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Relational database for the Master of Arts in Education Instructional Technology Program

Keith Anthony Castillo

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RELATIONAL DATABASE FOR THE MASTER OF ARTS IN
EDUCATION INSTRUCTIONAL TECHNOLOGY PROGRAM

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts
in
Education:
Instructional Technology

By
Keith Anthony Castillo
June 2003
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Approved by:

Dr. Eun-Ok Beak, First Reader

Dr. Amy S.C./Leh, Second Reader

6-1-03
ABSTRACT

This project was created to develop a database for students and teachers to allow accurate, efficient and reliable tracking of student academic information. The database was designed specifically for faculty and students within the Master of Arts in Education, Instructional Technology program at California State University San Bernardino. The current database system at the university does not allow students and teachers access to necessary student information that would serve as a tool to monitor progress within the program. A literature review was done to provide essential information on database significance and design as well as discuss the importance of utilizing database systems within the academic arena. The design of the database was made so that both students and instructors could efficiently obtain necessary information. The database was also integrated into a much larger database that the university is currently using so as to have all student information contained within one system.
ACKNOWLEDGMENTS

Thank you to Dr. Leh for staying in her office, providing support and allowing me the opportunity to experience the Instructional Technology program. To Dr. Baek, for her integrity and infinite wisdom. Finally, to the rest of faculty in the program, thank you for all of their support and to my friend Hank Richards for all of his encouragement.
DEDICATION

To my loving wife, Jennifer, for her patience, love, support and friendship, without her this project would not have been completed. To my daughter Alyssa and my son Kyle, yes daddy is finally finished with school and yes, he really does live with you and not at the university.
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CHAPTER ONE

BACKGROUND

Introduction

The contents of Chapter One present an overview of the project. The contexts of the problem are discussed followed by the purpose, significance of the project, and assumptions. Next, the limitations and delimitations that apply to the project are reviewed. Finally, definitions of terms are presented.

Purpose of the Project

The purpose of the project was to identify needs and problems associated with existing database systems at California State University San Bernardino and to design a working web-accessible database. The database will be comprised of relational tables that can be searched and reports generated and forms will be used to allow user-friendly access, via the Internet, to obtain information both by the students and instructors. This database was designed specifically to allow students and instructors within the Masters in Education Instruction Technology Program the ability to access current academic information for the purpose of advising and program planning.
Context of the Problem

With the rapid growth of any educational program it is difficult for faculty to obtain current levels of each student's academic standings. Faculty is often left at the mercy of what the students perceive their academic standing to be, rather than relying on a system that is efficient, organized and updated on a regular basis. Unless the student is diligent enough to keep updated academic records in hand, faculty may have difficulty in advising the student on course completion or placement due to the limited amount of available information. Students often find themselves rescheduling countless appointments in order to acquire appropriate documentation of their academic standing for the instructor to review and provide appropriate academic advisement.

Significance of the Project

The use of a web-accessible database would enhance the educational experience by allowing students enrolled in the Master of Arts in Education Instructional Technology Program to be informed of requirements met; the ability to appropriately map the courses needed to successfully complete the program requirements; and permit the faculty to view graduate placement. This database
would permit the faculty to adapt the program to meet the needs of the job market and industry standards.

Assumptions

The following assumptions were made regarding the project:

1. Students need to be able to track courses completed and monitor academic standing and progress in the program.

2. Professors do not have immediate access to accurate student academic information.

Limitations and Delimitations

During the development of the project, a number of limitations and delimitations were noted. These limitations and delimitations are presented in the next section.

Limitations

The following limitations apply to the project:

1. Continuity of the use of database programs: Legacy Database, File maker pro, Microsoft Access and MySQL.

2. Databases are departmentalized and are not related to one another.
3. Information is not shared and when it is shared it is not always accurate.

4. The information is not always current and can be delayed in entering into the database anywhere from one quarter to one year.

5. The database is limited to the ability to link to the Cal State TRACS system.

Delimitations

The following delimitations apply to the project:

1. Information is available for student’s access to the web.

2. Professors and students have current access to the web in the Master of Arts in Education Instructional Technology Option.

