccardo (1999)

Database Systems: Concepts, Languages and Architectures. The McGraw- Hill Companies. ISBN: 0077095006.

Baumeister, Hans-Peter (1999)

Western Europe, in Higher Education Through Open and Distance Learning— World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 244-255. ISBN: 0415197910.

Bharath, Ramachandran (1989)

Prolog: Sophisticated Applications in Artificial Intelligence. Northern Michigan University. Blue Ridge Summit, PA: Tab Books. ISBN: 0830693920.

Bivens, Herbert L. (1997)

Distance Learning Futures, Distance Learning Practice Leader NCR Worldwide Services Organization, available:<http://www.lucent.com/cedl/icdeenv2.html>.

Borghuis, Marthyn, Brinckman, Hans, Fischer, Albert, Hunter, Karen, Loo, Eleonore van der, Mors, Rob ter, Mostert, Paul, Zijlstra, Jaco (1996)

University Licensing Program (TULIP) - Final Report. New York: Elsevier Science. Page 12. ISBN: 0444825401.

Bowen, Kenneth A. (1991)

Prolog and Expert Systems: Applied Logic System. McGraw-Hill, Inc. ISBN: 0070067317.

Brailsford, T. J., Davies, P. M. C., Scarborough, S. C. and Trehwella, W. J. (1997)

Knowledge Tree: Putting Discourse into Computer-based Learning. Department of Life Science, University of Nottingham, ALT-J (1997) 5(1) 19-26.

Brandon, Ed (1999)

The University of the West Indies, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry, First published 1999 by Routledge. Page 125-136. ISBN: 0415197910.

Brindle, Geoff and Mitchell, William, Seal, Len and Bohme, Karl (1995)

A Virtual Laboratory System for Physiology Teaching. Department of Computing, and Department of Biological Sciences, Manchester Metropolitan University, ALT-J (1995) 3(1) 53-56.

Brown, Carol E. and O'Leary, Daniel E. (1993)

Introduction to Artificial Intelligence and Expert Systems, available: [http://www.bus.orst.edu/faculty/brownc/es\\_tutor/es\\_tutor.htm](http://www.bus.orst.edu/faculty/brownc/es_tutor/es_tutor.htm).

Brown, Sally and Smith, Brenda (1996)

Introducing Resources for Learning, in Resource-Based Learning, edited by Sally Brown and Brenda Smith, published in association with the Staff and Educational Development Association. Page 1-9. ISBN: 0749419326.

Bruning, Roger (1995)

Examining the Utility of Efficacy Measures in Distance Education Research, in Distance Education Symposium 3: Learners and Learning, edited by Chere Campbell Gibson. ACSDE (American Center for the Study of Distance Education) Research Monograph, number 13. The Pennsylvania State University. Page 17-29. ISBN: 1877780162.

Bull, Joanna

Active Learning 1: Computer Based Assessment: Some Issues for Consideration, available: <http://www.cti.as.uk/publ/actlea/issue1/bull/>.

Burge, E. (1993)

Adult Distance Learning: Challenges for Contemporary Practice, The Craft of Teaching Adult, in Thelma Barer-Stein and James A. Draper (Eds.). Toronto, Ontario: Culture Concepts (ED362 644). Page 215-230.

Busby, J. S. and Payne, K. H. (1999)

A Behavioral Training System for Planning Judgment. International Ecotechnology Research Center, Cranfield University. Journal of Computer Assisted Learning (1999) 15(1) 61-72.

Callear, David & King, Terry (1996)

Using Computer-Based Tests for Information Science, ALT-J 5(1), 27-32.

Chacon, Fabio (1999)

Distance Education in Latin America: Growth and Maturity, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 138-149. ISBN: 0415197910.

Cheng, Shun, Raab, Mandy M. and Belkowski, Brian

Expert System, Introduction of Expert System and Application of Expert System, available: [http://www.sis.pitt.edu/~raab/exp\\_int.html](http://www.sis.pitt.edu/~raab/exp_int.html).

Cook, Kathryn (1999)

Learner Control in CMS—Garrison & Baynton's Distance Learning Model, available: <http://fcis.oise.utoronto.ca/~kcook/framework.html>.

Cresswell, James E. (1998)

Back to the Future: Team-Centred, Resource-Based Learning as the Antecedent of Computer-Based Learning. Department of Biological Sciences, University of Exeter. ALT-J (1998) 6(1) 64-69.

Day, A. J. and Suri, A. K. (1999)

A Knowledge-Based System for Postgraduate Engineering Courses. University of Bradford. Journal of Computer Assisted Learning (1999) 15 (1), 14-27.

Desai, Bipin S (1990)

An Introduction to Database Systems. West Publishing Company. Page 2. ISBN: 0314667717.

Dodds, Tony, Nonyongo, Evelyn and Glennie, Jenny (1999)

Cooperation Competition or Dominance: a Challenge in Southern Africa, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 95-109. ISBN: 0415197910.

Duncan, Charles, Morrey, Martin, Bayne, Gwen Bayne, Maclaren, Lain, Walder, Patrick and McQuillan, John (1998)

Shared Teaching with Multimedia-Enhanced Videoconferencing, ALT-J 6(3) 4-15.

Elmasri, Ramez and Navathen, Shamkant B. (2000)

Fundamentals of Database Systems. Third International Edition - World Student Series. Reading, Mass.; Harlow: Addison-Wesley. Page 4, 195. ISBN: 0201542633.

Feldman, Boris (2000)

What are Active Server Pages (ASP), available: <http://www.asp-zone.com/aspfaq.asp>.

Ferraro, Roger

Distance Learning Resource. Computer Services Dept. at CCTC, available: <http://webster.commnet.edu/roger/home.htm>.

Fraser, Brian (1993)

Distance Learning Course for Teachers of Visually Impaired Children. Unit 3 (Aspects of handicap) /prepared for the Course Team by Brian Fraser /edited by Heather Mason. Birmingham: School of Education, University of Birmingham. ISBN: 0704412845.

Gibbs, Graham (1996)

Institutional Strategies for Implementing Resource-Based Learning, in Resource-Based Learning, edited by Sally Brown and Brenda Smith, published in association with the Staff and Educational Development Association. Page 10-21. ISBN: 0749419326.

Gonzales, Patricia (1995)

An Examination of Teaching and Learning Processes in Distance Education and Implications for Designing Instruction, Distance Education Symposium 3: Instruction, Edited by Michael F. Beaudoin. ACSDE Research Monograph, number 12. The Pennsylvania State University. Page 40-50. ISBN: 1877780154.

Gray, P. M. D. and Lucas, R. J. (1988)

Prolog and Database: Implementations and New Directions. Department Computing Science, University of Aberdeen. Chichester: Ellis Horwood Limited. ISBN: 0745803717.

