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**NAVAL
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MONTEREY, CALIFORNIA

THESIS

**THE DISTANCE TRAINING SYSTEM (DTS)
APPLICATION USING DREAMWEAVER MX2004 AND
JSP APPLICATION SERVER TECHNOLOGY**

by

Nikolaos Pogkas

September 2004

Thesis Advisor:
Thesis Co-Advisor:

Thomas Otani
Arijit Das

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**THE DISTANCE TRAINING SYSTEM (DTS) APPLICATION USING
DREAMWEAVER MX2004 AND JSP APPLICATION SERVER TECHNOLOGY**

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

In recent years, declining budgets, limitations on military personnel and decreases in training areas have reduced the opportunity to conduct live military training. For these reasons, Distance Learning Systems are available for providing an almost realistic training platform for enlisted staff and officers.

This thesis has two main objectives: The first is the development of a data model that can be used as a central information repository for an unlimited number of authenticated users. The Distance Training System (DTS) application was developed using a hierarchical approach. The DTS is a Content Management System (CMS) appropriate for users desiring the benefit of accessing the contents of a database. The other objective is the exploration of the interaction between application server technologies such as the JSP with a Web development tool such as Dreamweaver MX2004. This work focuses on the convenience of developing a fast and accurate web application product using HTML as long as it results in a correct and clean data model. Other server technologies are also used as references, such as Active Server Page (ASP), Coldfusion and PHP, which along with Java Servlet Pages (JSP), are the leading technologies in web database development for processing user events.

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I. INTRODUCTION

For reasons of cost and accessibility, the Hellenic Army has a growing need for training to be delivered on an “anywhere at anytime” basis through distributed training technologies. Those technologies can be developed by using tools, which are based on the Internet and called E-learning tools. E-learning tools refer to Internet-based programs designed for instructional purposes, such as interactive multimedia displays or threaded electronic messaging.

This thesis will develop a distance training product prototype using MySQL as the DBMS, Apache Tomcat as the web server and Macromedia’s Dreamweaver JSP as the controller. This model can be applied to short or long-term military schools used by the Hellenic Army or it can be used by educational institutions for information repository which others can use. Specifically, it would be possible for military officers or enlisted personnel to attend military schools or become evaluated without taking leave and being absent from their units for a long period of time. Students enrolled in Distance Learning (DL) courses remain assigned to their units while in training. Their status is the same as if they were attending a proponent school.

The proliferation of computer networks, including the Internet and corporate ‘intranets’, has enabled users to access a large number of data sources, such as data stored in databases. As a consequence, web designers and developers today increasingly face a different set of problems than they did a few years ago. Firstly, rather than creating brand-new sites, today’s designers and developers need to maintain existing sites in the face of changing standards, new technologies and evolving content. Secondly, the variations among different browsers have become so pronounced that it is no longer acceptable only to check the page in both Netscape and Internet Explorer. Lastly, today’s designers and developers need to build management systems, which facilitate the movement of site content maintenance from IT departments to non-technical users by creating forms that post content.

This type of application could be classified as a Learning Management System (LMS). It is a software package used to administer one or more courses to one or more learners. The reusability, durability, accessibility and interoperability is examined in order to standardize and modernize the manner in which military training and education are delivered through the maximization of technology-based learning to generate substantial costs savings.

Chapter II presents the most known server models and the advantages of JSP over the other competitive server models. However, web developers seldom decide based on rational criteria, such as which model fits their needs better than another. In reality, the choice is usually driven by the available technology, the budget, the technology used in an existing site and the skills and experience of the available human resources.

Chapter III analyzes JSP's implicit objects. Dreamweaver MX is not simply a layout tool. It is web development software, which makes it possible to work directly with the code view, add, remove or modify code and see the results using the design view.

Chapter IV presents how to insert java code in the form of scripting elements or java beans in a file, which is developed using Dreamweaver. In fact, this code is inserted into the servlet generated by the JSP page.

Chapter V discusses the main components of the Dreamweaver environment because the majority of the web designers and developers use other server technologies, and as a result, adequate resources are not available. Although JSP is the fastest among the others and the most powerful solution even over .NET, its code is daunting for those new to dynamic website development.

Chapter VI analyzes the application idea and components, the data model, the flow navigation and presents Dreamweaver's performance, reliability, and stability during the development of this product.

Finally, Chapter VII presents the overall conclusions, capabilities, and limitations from the analysis and the development of this application.

II. WEB APPLICATION ARCHITECTURE

The term architecture describes how the different components of a complex application relate to one another, and it is the starting point for the design of any application. There are numerous architectures used in database applications. The most common are client/server, distributed and web architectures. The focus of this thesis will be the web architecture since it is the most common flexible architecture currently used in the Internet environment.

The simplest form of web architecture consists of three tiers. The first is the presentation tier, which provides users with a natural interface and uses HTML (or XHTML) as its basic language. The middle tier executes the application logic and consists of technologies such as PHP, ASP, JSP and others able to handle several programming tasks like doing math or interacting with data sources including text files, databases and XML documents, which compose the data management tier. This architecture is commonly called the three-tier architecture. They can also handle tasks that pertain only to the web such as collect data sent by the user, do the necessary evaluation and computation based on those data, and return the result to the user.

Although the three-tier architecture has numerous advantages, it is not without limitations. Browsers can manipulate only HTML, CSS and client-side scripts. They cannot understand the server code “as-is”, and as a result, whatever the server sends to the browser must be in standard HTML. As shown in Figure 1, the computer holding the HTML files and where the control logic occurs is properly called a Web server (Apache, IIS, etc.). The controller plays the role of the application server and comes in many different forms, depending on the technologies used (JSP, PHP, etc.). The controller is responsible for processing user events. Some of these technologies, such as the JSP, generate programs that run on the web or application server (servlets) and act as a middle layer between a request coming from the client and the database server storing the information. This transformation has many advantages, which this chapter explains.