Definition of Terms

The following terms are defined as they apply to the project.

Database - A container or collection of information that has a specific subject or purpose. Examples of a typical database include a phone book, a Rolodex, or even a file cabinet. A database, as we are using it in this context, is maintained in a computer as the container.
Data Redundancy - the same data might be stored in different places.

Fields - A table is composed of rows and columns. The columns are the fields.

Form - a more user-friendly way to view and input information into a database.

GUI - Graphic User Interface.

Index - Indices are pointers to where information is stored in your database. They make it easier to find and sort information.

Records - A table is composed of rows and columns. The rows contain records.

Table - The table structure is the foundation of the database application. A table is a container for data about a single type of entity, such as persons or products. Using a separate table for each type of information means that you store data only once, which makes your database more efficient and reduces data-entry errors.

Relational Database - is the concept of a table (also called a relation) in which all data is stored. Each table is made up of records (horizontal rows also known as 'tuples') and fields (vertical columns also known as attributes).
Primary Key - Each table should include a field or set of fields that uniquely identifies each record stored in the table. This permits the relational database systems the ability to quickly find and bring together information stored in separate tables using queries, forms, and reports. This information is called the primary key of the table.
CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

Chapter Two consists of a discussion of the relevant literature. First discussed is "What is a database?" followed by the history of databases. The second issue will deal with the various types of databases and the chapter will conclude with a review of educational databases.

What is a Database?

A database is a structure that can house information about multiple types of entries as well as relationships among entries (Pratt, 1987). It is a collection of fields that create a library that introduces a standard that allows data to be stored and received. There are many different types of databases being utilized however one of the most common and simple forms of a database is the relational model.

History of Databases

If we had an actual time machine created by H.G. Wells then we could venture back to the days before computers existed. Long ago, there was a time when groups of people gathered together for times of storytelling
where elders would share their wisdom and information about past events. These individuals were the early historians and were the storehouses or the "living databases" for all that was known to have occurred. These early historians would then pass the information to the younger members of the family or community so that the information could be passed on and remembered.

But as time progressed and technologies advanced, the time for memorized information was turned over to a written form or record keeping. This written form allowed the individuals to transfer the information that they had in their memory into written form and this written form was often transferred into books or journals. Eventually the concept of the book took off and large quantities began to be collected and placed into the first real database system which is commonly known as the library.

Although libraries might be considered the primary beginning of the database lineage, they transcended into a modern day phenomenon, although they were still extremely primitive. Over time, the libraries themselves went through a series of changes that allowed the books to be categorized and stored collectively. The Dewey decimal system was eventually introduced and allowed each book to have a specific number or a primary key corresponding to
the identification of that specific book. This information was then collected and placed into a card catalog system. Libraries had finally introduced a standard by which data could be stored and retrieved.

As time progressed this written type of categorizing and storage of information was termed as an "analog system". As technology advanced, the introduction of the computer allowed the transfer of the analog system into a "digital system" that allowed the creation of computerized database systems. There are many different types of databases being utilized today and the amount of information that they are able to manage seems virtually endless.

Types of Databases

**Analytic Databases**

Analytic databases are primarily static, read-only databases that store archived, historical data used for analysis. An example could be a business storing sales records over ten years in an analytic database and then using the database to analyze marketing strategies directly related to area demographics.
Operational Databases

Operational databases are used to manage data that can be manipulated. These types of databases allow you to do more than simply view-archived data. Operational databases allow you to modify that data (add, change or delete data). These types of databases are usually used to track real-time information. For example, a business might have an operational database used to track their inventory.

Hierarchical Database

The Hierarchical Database Model defines hierarchically arranged data. To visualize this type of relationship imagine an upside down tree of data. In this tree, a single table acts as the “parent” or “root” of the database from which other tables “child” are linked to or “branch” out (See figure 1). The children and parents relationships in the system are thought of in these terms because a child may only have one parent but a parent can have multiple children. Parents and children are tied together by links called “pointers”. A parent will have a list of pointers to each of their children.