Griffin, Eoin (1995)

Making Expert Systems Work: Success and Failure in the Expert System World. IT Center, UCG, available: <http://it-hal.ucg.ie/EGrif.htm>.

Groat, Anne and Musson, Tim (1995)

Learning Styles: Individualizing Computer-Based Learning Environments. Napier University, ALT-J (1995) 3(2) 53-62.

Hancox, Peter J, Mills, William J and Reid, Bruce J (1990)

Keyguide to Information Sources in Artificial Intelligence/Expert Systems. London: Mansell. ISBN: 0720120071.

Harmon, Paul (1990)

Creating Expert Systems For Business and Industry. John Wiley & Son, Inc. 1990. ISBN: 0471614955.

Harold, Elliotte Rusty (1997)

What is Java, available: <http://metalab.unc.edu/javafaq/course/week1/07.html>.

Harry, Keith (1999)

Asia, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 162-163. ISBN: 0415197910.

Harry, Keith (1999)

Higher Education Through Open and Distance Learning--World Review of Distance Education and Open Learning, Volume 1., edited by Keith Harry. First

published 1999, by Routledge. Page 93-94, 123-124, 162-163, 225-226, 262-263. ISBN: 0415197910.

Hawkrigde, Davis (1998)

Cost-Effective Support for University Students Learning via the Web? ALT-J 6(3) 24-29.

Hosie, P. and Mazzard, T. (1999)

Using Technology for the Competitive Delivery of Education Services. The University of Western Australia and Curtin University of Technology. Perth. Journal of Computer Assisted Learning (1999) 15(2) 118-128.

Jacobson, Eric, Gundy, G. Craig and Willden, Jeffrey D. (1997)

WebTester: Computer-Based Assessment via the WWW. Weber State University. <http://star.ucc.nau.edu/~nauweb97/papers/webtester/default.html>.

Joy, Mike (1998)

Computer-Based Submission and Assessment in BOSS, Vol. 2 No. 3 – Issue contents, Computer Science, University of Warwick, available: <http://www.warwick.ac.uk/ETS/interactions/vol2no3/joy-luck.html>.

Keegan, Desmond (1990)

Foundations of Distance Learning Education. Second Edition - London: Routledge. ISBN: 0415031621.

Keenan, Ben

Expert Systems, available: <http://www.cs.cf.ac.uk/User/B.T.Keenan/project/>.

King, Bruce (1999)

Distance Education in Australia, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning:

Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 264-276. ISBN: 0415197910.

Kirkwood, Adrian, Jones, Ann and Jelfs, Anne (1996)

Changing the Role of Tutors in Distance Education with Information and Communication Technologies. Institute of Educational Technology. The Open University. ALT-J (1996) 4(1) 35-39.

Knight, Mike and Brown, Andy

What is Computer-Based Assessment. School of Architecture and Building Engineering, University of Liverpool, available:

<http://ctiweb.cf.ac.uk/HABITAT/HABITA4/compass.html>.

Mcmillan, Michael (1998)

Perl from the Group up Covers: Perl for UNIX, Windows 95 & Windows NT Environments, Windows NT System Magazine's "Inside the bos" Columnist. The McGraw-Hill Companies. ISBN: 0078824044.

Meek, Julia, Garnett, Marie and Grattan, John (1998)

Evaluation the Impact of Internet Provision on Students, Information-Gathering Strategies. School of Mathematics, University of Birmingham; Staff Development Office, University of Wales Aberystwyth; Institute of Geography and Earth Sciences, University of Wales Aberystwyth. ALT-J (1998) 6(1) 57-63.

Minoli, Daniel (1996)

Distance Learning Technology and Applications. Teleport Communications Group, Stevens Institute of Technology. London: Artech House. ISBN: 0890067392.

Mmari, Geoffrey (1999)

The Open University of Tanzania, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning:

Volume 1., edited by Keith Harry, First published 1999 by Routledge. Page 110-122. ISBN: 0415197910.

Moore, Michael G. and Thompson, Melody M. (1997)

The Effects of Distance Learning—Revised Ed, ACSDE (American Centre for the Study of Distance Education) Research Monograph, Number 15. The Pennsylvania State University. Page 1-7. ISBN: 1-877780189.

Murphy, Karen L. (1995)

Designing Online Coursework Mindfully. Distance Education Symposium 3: Course Design, Edited by Ellen D. Wagner and Margaret A. Koble. ACSDE (American Centre for the Study of Distance Education) Research Monograph, Number 14. The Pennsylvania State University. Page 58-73. ISBN: 1877780170.

Nicholson, Brain (1998)

A Case Study of Campus-Based Flexible Learning: Using the World Wide Web and Computer Conferencing. Information Technology Unit, University of Salford. ALT-J (1998) 6(3) 38-46.

O'Brien, Bart (1994)

Database Decisions: Briefings on the Management of Technology. London: Pitman Publishing. ISBN: 0273602896.

Orfali, Robert, Harkey, Dan and Edwards, Jeri (1999)

Client/Server Survival Guide. Third Edition - New York; Chichester: Wiley. ISBN: 0471316156.

Peraya, Daniel (1993)

Distance Education and the WWW. TECFA, Faculté de Psychologie et des Sciences de l'Education, Université de Genève, available:

<http://tecfa.unige.ch/edu-comp/edu-ws94/contrib/peraya.fm.html>.

Percival, Fred and Ellington, Henry (1981)

Distance Learning and Evaluation / Edited for the Association for Educational and Training Technology. London; New York: Kogan: Nichols Publishing Co. Page 1-5. ISBN: 085038494x.

Phillips, Gervase (1995)

Dissertations and Databases: the Historian as Software Engineer. ALT-J 3 (2), 48-52.

Pilipenko, Oleg P and Komissarova, Kelena (1995)

Approacher to Knowledge-Transfer Systems. Odessa State University, Ukraine and Kiev Institute of Psychology, Ukraine, ALT-J (1995) 3(2) 42-47.

Pillay, Hitendra and Raj, Leonard and Boles, Wageeh (1998)

Personalizing the Design of Computer-Based Instruction to Enhance Learning. Centre of Cognitive Process in Learning; School of Electrical and Electronic Systems Engineering, Queensland University of Technology, Australia. ALT-J (1998) 6(2) 17-32.

Pyefinch, Mary (1999)

SQL from the Group up, The Accelerated Track for Professional Programmers. CEO of Business Intelligence Agency, LLC. Osborn McGraw-Hill. Page 4. ISBN: 0072119748.

Quint, Vincent (1999)

User Interface Domain, available: [http://www.w3.org/user\\_interface.html](http://www.w3.org/user_interface.html).

Raggett, Dave, Lam, Jenny, Alexander, Ian Alexander & Kmiec, Michael (1998)

Raggett on HTML 4. Second Edition - Harlow: Addison Wesley. Page 1-15. ISBN: 0201178052.