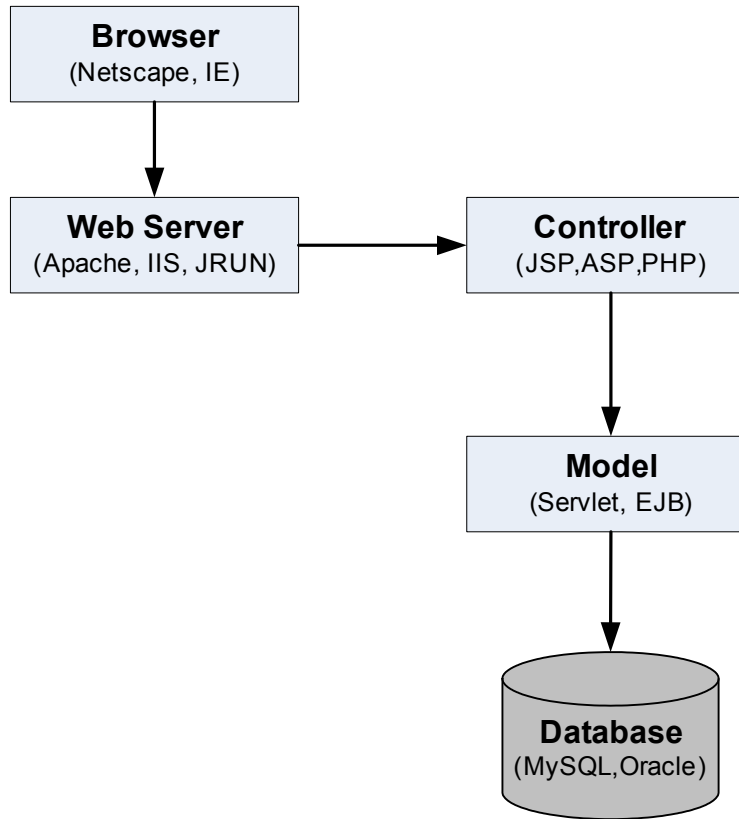


Figure 1. The Web Application Architecture (From Ref. 1)

This model has the advantage of creating an “ultra-thin” client (web form) because it is responsible only for the display logic. Controller logic resides in the application server, which implements technologies illustrated in Figure 1.

A. APPLICATION SERVERS

The utilization of application server technologies arose from the need to improve the performance of an application. A new process is generated when the user requests a web page. This procedure does not work correctly with a large number of simultaneous requests because the startup cost of creating a new process for each request reduces the performance of the entire application. The solution is for the application server to maintain a pool of processes or threads in the form of servlets programs and use these to execute requests as illustrated in Figure 2.

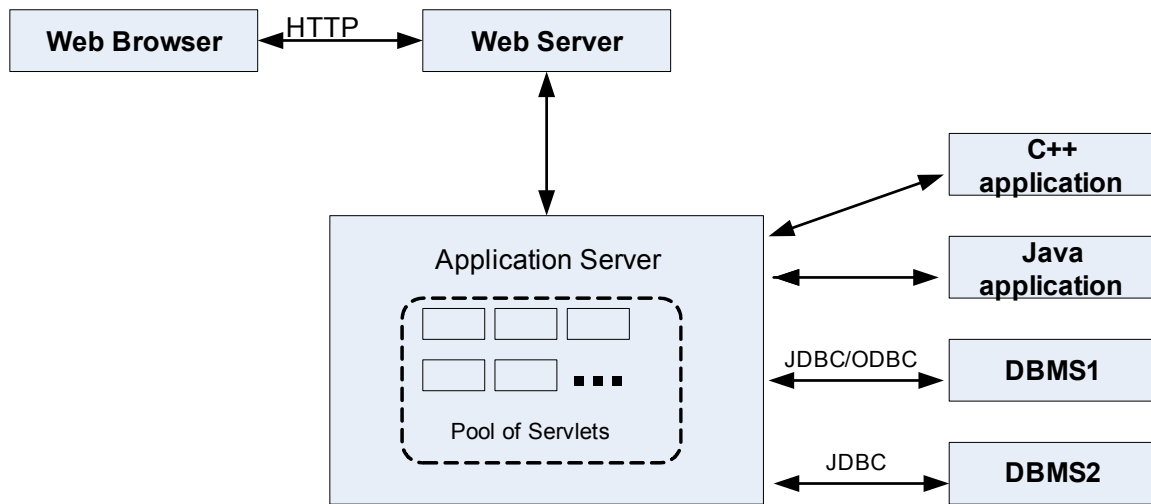


Figure 2. Application Server Architecture (From Ref. 2)

Before describing the application server technologies, it would be beneficial to refer to a possible architecture for a website with an application server as the one shown in Figure 2:

- The client (Web browser) interacts with the web server through the HTTP protocol requesting a dynamic page.
- The web server finds the page and passes it to the application server (request). The application server, using servlet programs, reads the code on the page, processes the page according to the instructions in the code, and replaces the code from the page with the results of processing the instructions. The code instructions may require the application server to extract data from a data source or update requests to the data sources and insert it into the webpage.
- The data source (RDBMS) returns the results (recordset) to the application server.
- The application server inserts data into the webpage and then passes the page to the requesting browser through the web server.
- The browser creates the webpage.

The next sections briefly describe the leading application server technologies and the reasons for developing the application using the JSP model.

1. ASP and .NET

Active Server Page (ASP) is the scripting language for the middle tier for use in creating and running dynamic and interactive web server applications. An Active Server Page (ASP) itself is a text file with the extension .asp containing HTML and a client- and server-side script.

For illustration purposes, consider the following simple code snippet that outputs a value that the user entered in a form field called “firstName”:

```
<p>Thank you, <% Response.Write(Request.Form("firstName")) %>, for your submission.</p>
```

This snippet declares the following points:

- The code for the ASP is contained in a special set of tags (<% and %>). In other words, those tags indicate server markup.
- ASP uses the Write method from the Response object for outputting data.
- There is explicit reference to the variable name (Dim firstName).
- The above variable is a form variable because of the expression Request.Form(“firstName”).

The disadvantages of this technology are its restrictions in using scripting languages such as VBScript or Jscript and its dependence on a Windows-based platform. Thus, ASP must rely on Active X, COM or other Microsoft technologies to enhance the code’s functionality. In addition, ASP is interpreted, which means the code must be read each time a webpage is called.

ASP.net (with the extension .aspx) is not just an improvement of ASP. ASP.net is much better than its predecessor because it is possible to use a full featured programming language such as C# or VB.net to build elegant web applications. The advantage of ASP.net is that OOP is now available to Internet programming just as is JSP. OOP makes it possible to build large applications, while still keeping the code clean and structured. The development of an application using ASP forces the writing of spaghetti code because VBScript is a scripting language, and as a result, the code is messy when building large applications. ASP.net separates code from display and it is even possible to have pages containing no ASP.net code at all.