This child/parent rule assures that data is systematically accessible. One disadvantage is that you must start at the parent and systematically work your way
through the levels to the child. This process means that the user must have prior knowledge of the schematic for which the database was created. This type of database allows for redundancy of data because of the many levels. Redundancy can occur because hierarchical databases handle one-to-many relationships but do not handle many-to-many relationships well. This is because a child may only have one parent.

Network Databases

The Network Database model was created to solve some of the problems with the Hierarchical Database Model. The Network model solves the problem of data redundancy by representing relationships in terms of sets rather than hierarchy. The network model is very similar to the hierarchical model that it was designed to replace. The hierarchical model is a subset of the network model. The network model uses a tree-like hierarchy with the exception that child tables were allowed to have more than one parent. This allowed the network model to support multiple relationships. A Network Database look is more like several trees that share branches. Children files can have multiple parents and parents can have multiple children. The network model is difficult to implement and
maintain. Computer programmers rather than real users used the network model. (Pascal, 2000)

Relational Databases

A relational model database, as viewed by most users, appears as being just a collection of tables. Formally these tables are called “relations” and this is where the relational model gets its name. The relational model allows the data to be manipulated on the basis of the data values. This means that the data retrieved from the fields in the table can be compared by value that is stored in a particular column with a corresponding row that is searchable (Sol, 1998).

The relational database model is set apart from other database models because of its simplistic design. The relational database usually consists of tables that contain fields. These fields are more commonly referred to as “columns” that run vertically and “rows” which contain the records. The fields are a more user-friendly way to input and access data. For this main reason, relational database systems are the most popular database systems used today (Sol, 1998).

Each table can be identified by a unique name and that name can be used by the database to find the table. The user only needs to know the table name in order to use
it. The relational model manipulates data on the basis of the data values themselves.

An example is a user requesting all the rows from the 'STUDENT_INFORMATION' table that have 'BOB' in the 'FIRST_NAME' column. This data access method makes the relational model different from the earlier database models. It is a much simpler model to understand. It is also incorporates useful tools for database administration. "Essentially, tables cannot only store actual data but they can also be used as the means for generating meta-data (data about the table and field names which form the database structure, access rights to the database, integrity and data validation rules etc)"

(Pascal, 2000, pg. 24).

Client/Server Databases

A database server is left running 24 hours a day, and 7 days a week. 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 several requests can be handled at one time. For web applications worldwide usage must be available all the time. These are the only types of
database that Internet Service Providers will provide (Gilfillan, 2002).

Structured Query Language

There are many ways of manipulating a relational database. The means by which the data is manipulated is through a program language. One of the most prevalent languages utilized to manipulate data in the relational model database is called "structured query language" (SQL) that was developed by IBM (Hartley & Martyn, 1998). The basic form of an SQL command is simply "select" "from" "where" and these commands are put into the form of a GUI which allows the user to select from a list of all tables containing information that applies to restrictions where the information will come from (Pratt, 1987).

An example of this structured query language would be a student attempting to access the database through the Internet and request to view the courses taken for their program plan. The query would then link to the relational tables that pertain to that student’s academic record, with restrictions to only select those individual classes that meet the criteria for the specific program plan. The end result would be the student would be able to view
those courses in a printable form format that satisfy the program requirements.

Utilizing Databases in Education

Databases used in education or educational databases allow students to develop electronic portfolios that are at the forefront of helping students to evaluate their academic progress. There is a dramatic movement in the field of educational measurement to go beyond standard multiple choice tests to develop measures which better represent instructional outcomes and enables students to demonstrate skills (Baker, Gearhart & Herman, 1990). Utilizing databases in the educational setting can also allow students to see first-hand the collection of work that they have completed in the form of an electronic portfolio. These portfolios can be considered a collection of information grouped and structured to enable learners to meet instructional goals (Sweeter, 1994). The instructional task of setting objectives, checking prerequisite learning, setting learning tasks and providing practice and assessment must be provided by a teacher or learning system.
CHAPTER THREE
METHODOLOGY

Introduction

This chapter describes how the project was developed. First a needs assessment was conducted regarding current database systems. Second, instructors, students and personnel at California State University San Bernardino were asked to complete a questionnaire and return them to the researcher. Based on the findings of the needs assessment, the database was conceptualized and constructed and forms, and reports were created. Finally the issues of: implementation of security, maintaining privacy and confidentiality, and connectivity to the SIS+ (TRACS) system were addressed.