Ramaiah, C. K., Sulaiman, Mubarak and Meadows, A. J. (1993)

Student Reaction to Parallel Hypertext and Menu-Based Interface. Department of Information and Library Studies, Loughborough University, ALT-J (1993) 1(2) 17-26.

Ricardo, Catherine (1990)

Database System – Principles, Design, And Implementation. Macmillan Publishing Company, a division of Macmillan, Inc. Page 148, 313-336, 357-387. ISBN: 002399665x.

Richmond, Alan

Dynamic HTML, available: <http://wdvl.internet.com/Authoring/DHTML/>.

Richmond, Alan

VRML for Rocket Scientists, Astronomers, and Truck Drivers, available: <http://wdvl.internet.com/Authoring/VRML/>.

Richmond, Alan

CGI: The Common Gateway Interface for Server-side Processing, available: <http://wdvl.internet.com/Authoring/CGI/>.

Richmond, Alan

Authoring JavaScript, available: <http://wdvl.internet.com/Authoring/JavaScript/>.

Ritchie, Gordon & Garner, Paul (1994)

Enhancing Laboratory Activity with Computer-Based Tutorials, ALT-J 3 (1), 49-52.

Sall, Ken (2000)

XML: Extensible Markup Language, available: <http://wdvl.internet.com/Authoring/Languages/XML/>.

Shackelford, James F. (1996)

Introduction to Materials Science for Engineers. Fourth Edition – N.J.: Upper Saddle River; London: Prentice Hall: Prentice-Hall International (UK). ISBN: 0024097616.

Shale, Douglas (1999)

University Distance Education in Canada, in Higher Education Through Open and Distance Learning—World Review of Distance Education and Open Learning: Volume 1., edited by Keith Harry. First published 1999 by Routledge. Page 150-161. ISBN: 0415197910.

Sharpe, R. and Bailey, P. (1999)

Evaluation and Design of Technologies to Meet Learning Outcomes. Educational Development Services, University of Plymouth. Journal of Computer Assisted Learning (1999) 15(3) 179-188.

Shomaker, Dianna (1998)

Distance Learning in Professional Education. Dinton, Salisbury Quay. ISBN: 1856421570.

Silberschatz, Abraham, Korth, Henry F. and Sudarsha, S. (1997)

Database System Concepts. Third Edition - The McGraw-Hill Companies, Inc. Page 4-19, 251, 63. ISBN: 007044756x.

Smart, Christina, Nicol, Jacqui and Miller, Peter (1996)

Teaching and Learning with the Web-- Creating an Interactive Learning Environment on the Web. CTI-- Teaching and Learning with the Web, Version 7.1.01, available: [http://www.ulst.ac.uk/cticomp/monitor\\_main.html](http://www.ulst.ac.uk/cticomp/monitor_main.html).

Sol, Selena (1998)

Analytic Database, available:

[http://wdvl.internet.com/Authoring/DB/Intro/analytic\\_databases.html](http://wdvl.internet.com/Authoring/DB/Intro/analytic_databases.html).

Sol, Selena (1998)

Operational Database, available:

[http://wdvl.internet.com/Authoring/DB/Intro/operational\\_databases.html](http://wdvl.internet.com/Authoring/DB/Intro/operational_databases.html).

Tremblay, Ellen (2000)

Distance Education Database Evaluation: Final Report. Textpertise Writing Service, prepared for TeleEducation NB, available:

<http://teleeducation.nb.ca/media/03.2000/dbreport/index.html>.

Twidale, M. B., Nichols, D. M. Nichols, Mariani, J. A., Rodden, T. & Sawyer, P. (1995)

Supporting the Active Learning of Collaborative Database Browsing Techniques. ALT-J 3 (1), 75-79.

Twomey, Eamonn (1996)

Is There a Role for Computer-Based Assessment? CTI Biology Donnan Laboratories, University of Liverpool, available:

<http://science.uniserve.edu.au/mirror/CUBE96/twomey.html>.

Van Vlack, Lawrence H. (1989)

Elements of Materials Science and Engineering. Sixth Edition - Reading, Mass.; Wokingham: Addison-Wesley. ISBN: 0201528223.

Vescoukis, C. and Retails, S. (1999)

Networked Learning with User-Enriched Educational Material. Software Engineering Laboratory, National Technical University of Athens. Journal of Computer Assisted Learning (1999) 15(3) 211-220.

Walker, Steve (1998)

Vol 2: Computer Based Assessment – the Chemistry Quiz. CTI Center for Chemistry, University of Liverpool, available:

<http://science.uniserve.edu.au/pubs/callab/vola/walker.html>.

Zhao, Zhengmai, Cook, John and Higgen, Nick (1996)

Online Learning for Design Students. De Montford University, Leicester. ALT-J  
(1996) 4(1) 69-76.

‘ALT - Association for Learning Technology’

<http://www.warwick.ac.uk/alt-E>

‘The Commonwealth of Learning-introduction’

<http://www.col.org/colintro.html>

‘CTI – Computer in Teaching Initiative’

<http://www.cti.ac.uk/>

‘ICDL – International Centre for Distance Learning’

<http://www-icdl.open.ac.uk/>

‘ITTI – Information Technology Training Initiative’

<http://www.icbl.hw.ac.uk/itti/itti1.html>

‘LTDI – Learning Technology Dissemination Initiative’

<http://www.icbl.hw.ac.uk/ltdi/more-det.htm>

‘TLTP – Teaching and Learning Technology Program’

<http://www.ncteam.ac.uk/tltp/>

‘TLTSN – Teaching and Learning Technology Support Network’

[http://www.tltp.ac.uk/tltsn/what\\_is.html](http://www.tltp.ac.uk/tltsn/what_is.html)

‘A Summary of the Literature’

Research Monograph No. 2. University Park, PA: The Pennsylvania State  
University, American Centre for the Study of Distance Education. (ED 330 321).

**'WWW Services Discipline Index'**

<http://slacvx.slac.stanford.edu/misc/internet-services.html>

**'WWW Virtual Library Entry for Educational Technology'**

<http://tecfa.unige.ch/infor-edu-comp.html>

**'Disciplines Index to National Support Centres'**

<http://www.warwick.ac.uk/ETS/edu-tech/disciplines>

**'University of Phoenix'**

<http://www.uophx.edu/>, offers continuing education and degree programs to working adults around the world through multiple campuses and the Online Degree Program.

**'Globewide Network Academy'**

<http://www.gnacademy.org/>, non-profit organisation lists more than 17,000 distance-learning courses and programs. Search the database or visit the bookstore.

**'LifeLongLearning.com'**

<http://www.lifelonglearning.com/>, search extensive database for distance learning courses. Link to news and articles about distance learning, and buy books on the subject.