For example, consider the following code snippets written in C#.

```
void Page_Load(Object S, EventArgs E) { myLabel.Text = "Hello!!";  
</script>
```

A simple ASP.net webpage is possible when embedding the above snippet into the following HTML code:

```
<head>  
<title>"Hello World" example!</title>  
</head>  
<body>  
<asp:Label id="myLabel" runat="server" />  
</body>  
</html>
```

Web services are another advantage of ASP.net. Web services allow several pieces of the application to run on different servers worldwide, and the entire application will work almost perfectly and seamlessly.

Nevertheless, this new technology presents several but significant disadvantages. Although the core of .NET works fine on a few non-Windows platforms, do not expect to deploy serious ASP.net applications on multiple servers and operating systems. Second, ASP.net is limited to C# and VB.net languages. Although C# presents significant similarities to Java, few developers exist who are familiar with the C# syntax and its auxiliary libraries.

2. PHP

PHP (a recursive acronym for "PHP: Hypertext Preprocessor") is a fast-growing open-source server, cross-platform model which integrates with other open-source products, including an Apache Web server and MySQL DBMS. Speed is one of PHP's advantages. ASP is built on a COM-based architecture. A COM object is run when an ASP programmer uses VBScript. As seen previously, writing to the client calls the Response COM object's Write method. Likewise, accessing a database uses another COM object to do so. This COM overhead is cumulative and slows down the computer programming.

In PHP modules, everything runs in PHP's memory space. In other words, PHP code will run faster because there is no overhead for communicating with different COM objects in different processes.

The previous introductory example for the ASP server model could be applied in this model to demonstrate the differences between the two technologies:

```
<p> Thank you, <?php echo $_POST['firstName']; ?>, for your  
submission.</p>
```

The above code snippet declares the following points:

- The code for the PHP is contained in a special set of tags (<?php and ?>). In other words, those tags indicate server markup.
- PHP uses the echo for outputting data.
- There is explicit reference to the variable name (firstName).
- The above variable is a form/POST variable because of the expression \$_POST['firstName'].

Despite the above advantages, one disadvantage of PHP is having to learn a completely new and less widely known API when compared with JSP.

3. Pure Servlets

Java servlets are java code that run either on web servers or application servers, acting as a middle layer between requests coming from Web browsers or other HTTP clients and databases or applications on the HTTP server, as seen in Figure 2. Their job is to perform the following tasks:

- Read the explicit data sent by the client.
- Read the implicit HTTP request data sent by the browser.
- Generate the results
- Send the explicit (e.g., the query results) along with the implicit HTTP response data to the client.

Since servlets are java programs and follow a standard API, they can do a variety of tasks such as building a webpage, access databases and maintain information from request to request simplifying techniques such as session tracking and caching of previous computations. Therefore, a servlet is java code with HTML embedded inside of it. For example, consider the following servlet file, which is generated by the Home_Page.jsp from the application:

```

package org.apache.jsp;

import javax.servlet.*;
import javax.servlet.http.*;
import javax.servlet.jsp.*;
import org.apache.jasper.runtime.*;
import java.sql.*;

public class Home_Page_jsp extends HttpJspBase {
    private int accesscount=0;
    private static java.util.Vector _jspx_includes;

    public java.util.List getIncludes() {
        return _jspx_includes;
    }
    public void _jspService(HttpServletRequest request,
        HttpServletResponse response)
        throws java.io.IOException, ServletException {
        JspFactory _jspxFactory = null;
        javax.servlet.jsp.PageContext pageContext = null;
        HttpSession session = null;
        ServletContext application = null;
        ServletConfig config = null;
        JspWriter out = null;
        Object page = this;
        JspWriter _jspx_out = null;
    try {
        _jspxFactory = JspFactory.getDefaultFactory();
        response.setContentType("text/html; charset=iso-8859-1");
        pageContext = _jspxFactory.getPageContext(this, request,
response,
                "", true, 8192, true);
        application = pageContext.getServletContext();
        config = pageContext.getServletConfig();
        session = pageContext.getSession();
        out = pageContext.getOut();
        _jspx_out = out;
    out.write("\r\n");
        out.write("<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0
Transitional//EN\"http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd\">\r\n");
        out.write("<html xmlns=\"http://www.w3.org/1999/xhtml\">\r\n");
            out.write("<head>\r\n");
                out.write("<title>Home Page");
                out.write("</title>\r\n");
                out.write("<meta http-equiv=\"Content-Type\" content=\"text/html;
charset=iso-8859-1\" />\r\n");
                out.write("<link href=\"DTStylesheet.css\" rel=\"stylesheet\"
type=\"text/css\" />\r\n");
                out.write("<style type=\"text/css\">\r\n");
                out.write("<!--\r\n.style1 {\r\n\tfont-size: 24pt;\r\n\tcolor:
#FF0000;\r\n}\r\nbody {\r\n\tbackground-color: #CCFFCC;\r\n}\r\n.style2
{color: #FF0000}\r\n.style4 {font-size: 14}\r\n-->\r\n");
                out.write("</style>\r\n");
                out.write("</head>\r\n\r\n");
                out.write("<body>\r\n\r\n");

```



```

        out.write("<table width=\"95%\" height=\"264\" border=\"o\"
cellpadding=\"3\" cellspacing=\"0\">\r\n ");
        out.write("<tr>\r\n ");
        out.write("<td>");
        out.write("<div align=\"center\" class=\"style1\">Distance
Training System ");
        out.write("</div>");
        out.write("</td>\r\n ");
        out.write("</tr>\r\n ");
        out.write("<tr>\r\n ");

```

The above code demonstrates that if it is necessary to generate HTML, it must be written to the out object.