Design

A needs assessment was conducted on 7 faculty members and staff in different departments at California State University, San Bernardino. These faculty members were chosen for the needs assessment because of their experience with database design, utilization and development along with their interest in modifying the current database system or creating a more efficient database model. Additionally, 20 students selected at
random and 2 additional campus personnel were included in the needs assessment (see Appendix A).

The needs assessment consisted of a questionnaire that was completed by the respondent and sent back to the researcher (see Appendix B). The questionnaire addressed areas such as current database systems, web accessibility, accuracy and efficiency of the current system, problems or concerns with the current system and improvements needed.

Data Analysis Procedures

The needs assessments were reviewed and the findings categorized into 2 main areas; a) the necessity of a relational database for faculty and students that is web-accessible and linked to the SIS+ (TRACS) system for validation and security purposes; b) the need for students and faculty to have immediate access to current and accurate information pertaining to their academic standing which can improve timeliness of the advisement process. (See Figure 2)
CHAPTER FOUR
RESULTS AND DISCUSSION

Introduction

Included in Chapter Four is a presentation of the result of completing the project.

Presentation of the Findings

The results indicated that there are three databases currently in place at California State University, San Bernardino that hold student data and information. The main database currently in place is the SIS + (TRACS) system that is web-accessible, has current and accurate student coursework and grade information and has implemented security for confidentiality issues. The main problem area is related to the fact that the information can only be viewed one quarter at a time and is not printable in a program plan format.

Secondly, there is an older database that operates off of the Legacy system which is not web accessible, information cannot be accessed for public viewing, written requests for the information from this system must be submitted and the IT department over this system requires sufficient time to access the information and make it available to the requesting party. The information is
often erroneous and outdated. Finally, there are departmentalized smaller database systems located in two departments that utilize File Maker PRO. These systems are also not web accessible, although they have the capability of being placed on the web. The information is usually delayed being imputed anywhere from one week, to one quarter to one year. These particular databases rely solely on the database manager to input the information manually.

Discussion of the Findings

Implementation of a relational database that is web accessible and linked to the current SIS+ (TRACS) system would allow the information to be accurate and current along with allowing students and faculty to have easy access to student information in a read-only format that is printable related to academic standing. In addition, by allowing the database to access the SIS+ (TRACS) system, security measures can be implemented as a form of checks and balances through the use of student ID and PIN number. This would also allow faculty in the presence of students to access student academic information with appropriate advisement.
Development of the Database

The following steps were taken in the development of the database:

1) **Creation of Fields Within the Database:**

   The purpose of the database will determine the information that needs to be stored within the tables that will dictate the information that the database will be able to generate. The design began with identifying the primary key. The primary key was taken from the existing databases that are currently used at Cal State, this consisted of the students social security number. The next fields linked to and support the identification of the social security number. The fields that were generated are as follows: PIN number, students first name, middle initial, last name, address (including city, state and zip code), home phone number, work phone number, email address, current employment, state date of the IT program and advisor. This table was then identified as "IT student information".

   The next five tables were created that would contain the course information that the students would take and complete. The tables were broken down as follows: MA Education Core (includes the fields...
EDUC 603, 663, 695); IT Core classes (includes the fields ETEC 500, 544, 546); Emphasis (includes the fields ETEC 605, 609); Elective (includes the fields ETEC 611, 612, 621, 623, 634, 674, 675, 682, 691, 692, EELB 604f, ESPE 691d); and Culminating Experience (includes the field EDUC 600). Each table is linked to a common related field that is “student ID” or the primary key (see Appendix C).

2) Create a Query:

A query was created that would filter and limit searches within the tables to obtain information solely for the individual who is requesting data. The student’s social security number dictates the limiting factor within the query (see Appendix D).

3) Designing the Program Plan Form

The existing program plan form was used in a general layout of the report that would be generated by the database. The fields in the related subject areas MA core, IT core, Emphasis, Electives and Culminating Experience would be filled by the fields within the related tables (see Appendix E).