**'Hobsons Global Careers and Education Service'**

<http://www.hobsons.com> is about education publishing and links to searchable databases of British and international colleges and distance learning programs. Extensively linked to the iCDL database of worldwide and supported at the Open University in the UK.

**'iCDL.**

<http://www-icdl.open.ac.uk/>, the International Center for Distance Learning (ICDL) is an international center for research, teaching, consultancy, information and publishing activities.

‘The Canadian TeleCampus Online Course Database’

<http://database.telecampus.com/>, Lists over 7,000 courses available online.

‘Cambridge Scientific Abstract Internet Database Service’

<http://www.library.uq.edu.au/iad/journals/csascript.html>, comprehensive coverage of all aspects of materials science is provided by this collection.

‘Aluminium Industry Abstracts ’

<http://www.englrib.uc.edu/selfhelp/alabs.html>, provides comprehensive coverage of the world’s technical literature on aluminium, production processes, products, applications, and business developments.

‘Engineered Materials Abstracts ’

<http://www.library.tudelft.nl/gids/nl/database/engmat-n.htm>, provides in depth coverage of polymers, ceramics, and composites in a variety of structural and other advanced applications.

‘Materials Business File’

[http://solarsnet.snu.ac.kr/over\\_data/ids/MBF.htm](http://solarsnet.snu.ac.kr/over_data/ids/MBF.htm), focuses on industry news, international trade data, government regulations and management issues related to the metals and materials industries.

‘Mechanical Engineering Abstracts’

<http://www.silverplatter.com/catalog/meab.htm>, surveys and summarises the world-wide literature in mechanical engineering, engineering management, and production engineering.

‘Metadex’

<http://www.fiz-karlsruhe.de/stn/Databases/metadex.html>, this is a source for information on metals and alloys: their properties, manufacturing, applications, and development.

**'WELDASEARCH'**

<http://www.nelinet.net/cdrates/rec00001/r0000165.htm>, this is a database covering the areas of joining metals, plastics and ceramics, metal and ceramic spraying, thermal cutting, brazing, soldering and related topics.

**'World Ceramics Abstracts'**

<http://www.nelinet.net/cdrates/rec00001/r0000071.htm>, provides in depth coverage on the ceramics and other materials-based industries including traditional and advanced ceramics, metals, composites, and cements.

**'Database: Japanese Materials Science and Engineering'**

[http://www-japan.mit.edu/MatSciEng/materials\\_databases.html](http://www-japan.mit.edu/MatSciEng/materials_databases.html), presents the databases that are experimental partial or development in nature.

**'DemoBase-Materials Science Demonstrations Database'**

<http://ntwww.hcf.jhu.edu/matsci/TableofContents.cfm>, constructs database with the main divisions and several sub-divisions according to the natural of materials science and chosen materials.

**'IDS Database List'**

<http://www.csa.com/ijs-menu.html>, the databases available through the Internet Database Service include current abstracts combined with five years of back-volume data. For Materials Science and Technology database, an archive file containing more extensive back-volume data is available as a subscription option.

**'Instructional Materials Database for Materials Science and Technology'**

<http://www.pnl.gov/education/mstdata.htm>, provide a primary site for people to find current information on available and in process instructional materials for the field.

**'DEOS Distance Learning Database'**

<http://www.wested.org/hyper-discussions/deos-fw1/8599.html>, [ODOS] distance-learning database.

**'University of Michigan, Biomaterials Properties Database'**

[http://www.lib.umich.edu/libhome/Dentistry.lib/Dental\\_tables/intro.html](http://www.lib.umich.edu/libhome/Dentistry.lib/Dental_tables/intro.html), the database is being constructed and has table listing of biomaterials properties now.

**'Database: CAS Materials Science Collection with METADEX'**

<http://www.nelinet.net/cdrates/list0/10000055.htm>, gives brief report display.

**'Materials Science Citation Database'**

<http://www.isinet.com/products/citation/citmsci.html>, provides access to current bibliographic information and cited references, covering over 1,700 leading publications. The *MSCI*, which is available on CD-ROM, provides over 138,000 source items per year on numerous topics related to materials science.

**'Distance Learning'**

<http://www.distance-learning.hobsons.com/>, joint effort by Hobsons Publishing and the UK's Open University, giving details of international distance and open education and training, also gives access to "largest global database of distance and open learning courses".

**'Distance Learning Through Telematics'**

<http://www.fae.plym.ac.uk/tele/tele.html>, Hugely-technical web site from Plymouth University's School of Graduate Studies in Arts and Education, about

using video conferencing, satellites and other gizmos for what used to be called correspondence courses.

**'Distance Learning Links'**

<http://www.algonquinc.on.ca/apec/library/distlearnlinks.html>, particularly online materials related to World Wide Web Course Delivery for Adult Learning.

**'Open University -UK@'**

<http://www.open.ac.uk/frames.html>, providing open and distance learning in Europe, including on-line courses.

**'University of London External Program'**

<http://www.lon.ac.uk/external/>, get undergraduate/postgraduate qualifications without coming to London through the External Program. Open/distance learning and independent study: home or college.

**'The University of British Columbia'**

<http://videos.cstudies.ubc.ca/>, UBC Access Guided Independent Study Catalogue for agricultural, health, and wood science instructional videos from the distance education courses.

**'Warwick University - Educational Technology Service'**

<http://www.warwick.ac.uk/ETS/>, the ETS exists to promote and support the appropriate use, production, implementation and evaluation of technology-based learning methods and materials.

**'UM Extension - Distance Learning'**

<http://www.edoutreach.washington.edu/extinfo/dlinfo.htm>, UW Extension offers more than 140 distance-learning courses.

**'Iowa Database'**

[http://www3.iptv.org/iowa\\_database/default.html](http://www3.iptv.org/iowa_database/default.html), distance-learning database, offers several feature to support distance learning.