On the other hand, JSP interchanges the roles of output and application logic. JavaServer pages are written in HTML with java code embedded in special HTML tags. For example, consider the JavaServer page (Home_Page.jsp) that corresponds to the above servlet written in Dreamweaver's IDE:

```

import="java.sql.*" errorPage="" %>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<title>Home Page</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1"
/>
<link href="DTStylesheet.css" rel="stylesheet" type="text/css" />
<style type="text/css">
<!--
.style1 {
    font-size: 24pt;
    color: #FF0000;
}
body {
    background-color: #CCFFCC;
}
.style2 {color: #FF0000}
.style4 {font-size: 14}
-->
</style>
</head>

<body>
<table width="95%" height="264" border="o" cellpadding="3"
cellspacing="0">
    <tr>
        <td><div align="center" class="style1">Distance Training System
</div></td>
    </tr>
    <tr>

```



```

Prod_Version=ShockwaveFlash" type="application/x-shockwave-flash"
bgcolor="#9CFF9C" ></embed>
  </object></td>
</tr>
<tr>
  <td>Register (only <strong>Admin</strong> and other legitimate
users) </td>
  <td><object classid="clsid:D27CDB6E-AE6D-11cf-96B8-
444553540000"
codebase="http://download.macromedia.com/pub/shockwave/cabs/flash/swfla
sh.cab#version=5,0,0,0" width="103" height="24">
  <param name="BGCOLOR" value="#9CFF9C" />
  <param name="movie" value="button7.swf" />
  <param name="quality" value="high" />
  <embed src="button7.swf" width="103" height="24"
quality="high"
pluginspage="http://www.macromedia.com/shockwave/download/index.cgi?P1_
Prod_Version=ShockwaveFlash" type="application/x-shockwave-flash"
bgcolor="#9CFF9C" ></embed>
  </object></td>
</tr>
</table></td>
</tr>
</table>
<p>&nbsp;</p>
<p>Current time: <%=new java.util.Date() %></p>
<p>Server: <%=application.getServerInfo() %></p>
<p><%! private int accesscount=0; %>
Accesses to site since server reboot:
<%=++accesscount%></p>
</body>
</html>

```

A comparison of these two files demonstrates how different they are from each other. However, they are identical behind the scenes. JSP is another way of writing servlets. JSP was used to build the application, but the JSP webpages written were translated into servlets, which were compiled and it is the servlets that run at each request. Why not use servlets instead of JSP? Servlets are better suited for performing complex application logic, whereas this product is focuses on presentation with some logic inside, not to mention that using Dreamweaver simplified the creation and reusability of the XHTML.

XHTML is the current standard for HTML which brings HTML in line with XML. Thus, the relationship between the two is historical: XHTML replaces HTML. The use of the XHTML makes it possible to describe the structure of the webpage using headings (<h1>, <h2> etc), lists (, ,), body text (<p>) and so forth, but

presentation tags are no longer allowed. CSS and XSLT handle these tasks. The advantage of XHTML is its backward-compatibility. Browsers created before XHTML specification can still display XHTML almost perfectly.

B. THE JSP SELECTION

JSP was chosen over ASP for the following reasons:

- Open Approach.

JSP technology is designed to be both platform and server independent, created with input from a broader community of tool, server, and database vendors. Instead of being tied to a single platform or vendor, JSP technology can run on any web server and is supported by a wide variety of tools from multiple vendors. Specifically, for the used web server, ASP works only with Microsoft's IIS, whereas JSP works with any web server, including Apache, Netscape, and IIS.

- From the developer's perspective.
 - Extensible JSP tags: While both ASP and JSP use a combination of tags and scripting to create dynamic web pages, JSP technology enables developers to extend the JSP tags available. Thus, the JSP specification prescribes a core set of tags, but it is possible to create new ones through custom tag libraries.
 - Reusability across platforms: JSP technology emphasizes components (JavaBeans, Enterprise JavaBeans, custom JSP tags) over scripting. These components are reusable across platforms. On the other hand, ASP does not support any cross-platform component.
 - Java utilization: The use of the Java programming language in the JSP technology makes the developer's work easier because it provides superior performance, power and scalability over the other scripting interpreted languages (VBScript or javascript).

JSP was selected over Microsoft's new technology .NET because a lack of familiarity with .NET's C# language, and secondly, it was possible that the final product would not work on multiple servers and operating systems. The same reasons led to the deployment of JSP over PHP. PHP requires learning an entirely new, less widely used language, not to mention that JSP is much more supported by a wide range of tool vendors than is PHP.

Finally, JSP was chosen over servlets because this application is more concerned about the presentation rather than performing complicated logic computations. Although JSP provides exactly the same capabilities as the servlets, JSP was selected for the following reasons:

- Dreamweaver usage: Macromedia's Dreamweaver was used for the JSP pages. It was not possible to take advantage of the facilities that a web-site development tool provides by writing servlets. For instance, be cognizant of the JSP tags library when developing an application writing only Java code.
- Presentation issues: It was easier to write, reuse and maintain the XHTML using JSP because it avoided the inconvenient *print* statements to generate XHTML along with the error-prone and time-consuming characters (semicolons, backslashes etc.) necessary to produce XHTML output using servlets.
- Distinguishing application parts: After creating the main page template and forms layout, the presentation layer is no longer worrisome and the focus is then on the project logic (database accessibility, queries and so forth).

The aforementioned reasons led to the choice of the JSP server model to develop the application instead of the other competing technologies. As a result, the JSP compilation process is now presented.

Figure 3 shows the process by which JSP pages are compiled. When a request for a JSP page is received, the web server, (Tomcat in this case, finds the compiled version of the page and checks to determine whether it is current. This is done by looking for an uncompiled version of the page with a creation date and time later than the compiled page's creation date and time. If the page is not current, the new page is parsed and transformed into a java source file and that source file is then compiled. Note that this compile happens only once as long as the server is still running and the java source is not changed. However, the server will recompile the JSP source the next time the page is requested if a change is made to it. The servlet is then loaded and executed. If the compiled JSP page is current, then it is loaded into memory and executed. If it is already in memory, then it is simply executed.