4) Creation of Web Accessible Form

The form was created by using the existing fields in the IT student table. A banner was added in
the header of the form that is the California State University San Bernardino logo. A button was added to the bottom of the form that would allow students to search the database using the query to locate the courses that have been completed within the Master of Arts in Education Instructional Technology Option program. This information is limited to a read-only permission that would allow the program plan to be printed (see Appendix E).

5) Security Implementation:

Security implementation needs to be established that would allow only students currently enrolled to access academic information. Due to personal information and social security number, which is considered a legal property of that student, strict security limitations needed to be in place. The secured entry to the database would piggyback off of the security web page California State University San Bernardino currently has in place (see Appendix F).
Figure 1. Hierarchical Database Flow Chart
Password Protected - the last 6 digits of the Student's SSN

Web Access Page

Primary Route - Data is verified by tracks system

Students General Information

6 month post graduation password use only.

Post Graduate Information

Information can be use to analyze the ITMA program. (ex.) Where students are working, Changes in employment

CSUSB Tracks Link

courses taken then linked to tables once verified

Key Id links tables creating a table reference database

Classes Taken Table not visible, students only sees report

Report to be created in the image of the program plan

Reports can be generated based on the information collected

Reports on student demographics. Identify trends and investigate potential option for program expansion.

Figure 2. Student Database Flowchart
CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

Included in Chapter Five the recommendations extracted from the project are presented. Lastly, the Chapter concludes with a summary.

Recommendations

In regards to the Masters in Education Instructional Technology program, by relating the two databases together only students who are currently enrolled in the program can access their information. The information could be related to those courses taken at Cal State and put into program form as a report that could be printed out which allows the students to submit a program plan that is current and accurate. Finally, the information would not need to be inputted manually, thereby decreasing the chance of human error and insuring that only those students currently enrolled in the program would have the ability to access their information.

The proposed database can be outlined as follows:

1) **Primary key is defined**: This primary key will contain the student social security number. The student social security number would then relate
to the SIS+ system to validate student enrollment and academic status (Appendix C)

2) **Students PIN number**: Student PIN number will act as a check and balance to further secure student confidentiality and student enrollment and academic status (Appendix F)

3) **Structured query**: A structured query will define the information that is being requested and restrictions. This will allow the relationship between the proposed database and the SIS+ system that will generate records from the tables and put them into a read-only format (Appendix D)

4) **Distribution of data**: The information would be related to and stored in a table where a report can be generated and printed as a program plan (Appendix E)

5) **A sample Database**: (is represented in the form of a CD) [Appendix G]

**Summary**

The need for computer based assessment alternatives, researchers and educators seem to agree that computer use leads to more time on task, greater student motivation,
more peer assistance and more efficient use of time. Researchers and educators agree that computer use is an effective tool for self-evaluation. Furthermore, this allows educators the ability to assist students with academic guidance, accessing information that is efficient, reliable and accurate. By making systems available on the Internet, students have the ability to access information that assists not only the educational experience, but promotes educational development.
<table>
<thead>
<tr>
<th>Participant</th>
<th>Position</th>
<th>Department</th>
<th>Roles related to the database</th>
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<tbody>
<tr>
<td>A</td>
<td>Professor</td>
<td>Math, Science and Technology</td>
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<td>Professor</td>
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<td>G</td>
<td>Program Assistant</td>
<td>College of Education</td>
<td>Verify student standings</td>
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<td>H</td>
<td>Network Coordinator</td>
<td>Casedental Office C.A.S.E</td>
<td>Construct databases for various departments</td>
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<td>I</td>
<td>Part time lecturer</td>
<td>Math, Science and Technology</td>
<td>Academic Advisement</td>
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<td>Academic Standings Information/Graduation Verification</td>
</tr>
<tr>
<td>AC</td>
<td>Student</td>
<td>College of Education</td>
<td>Academic Standings Information/Graduation Verification</td>
</tr>
</tbody>
</table>
APPENDIX B

QUESTIONNAIRE
Questions:

1. What software is used to create the database?

2. How do you determine the fields in the database?

3. What type of database is in place that allows students to access grades and program standing?

4. How do you determine the primary key for the relational database?

5. Is the database web accessible?

6. What types of securities are in place with the database?

7. Is the information from the database accurate and current?

8. Does the database relate to the Sis+ "Trac" system?
APPENDIX C

THE PRIMARY KEY IS DEFINED
<table>
<thead>
<tr>
<th>Field ID</th>
<th>Field</th>
<th>Data</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student ID</td>
<td>Auto Number</td>
<td>Number automatically generated by the system.</td>
</tr>
<tr>
<td>2</td>
<td>SS#</td>
<td>Text</td>
<td>The system will only accept the last six digits.</td>
</tr>
<tr>
<td>3</td>
<td>DOB</td>
<td>Text</td>
<td>Presented as an input of a 6 digit entry.</td>
</tr>
<tr>
<td>4</td>
<td>Last Name</td>
<td>Text</td>
<td>As presented</td>
</tr>
<tr>
<td>5</td>
<td>First Name</td>
<td>Text</td>
<td>As presented</td>
</tr>
<tr>
<td>6</td>
<td>Middle Initial</td>
<td>Text</td>
<td>As presented</td>
</tr>
<tr>
<td>7</td>
<td>Address</td>
<td>Text</td>
<td>As presented</td>
</tr>
<tr>
<td>8</td>
<td>City</td>
<td>Text</td>
<td>As presented</td>
</tr>
<tr>
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<td>Zip</td>
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<td>13</td>
<td>Email</td>
<td>Text</td>
<td>As presented</td>
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<tr>
<td>14</td>
<td>Current Employment</td>
<td>Text</td>
<td>Not required but will aid in post graduation transitions.</td>
</tr>
<tr>
<td>15</td>
<td>Start date of the program</td>
<td>Text</td>
<td>Not required but will aid in flagging a potential need to increase the number of courses provided in a quarter</td>
</tr>
<tr>
<td>16</td>
<td>Advisor</td>
<td>Text</td>
<td>Determining the advisors case load and possible need to hire more staff.</td>
</tr>
</tbody>
</table>
APPENDIX D

STRUCTURED QUERY
APPENDIX E

PROGRAM PLAN FORM
## Graduate Approved Program Plan

**California State University, San Bernardino**

**Masters of Arts in Education**

**Instructional Technology Option**

**Classification Date:**

**Bulletin Year Held:**

### Name:

**SS#**

### Address:

**Home #**

**Work #**

**Baccalaureate Degree From:**

**Year:**

**Prerequisite:**

ETES 537

**Graduate Writing Requirement:** Expository Writing (DB/EQUIVALENT/WRE)

<table>
<thead>
<tr>
<th>Quarter/Year</th>
<th>Grade</th>
<th>Notes</th>
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</thead>
</table>

### Study Plan

**M.A. Core**

<table>
<thead>
<tr>
<th>Units</th>
<th>Grade</th>
<th>Notes</th>
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</thead>
</table>

**Instructional Technology Core**

<table>
<thead>
<tr>
<th>Units</th>
<th>Grade</th>
<th>Notes</th>
</tr>
</thead>
</table>

**Emphasis**

<table>
<thead>
<tr>
<th>Units</th>
<th>Grade</th>
<th>Notes</th>
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</thead>
</table>

**Electives**

<table>
<thead>
<tr>
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<th>Grade</th>
<th>Notes</th>
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</thead>
</table>

**Culminating Experience**

<table>
<thead>
<tr>
<th>Units</th>
<th>Grade</th>
<th>Notes</th>
</tr>
</thead>
</table>

**Note:** 48 units required for completion of degree.

**Adviser, Instructional Technology:**

**Coordinator, Instructional Technology:** Amy Leh

**Wednesday, December 04, 2002**

Page 1 of 1
APPENDIX F

WEB SECURITY ACCESS
CSUSB Master of Arts in Education

Instructional Technology Option

Course work and grades are available 10 to 12 days after the quarter.

Note: The grade server can accept only a limited number of concurrent users. It may display a failure message when too many people attempt to access it once. If this happens, please retry your request. This is for viewing purposes only. The file will print in then form of your
APPENDIX G

SAMPLE DATABASE CD
REFERENCES