## Reference:

1. 'Data Bases for Office Automation'  
Michel Adiba and Mauricio Lopez page 1, in Databases, edited by J. Paradaens – London: Academic 1987, – (International Lecture Series in Computer Science). ISBN: 0125449623.
2. 'An Introduction to Database Systems'  
Bipin S. Desai, Page 2, West Publishing Company (1990). ISBN: 0314667717.
3. 'Database System Concepts'  
Abraham Silberschatz, Henry F. Korth and S. Sudarshan, third edition, page 4-19, 251, 63, The McGraw-Hill Companies, Inc. (1997). ISBN: 007044756x.
4. 'Fundamentals of Database Systems'  
Ramez Elmasri and Shamkant B. Navathen, Third Internation Edition. Page 4, 195, World Student Series. Reading, Mass; Harlow: Addison-Wesley (2000). ISBN: 0201542633.
5. 'Database System – Principles, Design, And Implementation'  
Catherine Ricardo, Page 148, 313-336, 357-387, Macmillan Publishing Company, a division of Macmillan, Inc (1990). ISBN: 002399665x.
6. 'Database Systems, Concepts, Languages and Architectures'  
Paolo Atzeni, Stefano Ceri, Stefano Parboschi and Riccardo Torlone, The McGraw-Hill Companies, 1999. ISBN: 0077095006.
7. 'Analytic Database'  
Selena Sol (1998), available:  
[http://wdvl.internet.com/Authoring/DB/Intro/analytic\\_databases.html](http://wdvl.internet.com/Authoring/DB/Intro/analytic_databases.html).
8. 'Operational Database'  
Selena Sol (1998), available:  
[http://wdvl.internet.com/Authoring/DB/Intro/operational\\_databases.html](http://wdvl.internet.com/Authoring/DB/Intro/operational_databases.html).
9. 'Distance Learning and Evaluation / edited for the Association for Educational and Training Technology'  
Edited by Fred Percival and Henry Ellington, London; New York: Kogan: Nichols Publishing Co. (1981). ISBN: 085038494x.
10. 'The Effects of Distance Learning—Revised Edition'

Michael G. Moore and Melody M. Thompson (1997), ACSDE (American Centre for Study of Distance Education) Research Monograph, Number 15, page 1-7, The Pennsylvania State University. ISBN: 1-877780189.

11. 'Raggett on HTML 4, Second Edition'  
Dave Raggett, Jenny Lam, Ian Alexander & Michael Kmiec, Second Edition, Page 1-15. Harlow: Addison Wesley 1998. ISBN: 0201178052.
12. 'User Interface Domain'  
Quient Vincent (1999), available: [http://www.w3.org/user\\_interface.html](http://www.w3.org/user_interface.html).
13. 'Dynamic HTML'  
Alan Richmond, available: <http://wdvl.internet.com/Authoring/DHTML/>.
14. 'VRML for Rocket Scientists, Astronomers, and Truck Drivers'  
Alan Richmond, available: <http://wdvl.internet.com/Authoring/VRML/>.
15. 'XML: Extensible Markup Language'  
Alan Richmond, available: <http://wdvl.internet.com/Authoring/Languages/XML/>.
16. 'CGI: The Common Gateway Interface for Server-side Processing'  
Alan Richmond, available: <http://wdvl.internet.com/Authoring/CGI/>.
17. 'What is Java'  
Elliote Rusty Harold (1997), available:  
<http://metalab.unc.edu/javafaq/course/week1/07.html>.
18. 'Authoring JavaScript'  
Available: <http://wdvl.internet.com/Authoring/JavaScript/>.
19. 'Perl from the Group up Covers Perl for UNIX, Windows 95 & Windows NT Environments'  
Michael Mcmillan, Windows NT System magazine's "Inside the bos" Columnist, The McGraw-Hill Companies, 1998. ISBN: 0078824044.
20. 'What are Active Server Pages (ASP)'  
Boris Feldman (2000), available: <http://www.asp-zone.com/aspfaq.asp>.
21. 'SQL from the Group up, The Accelerated Track for Professional Programmers'  
Mary Pyefinch, CEO of Business Intelligence Agency, LLC, Page 4. Osborne McGraw-Hill 1999. ISBN: 0072119748.

22. 'Teaching and Learning with the Web-- Creating an Interactive Learning Environment on the Web' Christina Smart, Jacqui Nicol and Peter Miller (1996), CTI-  
- Teaching and Learning with the Web, Version 7.1.01, available:  
[http://www.ulst.ac.uk/cticomp/monitor\\_main.html](http://www.ulst.ac.uk/cticomp/monitor_main.html).
23. 'Introducing Resources for Learning'  
Sally Brown and Brenda Smith (1996) in Resource-Based Learning, 1-9, edited by Sally Brown and Brenda Smith, Published in association with the Staff and Educational Development Association, 1996. ISBN: 0749419326.
24. 'Institutional Strategies fro Implementing Resource-Based Learning'  
Graham Gibbs (1996) in Resource-Based Learning, 10-21, edited by Sally Brown and Brenda Smith, Published in association with the Staff and Educational Development Association, 1996. ISBN: 0749419326.
25. 'ALT - Association for Learning Technology'  
<http://www.warwick.ac.uk/alt-E>
26. 'The Commonwealth of Learning-introduction'  
<http://www.col.org/colintro.html>
27. 'CTI – Computer in Teaching Initiative'  
<http://www.cti.ac.uk/>
28. 'ICDL – International Centre for Distance Learning'  
<http://www-icdl.open.ac.uk/>
29. 'ITTI – Information Technology Training Initiative'  
<http://www.icbl.hw.ac.uk/itti/itti1.html>
30. 'LTDI – Learning Technology Dissemination Initiative'  
<http://www.icbl.hw.ac.uk/ltdi/more-det.htm>
31. 'TLTP – Teaching and Learning Technology Program'  
<http://www.ncteam.ac.uk/tltp/>
32. 'TLTSN – Teaching and Learning Technology Support Network'  
[http://www.tltp.ac.uk/tltsn/what\\_is.html](http://www.tltp.ac.uk/tltsn/what_is.html)
33. 'A Summary of the Literature '  
Research Monograph No. 2. University Park, PA: The Pennsylvania State University, American Centre for the Study of Distance Education. (ED 330 321).

34. 'WWW Services discipline index'  
<http://slacvx.slac.stanford.edu/misc/internet-services.html>
35. 'WWW Virtual Library entry for Educational Technology'  
<http://tecfa.unige.ch/infor-edu-comp.html>
36. 'Disciplines index to national support centres'  
<http://www.warwick.ac.uk/ETS/edu-tech/disciplines>
37. 'Western Europe'  
 Hans-Peter Baumeister (1999) in Higher Education Through Open and Distance Learning—World review of distance education and open learning: Volume 1, 244-255, edited by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
38. 'University Licensing Program (TULIP) - Final Report''  
 Marthyn Borghuis, Hans Brinckman, Albert Fischer, Karen Hunter, Eleonore van der Loo, Rob ter Mors, Paul Mostert, Jaco Zijlstra. New York: Elsevier Science 1996. Page 12. ISBN: 0444825401.
39. 'University of Phoenix'  
<http://www.uophx.edu/>,  
 Offers continuing education and degree programs to working adults around the world through multiple campuses and the Online Degree Program.
40. 'The Open University of Tanzania'  
 Geoffrey Mmari (1999) in Higher Education Through Open and Distance Learning—World review of distance education and open learning: Volume 1, 110-122, edited by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
41. 'Cooperation Competition or Dominance: a Challenge in Southern Africa'  
 Tony Dodds, Evelyn Nonyongo and Jenny Glennie (1999) in Higher Education Through Open and Distance Learning—World review of distance education and open learning: Volume 1, 95-109, edited by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
42. 'The University of the West Indies'  
 Ed Brandon (1999) in Higher Education Through Open and Distance Learning—World review of distance education and open learning: Volume 1, 125-136, edited by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.