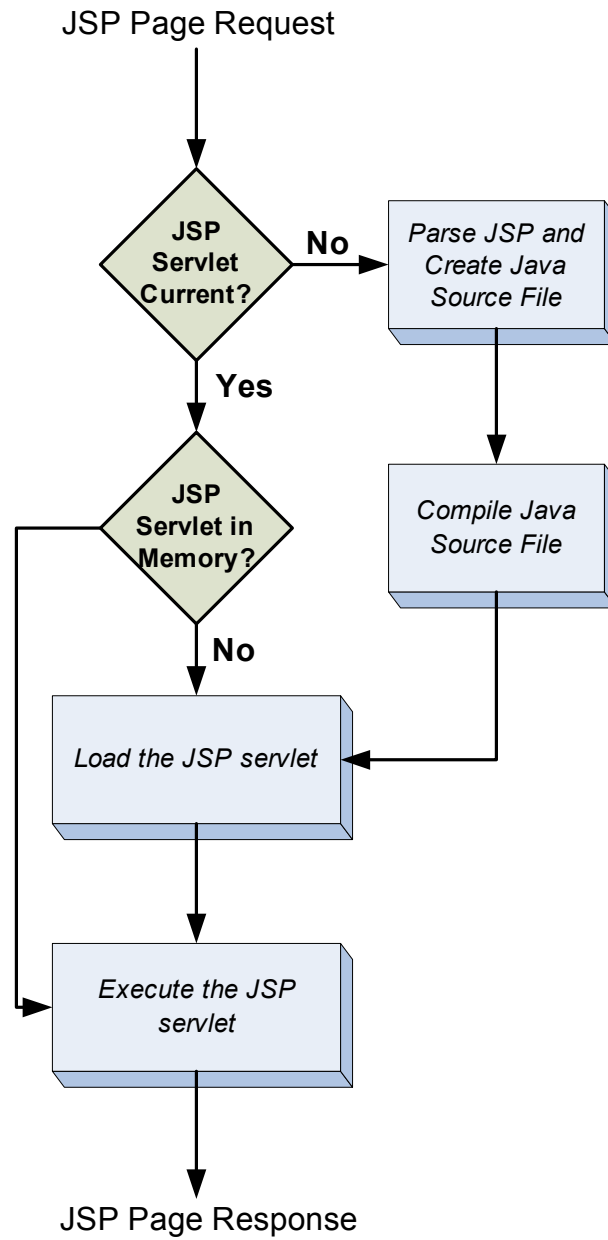


Figure 3. JSP Compilation Process (From Ref. 3)

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III. JSP SYNTAX BASICS

The basics of the JSP structure are presented before describing the application in order to provide the necessary understanding of the position of the scripting elements along with the code structure and style of a JSP webpage. Generally, a JSP page consists of static content, JSP directives, Java code and JSP tags. Static content is the XHTML into which the JSP code is embedded. Consequently, the other basic syntax elements using examples from the application are then offered.

A. JAVA CODE

JSP is used over servlets because of the desire to build user interfaces with some logic for the application. Although putting a small amount of code in the web pages works fine, using large pieces of java code makes the code view difficult to read and hard to reuse. In other words, the fewer lines of java code in the JSP page the better. Otherwise, this would defeat the purpose of using JSPs over the java Servlet API. As stated earlier, the code written in the webpage is inserted into the servlet, which is generated from the webpage and stored in a different directory on the Web server. It is possible to insert Java code using JSP scripting elements in the form of expressions, scriptlets and declarations.

1. Expressions

Java code between `<%=` and `%>` without semicolons is called a JSP Expression. The results of evaluating a expression performed at runtime when the page is requested are converted to a string and directly included within the output page. Typically, expressions are used to display simple values of variables or return values by invoking a bean's getter methods discussed later in this chapter. For example, consider the following JSP Expression from the `Home_Page.jsp`:

```
<p>Current time: <%=new java.util.Date() %></p>
```

```
<p>Server: <%=application.getServerInfo() %></p>
```


The first line outputs the current date and time whereas the second line outputs information about the Web server. Expressions have access to predefined variables such as request, response, session and so forth. Specifically, the “application” implicit object is used to extract web server information, which is a predefined variable representing the ServletContext obtained from the servlet configuration object.

2. Scriptlets

JSP code fragments or scriptlets are embedded within `<% ... %>` tags. This Java code is run when the request is serviced by the JSP page, and it is possible to have almost any valid Java code within a scriptlet, and it is not limited to one line of source code. Scriptlets have access to the same predefined variables as JSP expressions. For instance, the following code fragment entered in the `Course_Request.jsp` file of the application to handle the radio button responses of the `Search.jsp` page is a scriptlet example:

```
<%  
  
int searchMethodInt=1;  
  
String searchMethodStr=request.getQueryString( );  
  
if((searchMethodStr.equals("radiobutton=1&Submit=Submit"))){  
    response.sendRedirect("Keyword_Request.jsp");  
    }  
}  
%>
```

In this particular case, the `getQueryString()` returns the form data. Thus, if “radiobutton=0&Submit=Submit”, then the redirect is to `Course_Request.jsp`. Otherwise, if “radiobutton=1&Submit=Submit”, the redirect is to `Keyword_Request.jsp` and it is possible to search for information using a specific word or phrase. The `sendRedirect(String url)` method generates a 302 response code along with a Location header giving the URL of the new document. Either an absolute or a relative URL is permitted. The 302 response code is one of the HTTP’s status codes, which allows the browser to connect to a new location.

3. Declarations

The JSP declarations make it possible to define page-level variables to save information or define supporting methods that the rest of a JSP page may need. A declaration has the following form:

```
<%! Field or Method Definition %>
```

They are inserted into the main body of the servlet but out of the `_jspService` method and they must not override the standard servlet life-cycle methods such as `service`, `doGet`, `init` and so on. JSP declarations do not produce any output but are used in conjunction with JSP expressions or scriptlets. In a JSP declaration, it is possible to write instance variables, method definitions or anything that to be put in an existing method. However, if there are a large number of method definitions put in the JSP code, it would be easier and more convenient to use separate Java classes (utility classes) and not use JSP declarations. Thus, the reusability of the classes are improved and the testing of the webpage easier because of clean and readable code.

Consider the following JSP declaration from the `Home_Page.jsp` of the application:

```
<p><%! private int accesscount=0;%>  
  
Accesses to site since server reboot:  
  
<%=++accesscount%></p>
```

First of all, from the above example, notice that since declarations do not generate any output, the JSP declaration is used in conjunction with a JSP expression (third line) in order to obtain the result of this code snippet. The second observation is a counter was created which counts the number of times that the website is accessed in just two lines of code. When multiple users request access to a webpage, only one instance of the servlet that corresponds to that specific webpage is created, and each user “gets” one thread using the service method of that servlet instance.

4. Java Beans

Beans are Java classes that are written in order to overcome the disadvantages of scriptlets and JSP expressions for large applications. They are written in standard format, that is, a bean class must have an explicitly default constructor, no instance variables and accessors along with mutators for accessing the values of the class. Although Java Beans were not used in this project, Dreamweaver provides the possibility for inserting a Java Bean in a webpage using the following interface or a collection of beans as shown below:

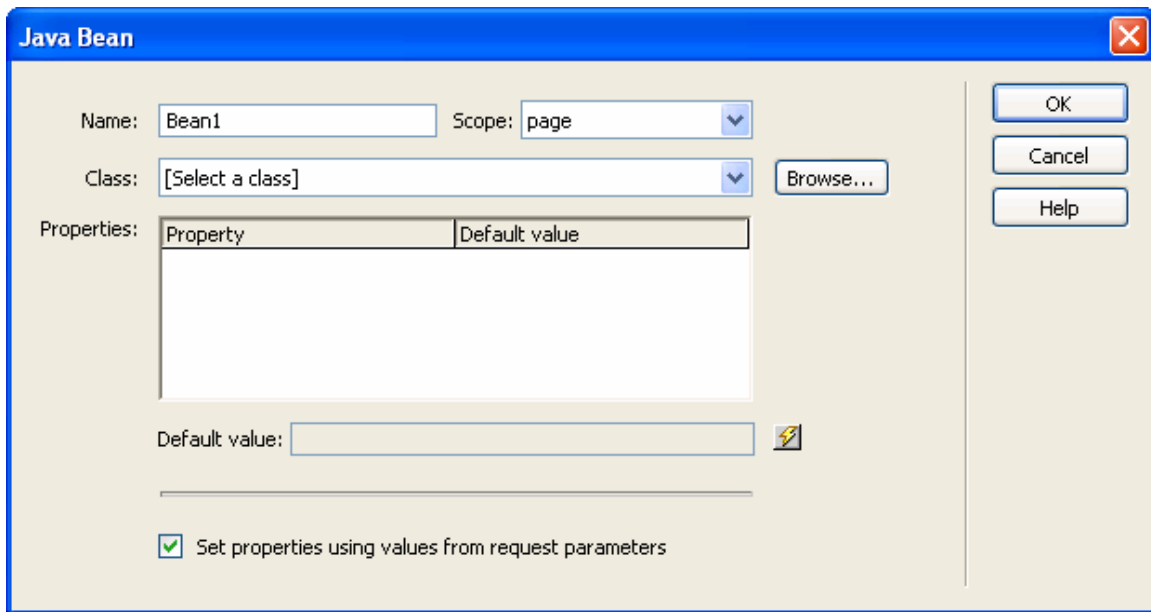


Figure 4. Java Bean Interface

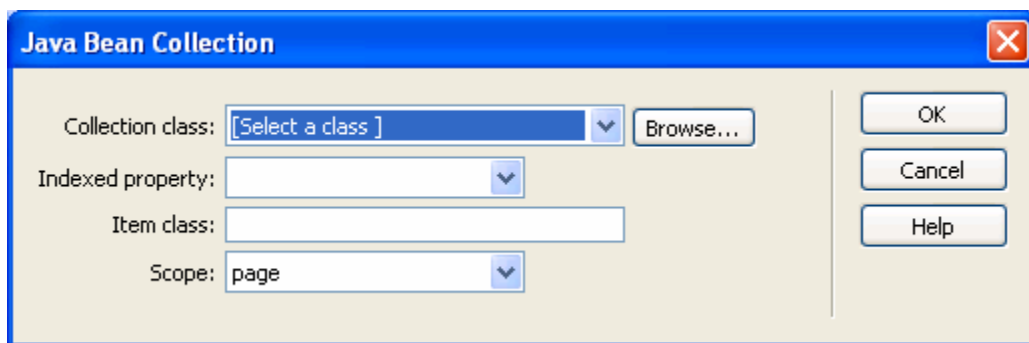


Figure 5. Java Bean Collection

B. JSP DIRECTIVES

JSP directives appear between `<%@` and `%>` markers. They indicate directives to the server prior to compiling the JSP page and affect the overall structure of the servlet that results from the JSP page. In JSP, there are three main types of directives: page, include and taglib. The “page” directive defines the language used in the webpage, the content type of the document, import statements and the error page attribute, which specifies a JSP page that should process any exceptions thrown but not caught in the current page. They are usually placed at the beginning of the code and they remain the same for all the web pages of the application. The following page JSP directive is provided by the Dreamweaver IDE when creating a new webpage:

```
<%@ page contentType="text/html; charset=iso-8859-1" language="java"
import="java.sql.*" errorPage="" %>
```

The above directive is not unchangeable. If the desire is to import some helper classes to the document, it is possible to organize them into packages and then import these packages to the document. For instance, importing a helper package to the above page directive would be written as follows:

```
<%@ page contentType="text/html; charset=iso-8859-1" language="java"
import="java.sql.*, helperPackage.*" errorPage="" %>
```

It is worth mentioning that the import attribute is the only page attribute allowed to appear multiple times within the same document.

The second JSP directive, “include”, makes it possible to insert a file into the JSP page at the time the JSP file is translated into the servlet. This directive’s main advantage is that the attributes and characteristics inserted from the code of the secondary page completely affects the requested (main) page. The disadvantage it is necessary to update the main page whenever any changes are made to the included file. However, Dreamweaver makes the necessary corrections automatically. In this project, the directive used is as follows:

```
<%@ include file="Connections/conne.jsp" %>
```

In this particular case, after establishing the connection to the database and saving it as `conne.jsp`, to be discussed later in more detail, Dreamweaver automatically creates a directory for this connection. As a result, in order to have access to the database records, the MySQL driver code is included to every webpage that must have access to the DBMS.

The third JSP directive, `taglib`, defines custom markup tags. Specifically, this directive tells the server where to find definitions for the custom tags in use in a specific page. This type of directive was not used in this application.

Finally, the JSP tag is the last element of a JSP page structure. A JSP tag is an XML-like interface in a library of Java code. The JSP specification prescribes a set of tags, but it is possible to create the tags through custom tag libraries. When desiring to add the tag in a file, the class that implements a specific API is written and then that class is mapped to a tag name via an XML descriptor file. The concept of the JSP tag was not expounded upon in this thesis since self-defined tags were not used except for those that Dreamweaver provided automatically.