43. 'Distance Education in Latin America: Growth and Maturity'  
 Fabio Chacon (1999) in Higher Education Through Open and Distance Learning—  
 World review of distance education and open learning: Volume 1, 138-149, edited  
 by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
44. 'University Distance Education in Canada'  
 Douglas Shale (1999) in Higher Education Through Open and Distance Learning—  
 World review of distance education and open learning: Volume 1, 150-161, edited  
 by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
45. 'Asia'  
 Keith Harry (1999) in Higher Education Through Open and Distance Learning—  
 World review of distance education and open learning: Volume 1, 162-163, edited  
 by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
46. 'Distance Education in Australia'  
 Bruce King (1999) in Higher Education Through Open and Distance Learning—  
 World review of distance education and open learning: Volume 1, 264-276, edited  
 by Keith Harry, First published 1999 by Routledge. ISBN: 0415197910.
47. 'Distance Learning Futures'  
 Herbert L. Bivens (1997), Distance Learning Practice Leader NCR Worldwide  
 Services Organization, available: <http://www.lucent.com/cedl/icdeenv2.html>.
48. 'Distance Learning Course for Teachers of Visually Impaired Children,'  
 Brain Fraser, in Unit 3 (Aspects of handicap) edited by Heather Mason.  
 Birmingham: School of Education, University of Birmingham (1993). ISBN:  
 0704412845.
49. 'Distance Education Database Evaluation-Final Report'  
 Ellen Tremblay (2000) prepared for TeleEducation NB. Available:  
<http://teleeducation.nb.ca/media/03.2000/dbreport/index.html>
50. 'The Canadian TeleCampus Online Course Database'  
<http://database.telecampus.com/>, Lists over 7,000 courses available online.
51. 'Hobsons Global Careers and Education Service '  
<http://www.hobsons.com>.

Which is about education publishing and links to searchable databases of British and international colleges and distance learning programs. Extensively linked to the iCDL database of worldwide and supported at the Open University in the UK.

52. 'iCDL'

<http://www-icdl.open.ac.uk/>,

The International Centre for Distance Learning (ICDL) is an international centre for research, teaching, consultancy, information and publishing activities.

53. 'The Canadian TeleCampus Online Course Database'

<http://database.telecampus.com/>,

Lists over 7,000 courses available online.

54. 'The Science and Engineering of Materials'

Donald R, Askeland, Third S.I. Edition. London: Chapman & Hall, 1996. ISBN: 0412539101.

55. 'Cambridge Scientific Abstract Internet Database Service'

<http://www.library.uq.edu.au/iad/journals/csascript.html>,

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56. 'Aluminium Industry Abstracts'

<http://www.engrlib.uc.edu/selfhelp/alabs.html>,

Provides comprehensive coverage of the world's technical literature on aluminum, production processes, products, applications, and business developments.

57. 'Engineered Materials Abstracts'

<http://www.library.tudelft.nl/gids/nl/database/engmat-n.htm>,

Provides in depth coverage of polymers, ceramics, and composites in a variety of structural and other advanced applications.

58. 'Materials Business File'

[http://solarsnet.snu.ac.kr/over\\_data/ids/MBF.htm](http://solarsnet.snu.ac.kr/over_data/ids/MBF.htm),

Focuses on industry news, international trade data, government regulations and management issues related to the metals and materials industries.

59. 'Mechanical Engineering Abstracts'

<http://www.silverplatter.com/catalog/meab.htm>,

Surveys and summarises the world-wide literature in mechanical engineering, engineering management, and production engineering.

60. 'Metadex'

<http://www.fiz-karlsruhe.de/stn/Databases/metadex.html>,

This is a source for information on metals and alloys: their properties, manufacturing, applications, and development.

61. 'WELDASEARCH'

<http://www.nelinet.net/cdrates/rec00001/r0000165.htm>,

This is a database covering the areas of joining metals, plastics and ceramics, metal and ceramic spraying, thermal cutting, brazing, soldering and related topics.

62. 'World Ceramics Abstracts'

<http://www.nelinet.net/cdrates/rec00001/r0000071.htm>,

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63. 'Database: Japanese Materials Science and Engineering'

[http://www-japan.mit.edu/MatSciEng/materials\\_databases.html](http://www-japan.mit.edu/MatSciEng/materials_databases.html),

Presents the databases that are experimental partial or development in nature.

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<http://ntwww.hcf.jhu.edu/matsci/TableofContents.cfm>,

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<http://www.csa.com/ijs-menu.html>,

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66. 'Instructional Materials Database for Materials Science and Technology'

<http://www.pnl.gov/education/mstdata.htm>,

Provide a primary site for people to find current information on available and in process instructional materials for the field.

67. 'Approacher to Knowledge-Transfer Systems'  
 Oleg P. Pilipenko Odessa State University, Ukraine, Helena Komissarova, Kiev  
 Institute of Psychology, Ukraine. ALT-J (1995) 3(2) 42-47.
68. 'Learning Styles: Individualizing Computer-Based Learning Environments'  
 Anne Groat and Tim Musson, Napier University, ALT-J (1995) 3(2) 53-62.
69. 'What is Computer-Based Assessment'  
 Mike Knight and Andy Brown, School of Architecture and Building Engineering,  
 University of Liverpool, available:  
<http://ctiweb.cf.ac.uk/HABITAT/HABITA4/compass.html>.
70. 'Expert System'  
 Mandy M. Raab (Ph.D), Introduction of expert system and application of expert  
 system, available: <http://www.sis.pitt.edu/~raab/>,  
 Introduction of expert system and application of expert system
71. 'Creating Expert Systems For Business and Industry'  
 Paul harmon, Brian Sawyer, Foreward, Edward A. Feigenbaum. John Wiley & Son,  
 Inc. 1990. ISBN: 0471614955.
72. 'Expert Systems'  
 Ben Keenan, available: <http://www.cs.cf.ac.uk/User/B.T.Keenan/project/>.
73. 'Supporting the Active Learning of Collaborative Database Browsing Techniques '  
 M. B. Twidale, D. M. Nichols, J. A. Mariani, T. Rodden & P. Sawyer (1995) ALT-J  
 3 (1), 75-79.
74. 'Student Reaction to Parallel Hypertext and Menu-Based Interface'  
 C. K. Ramaiah, Mubarak Sulaiman and A. J. Meadows, Department of Information  
 and Library Studies, Loughborough University. ALT-J (1993) 1(2) 17-26.
75. 'Learner Control in CMS—Garrison & Baynton's Distance Learning Model'  
 Kathryn Cook (1999), available: <http://fcis.oise.utoronto.ca/~kcook/framework.html>.
76. 'Cost-Effective Support for University Students Learning via the Web? '  
 Davis Hawkridge (1998) ALT-J 6(3) 24-29.
77. 'Introduction to Artificial Intelligence and Expert Systems'  
 Carol E. Brown and Daniel E. O'Leary (1993), available:  
[http://www.bus.orst.edu/faculty/brownc/es\\_tutor/es\\_tutor.htm](http://www.bus.orst.edu/faculty/brownc/es_tutor/es_tutor.htm).

78. 'Knowledge Tree: Putting Discourse into Computer-Based Learning'  
T. J. Brailsford, P. M. C. Davies, S. C. Scarborough and W. J. Trehwella,  
Department of Life Science, University of Nottingham, ALT-J (1997) 5(1) 19-26.
79. 'Adult Distance Learning: Challenges for Contemporary Practice'  
By Burge, E. In Thelma Barer-Stein and James A. Draper (Eds.) The craft of  
teaching adult 215-230 (1993). Toronto, Ontario: Culture Concepts. (ED362 644).
80. 'Examining the Utility of Efficacy Measures in Distance Education Research'  
Roger Bruning (1995), Distance Education Symposium 3: Learners and Learning,  
edited by Chere Campbell Gibson, page 17-29, ACSDE (American Centre for Study  
of Distance Education) Research Monograph, number 13, The Pennsylvania State  
University. 1877780162.
81. 'Distance Education and the WWW'  
Daniel Peraya (1993), TECFA, Faculté de Psychologie et des Sciences de  
l'Education, Université de Genève, available:  
<http://tecfa.unige.ch/edu-comp/edu-ws94/contrib/peraya.fm.html>.
82. 'Changing the Role of Tutors in Distance Education with Information and  
Communication Technologies'  
Adrian Kirkwood, Ann Jones and Anne Jelfs, Institute of Educational Technology,  
The Open University. ALT-J (1996) 4(1) 35-39.
83. 'Client/Server Survival Guide'  
Robert Orfali, Dan Harkey, Heri Edwards. Third Edition, New York; Chichester:  
Wiley 1999. ISBN: 0471316156.
84. 'A Virtual Laboratory System for Physiology Teaching'  
Geoff Brindle and William Mitchell, Department of Computing; Len Seal and Karl  
Bohme, Department of Biological Sciences; Manchester Metropolitan University.  
ALT-J (1995) 3(1) 53-56.
85. 'deos-fwl: [DEOS] One More Distance Learning Database'  
<http://www.wested.org/hyper-discussions/deos-fwl/8599.html>.  
[ODOS] distance learning database.
86. 'University of Michigan, Biomaterials Properties Database'  
[http://www.lib.umich.edu/libhome/Dentistry.lib/Dental\\_tables/intro.html](http://www.lib.umich.edu/libhome/Dentistry.lib/Dental_tables/intro.html).

The database is being constructed and has table listing of biomaterials properties now.

87. 'Database: CAS Materials Science Collection with METADEX'

<http://www.nelinet.net/cdrates/list0/10000055.htm>,

Gives brief report display.

88. 'Evaluation the Impact of Internet Provision on Students' Information-Gathering Strategies'

Julia Meek, School of Mathematics, University of Birmingham; Marie Garnett, Staff Development Office, University of Wales Aberystwyth; John Grattan, Institute of Geography and Earth Sciences, University of Wales Aberystwyth. ALT-J (1998) 6(1) 57-63.

89. 'Personalizing the Design of Computer-Based Instruction to Enhance Learning'

Hitendra Pillay and Leonard Raj, Centre of Cognitive Process in Learning; Wageeh Boles, School of Electrical and Electronic Systems Engineering, Queensland University of Technology, Australia. ALT-J (1998) 6(2) 17-32.

90. 'Database Decisions: Briefings on the Management of Technology'

Bart O'Brien, London: Pitman Publishing 1994. ISBN: 0273602896.

91. 'Designing Online Coursework Mindfully'

Karen L. Murphy (1995), Distance Education Symposium 3: Course Design, Edited by Ellen D. Wagner and Margaret A. Koble, page 58-73, ACSDE (American Centre for Study of Distance Education) Research Monograph, Number 14, The Pennsylvania State University. ISBN: 1877780170.

92. 'Online Learning for Design Students'

Zhengmai Zhao, John Cook and Nick Higgen, De Montford University, Leicester. ALT-J (1996) 4(1) 69-76.

93. 'Computer-Based Instruction: Methods and Development'

Stephen M. Alessi, Second Edition. Englewood Cliffs, N.J.; London: Prentice-Hall, 1991. Page 17-90. ISBN: 0131641611.

94. 'An Examination of Teaching and Learning Processes in Distance Education and Implications for Designing Instruction'

- Patricia Gonzalez (1995), Distance Education Symposium 3: Instruction, Edited by Michael F. Beaudoin, page 40-50, ACSDE (American Centre for Study of Distance Education) Research Monograph, number 12, The Pennsylvania State University. ISBN: 1877780154.
95. 'Back to the Future: Team-Centred, Resource-Based Learning as the Antecedent of Computer-Based Learning'  
James E. Cresswell, Department of Biological Sciences, University of Exeter. ALT-J (1998) 6(1) 64-69.
96. 'A Knowledge-Based System for Postgraduate Engineering Courses'  
A. J. Day and A. K. Suri, University of Bradford. Journal of Computer Assisted Learning (1999) 15 (1), 14-27.
97. 'Introduction to Materials Science for Engineers'  
James F. Shackelford, University of California, Fourth Edition. Upper Saddle River, N.J.; London: Prentice Hall: Prentice Hall International (UK) 1996. ISBN: 0024097616.
98. 'Dissertations and Databases: the Historian as Software Engineer'  
Gervase Phillips (1995) ALT-J 3 (2), 48-52.
99. 'Making Expert Systems Work: Success and Failure in the Expert System World'  
Eoin Griffin (1995), IT Centre, UCG, available: <http://it-hal.ucg.ie/EGrif.htm>.
100. 'Introduction to artificial intelligence and expert systems'  
Carol E. Brown and Daniel E. O'Leary (1993), available:  
[http://www.bus.orst.edu/faculty/brownc/es\\_tutor/es\\_tutor.htm](http://www.bus.orst.edu/faculty/brownc/es_tutor/es_tutor.htm).
101. 'Prolog and Expert Systems: Applied Logic System'  
Kenneth A. Bowen. McGraw-Hill, Inc. 1991. ISBN: 0070067317.
102. 'Prolog: Sophisticated Applications in Artificial Intelligence'  
Ramachandran Bharath, Northern Michigan University. Blue Bridge Summit, PA: Tab Book 1989. ISBN: 0830693920.
103. 'Prolog and Database, Implementations and New Directions'  
P. M. D. Gray and R. J. Lucas, Department Computing Science, University of Aberdeen. Chichester: Ellis Horwood Limited 1988. ISBN: 0745803717.

104. Keyguide to Information Sources in Artificial Intelligence/Expert Systems, by Peter J Hancox, William J Mills, Bruce J Reid. London: Mansell 1990. ISBN: 0720120071.
105. 'Materials Science Citation Database'  
<http://www.isinet.com/products/citation/citmsci.html>,  
Provides access to current bibliographic information and cited references, covering over 1,700 leading publications. The *MSCI*, which is available on CD-ROM, provides over 138,000 source items per year on numerous topics related to materials science.
106. 'Using computer-based tests for information science'  
David Callear & Terry King (1996) *ALT-J* 5(1), 27-32.
107. 'Active Learning 1: Computer based assessment: some issues for consideration'  
Joanna Bull, available: <http://www.cti.as.uk/publ/actlea/issue1/bull/>.
108. 'Vol 2: Computer Based Assessment – the Chemistry Quiz'  
Steve Walker (1998), CTI Center for Chemistry, University of Liverpool, available: <http://science.uniserve.edu.au/pubs/callab/vola/walker.html>.
109. 'Is There a Role for Computer-Based Assessment?'  
Eamonn Twomey, CTI Biology Donnan Laboratories, University of Liverpool, available: <http://science.uniserve.edu.au/mirror/CUBE96/twomey.html>.
110. 'Computer-Based Submission and Assessment in BOSS'  
Mike Joy (1998), Vol. 2 No. 3 – Issue contents, Computer Science, University of Warwick, available:  
<http://www.warwick.ac.uk/ETS/interactions/vol2no3/joy-luck.html>.
111. 'WebTester: Computer-based assessment via the WWW'  
Eric Jacobson, G. Craig Gundy, and Jeffrey D. Willden (1997), Weber State University, available:  
<http://star.ucc.nau.edu/~nauweb97/papers/webtester/default.html>.
112. 'A Behavioral Training System for Planning Judgment'  
J. S. Busby and K. H. Payne, International Ecotechnology Research Centre, Cranfield Univeristy. *Journal of Computer Assisted Learning* (1999) 15(1) 61-72.
113. 'Enhancing Laboratory Activity with Computer-Based Tutorials'

Gordon Ritchie, & Paul Garner (1994), ALT-J 3 (1), 49-52

114. 'Elements of Materials Science and Engineering'  
Lawrence H. Van Vlack, Sixth Edition. Reading, Mass.; Wokingham: Addison-Wesley, 1989. ISBN: 0201528223.
115. 'A Case Study of Campus-Based Flexible Learning Using the World Wide Web and Computer Conferencing'  
Brain Nicholson, Information Technology Unit, University of Salford. ALT-J (1998) 6(3) 38-46.
116. 'World Review of Distance Education and Open Learning'  
Volume 1, page 93-94, 123-124, 162-163, 225-226, 262-263.  
Edited by Keith Harry, first published 1999, by Routledge. ISBN: 0415197910.
117. 'Using Technology for the Competitive Delivery of Education Services'  
P. Hosie and T. Mazzard, The University of Western Australia and Curtin University of Technology, Perth. Journal of Computer Assisted Learning (1999) 15(2) 118-128.
118. 'Distance Learning'  
<http://www.distance-learning.hobsons.com/>  
Joint effort by Hobsons Publishing and the UK's Open University, giving details of international distance and open education and training. also gives access to "largest global database of distance and open learning courses".
119. 'Distance Learning in Professional Education'  
D Shomaker PhD, RN, FAAN. Dinton, Salisbury Quay 1998. ISBN: 1856421570.
120. 'Distance Learning Through Telematics '  
<http://www.fae.plym.ac.uk/tele/tele.html>  
Hugely-technical web site from Plymouth University's School of Graduate Studies in Arts and Education, about using video conferencing, satellites and other gizmos for what used to be called correspondence courses.
121. 'Evaluation and Design of Technologies to Meet Learning Outcomes'  
R. Sharpe and P. Bailey, Educational Development Services, University of Plymouth. Journal of Computer Assisted Learning (1999) 15(3) 179-188.

122. 'Shared Teaching with Multimedia-Enhanced Videoconferencing'  
Charles Duncan, Martin Morrey, Gwen Bayne, Lain Maclaren, Patrick Walder &  
John McQuillan (1998) ALT-J 6(3) 4-15.
123. 'Distance Learning Links'  
<http://www.algonquinc.on.ca/apec/library/distlearnlinks.html>,  
Particularly online materials related to World Wide Web Course Delivery for  
Adult Learning.
124. 'Open University -UK@'  
<http://www.open.ac.uk/frames.html>,  
Providing open and distance learning in Europe, including on-line courses.
125. 'University of London External Program'  
<http://www.lon.ac.uk/external/>,  
Get undergraduate/postgraduate qualifications without coming to London through  
the External Program. Open/distance learning and independent study: home or  
college.
126. 'The University of British Columbia'  
<http://videos.cstudies.ubc.ca/>,  
UBC Access Guided Independent Study Catalogue for agricultural, health, and  
wood science instructional videos from the distance education courses.
127. 'Warwick University - Educational Technology Service'  
<http://www.warwick.ac.uk/ETS/>,  
The ETS exists to promote and support the appropriate use, production,  
implementation and evaluation of technology-based learning methods and  
materials.
128. 'Networked Learning with User-Enriched Educational Material'  
V. C. Vescoukis and S. Retails, Software Engineering Laboratory, National  
Technical University of Athens. Journal of Computer Assisted Learning (1999)  
15(3) 211-220.
129. 'Distance Learning Technology and Applications'  
Daniel Minoli, Teleport Communications Group, Stevens Institute of Technology.  
London: Artech House, 1996. ISBN: 0890067392.

130. 'UM Extension - Distance Learning'  
<http://www.edoutreach.washington.edu/extinfo/dlinfo.htm>,  
UW Extension offers more than 140 distance-learning courses.
131. 'Electronic University'  
A Guide to Distance Learning Programs Distance Education; Universities;  
Correspondence Schools; Higher Education; Directories.
132. 'Foundations of Distance Learning Education'  
Desmond Keegan, Second Edition. London: Routledge 1986. ISBN:  
0415031621.
133. 'Distance Learning Resource'  
Roger Ferraro, Computer Services Dept. at CCTC, available:  
<http://webster.comnet.edu/roger/home.htm>.
134. 'Iowa Database'  
Available: [http://www3.iptv.org/iowa\\_database/default.html](http://www3.iptv.org/iowa_database/default.html)  
Distance learning database, offers several features to support distance learning.