IV. DEFINING THE PROJECT

A. SUPPORTING TECHNOLOGY

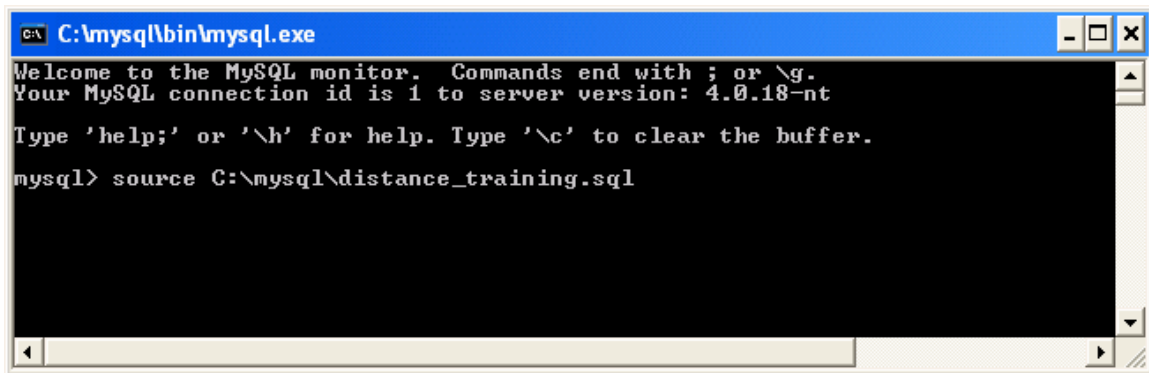
Generally, before starting to develop any web based application, it is appropriate to make some architectural decisions. First, it is necessary to decide which architecture to use, for example client/server, three-tier, or peer-to-peer. For this application, the simple website architecture (three-tier) is selected, which is perhaps the simplest and most familiar to Internet developers. This first step is important because it is resulted after understanding the requirements and the basic enterprise platform for the organization. The next step is to determinate the tools and the components that constitute this project. For the completion of this project, Dreamweaver MX2004 was used as the web development tool. Except for the page layout facilities provided to the developer by using this tool, it is possible to take advantage of one of its application server components, which is (JSP for this project. The other components participating in this application are the web server, which is Tomcat for this project, and the database server (MySQL) described in the following sections.

1. MySQL

MySQL is a multithreading relational database management system. Its main advantage over the other commercial database systems is that it is free and fast. Although the commercial database engines such as Oracle 9i, Microsoft SQL Server or Sybase support every feature imaginable, there is a performance cost to pay for these features. None of these database engines can compete with MySQL for read-heavy database applications basically due to MySQL's limited transaction management and logging capabilities. However, due to the above limitations, MySQL is very fast for pure query applications. Therefore, there are web-oriented data publishing companies that maintain their databases using Oracle, but download them to MySQL for query publishing on their web servers.

The binary distribution of MySQL 4.0 for Windows was downloaded from MySQL's downloads page: <http://www.mysql.com/downloads>. The default directory C:\mysql was used to install the database software. It could be installed in a different

directory, but in this case, it would have been necessary to create a configuration file pointing to the directory chosen. These queries are run using the command line, which appears if the `mysql.exe` is run in the `C:\mysql\bin`. In order to keep track of the relational schema and the data entered in the relations, a text editor (`distance_training.sql`) was created, which was kept in the `C:\mysql` directory. Consequently, in order to generate the `distance_training` database in the copy of MySQL, the following source command as shown in the screenshot was run:



```
C:\mysql\bin\mysql.exe
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 1 to server version: 4.0.18-nt
Type 'help;' or '\h' for help. Type '\c' to clear the buffer.
mysql> source C:\mysql\distance_training.sql
```

Figure 6. MySQL Source Command

The source command is used to run SQL commands stored in an external document. All the necessary code of the database is stored in the text file `distance_training.sql` and using the source command tells MySQL to generate relations and populate these relations according to the information specified in the text file. When running the source command, a number of success messages are obtained that indicate that the `distance_training` database is properly installed and running in MySQL:

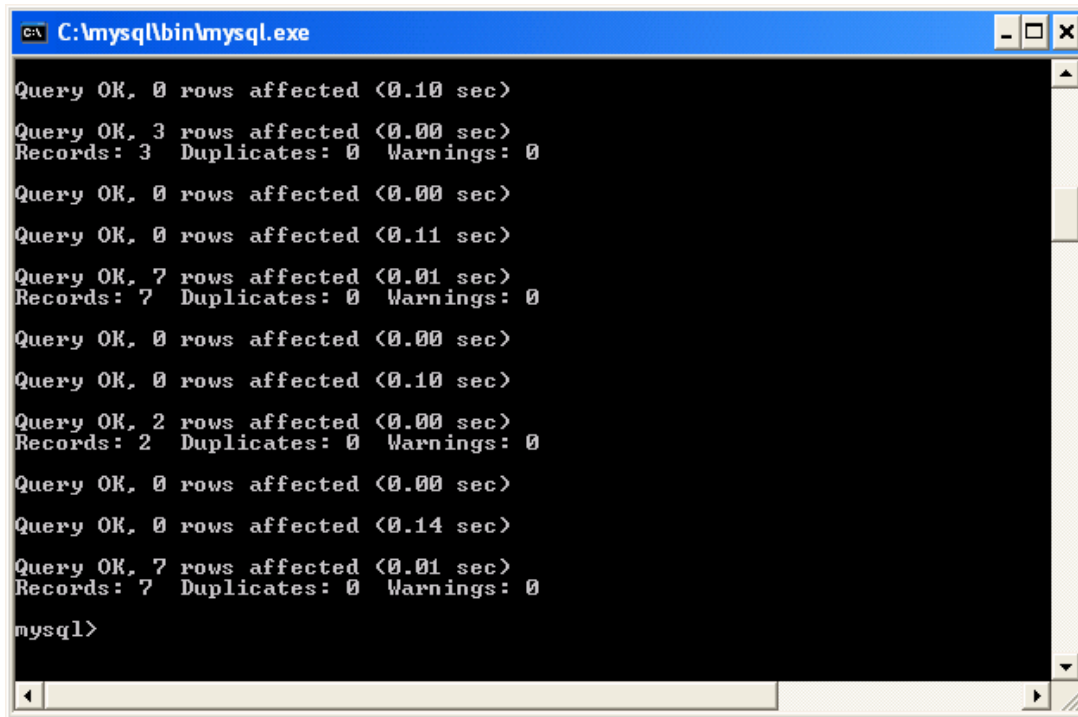


Figure 7. Success Messages

2. Web Server- Tomcat

After the database server, the Tomcat zip file was downloaded as the web server from <http://jakarta.apache.org/tomcat/>. Tomcat was configured as a standalone server for servlet and JSP development following the steps shown below:

- Setting the JAVA_HOME Variable

The most critical Tomcat setting is the JAVA_HOME Variable because improper setting of this variable stops Tomcat from finding the classes used by javac, and therefore, prevents Tomcat from handling JSP pages. On this platform (Windows XP Pro), this variable is set as follows:

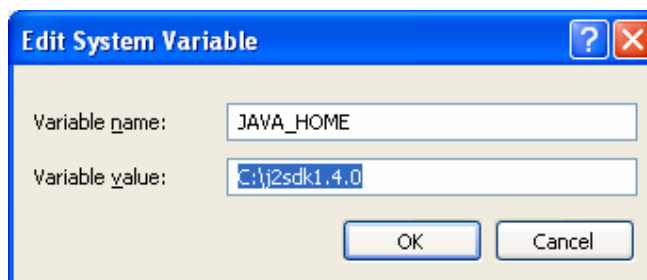


Figure 8. Variable

- Specifying the server port.

Tomcat uses port 8080 by default in order to avoid conflicts with other servers running on the system, such as IIS, which is registered on port 80. In order to ensure that the Web server's port is set to 8080 or if it is necessary to modify the port number, the Connector element in the `install_dir/conf/server.xml` verifies this. In the web server, the following applied:

```
<Connector className="org.apache.coyote.tomcat4.CoyoteConnector"

    port="8080" minProcessors="5" maxProcessors="75"

    enableLookups="true" redirectPort="8443"

    acceptCount="100" debug="0" connectionTimeout="20000"

    useURIVValidationHack="false" disableUploadTimeout="true" />
```

- Enabling Servlet Reloading

As stated in Chapter II (The JSP Selection) which describes the JSP compilation process, when a request for a JSP page is received, the web server (Tomcat) finds the compiled version of the page and checks to determine whether it is current by looking for an uncompiled version of the page having a creation date and time later than the compiled page's creation date and time. Although this feature may slightly degrade performance, it is very useful from the programmer's point of view because there is no need to restart the server every time a servlet is compiled. By looking at the `install_dir/conf/server.xml` directory, note that the `reloadable` attribute is set to `true`. Check the alignment throughout.

```
<DefaultContext reloadable="true"/>
```

- Enabling the ROOT Context

The ROOT Context is the default web application in Tomcat, which is already enabled in Tomcat 4.0 and some versions of Tomcat 4.1. If, however, it is not enabled in this server, it is possible to uncomment the following line in the `install_dir/conf/server.xml` directory:

```
<Context path="" docBase="ROOT"
debug="0"/>
```

- Turning on the Invoker Servlet

The invoker servlet makes it possible to run servlets without making any change to the WEB-INF/web.xml file in the Web application. In this project, the /servlet/*servlet-mapping element is uncommented in install_dir/conf/web.xml.

The local deployment environment is now finished. It is next necessary to create the personal development environment as well, in order to be able to compile the servlets generated from the JSP pages. Configuring the development environment involves the following steps:

- Creating a Development Directory

In the C:\TOMCAT\webapps\ROOT directory, a new location is created called website. In this directory, all the JSP documents, flash objects, images, Cascading Style Sheet documents and database are stored. Every file participating in the project is stored in this directory.

- Setting Our Classpath

This variable is set in order to tell the Java compiler (javac) where to find the servlet classes. Before setting this variable, only the web server knows about the servlet classes. Thus, if the classpath is not set in the system, an attempt is made to compile servlets, tag libraries or other classes using the servlet API. In this server, the JAR files containing the servlet API are located in C:\TOMCAT\server\lib.

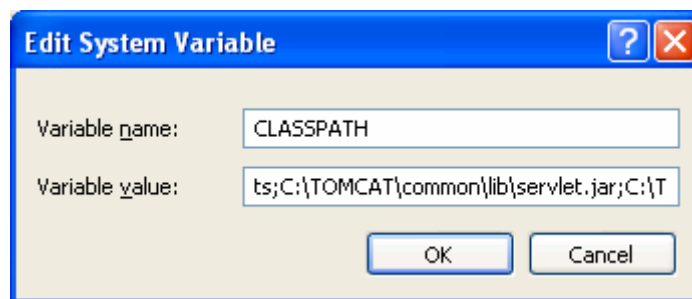


Figure 9. Setting the Class Path

In addition to the servlet JAR file, it is also necessary to include both the development and the current directory “.” in the classpath, as shown below.

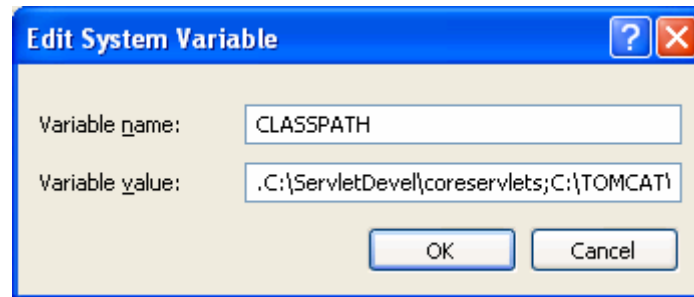


Figure 10. Including the Current Directory in the Classpath

- Making shortcuts to start and stop the server

It was determined that it is more convenient to place shortcuts to the server startup and shutdown icons on the desktop in order to avoid going to the C:\TOMCAT\bin frequently to start and stop the server.

- Testing the Setup

Finally, before starting with Dreamweaver, the configuration was tested by verifying the SDK installation, checking the basic server configuration (access to Tomcat's home page), and deploying some simple servlets and JSP Pages.

Lastly, the servlet source and their classes generated from the JSP Pages are stored in the C:\TOMCAT\work\Standalone\localhost_\website directory.

During the development of this project, it was necessary to refer to these files frequently in order to understand what is going on behind the scenes and for troubleshooting problems on the webpages.

3. Dreamweaver MX

Macromedia Dreamweaver MX is a complete web application development tool that combines many critical web authoring tools such as databases, SQL, Java, XML, XSLT and so forth with application server technologies such as JSP, ASP.NET, PHP and others. Dreamweaver's main interface components will be referred to during the development of this application. After configuring the database server and setting up the

JSP engine, the first step is to set Dreamweaver to work with dynamic webpages. A location in the ROOT directory of the web server (website) was created and the application was named DistanceTraining, as shown below:

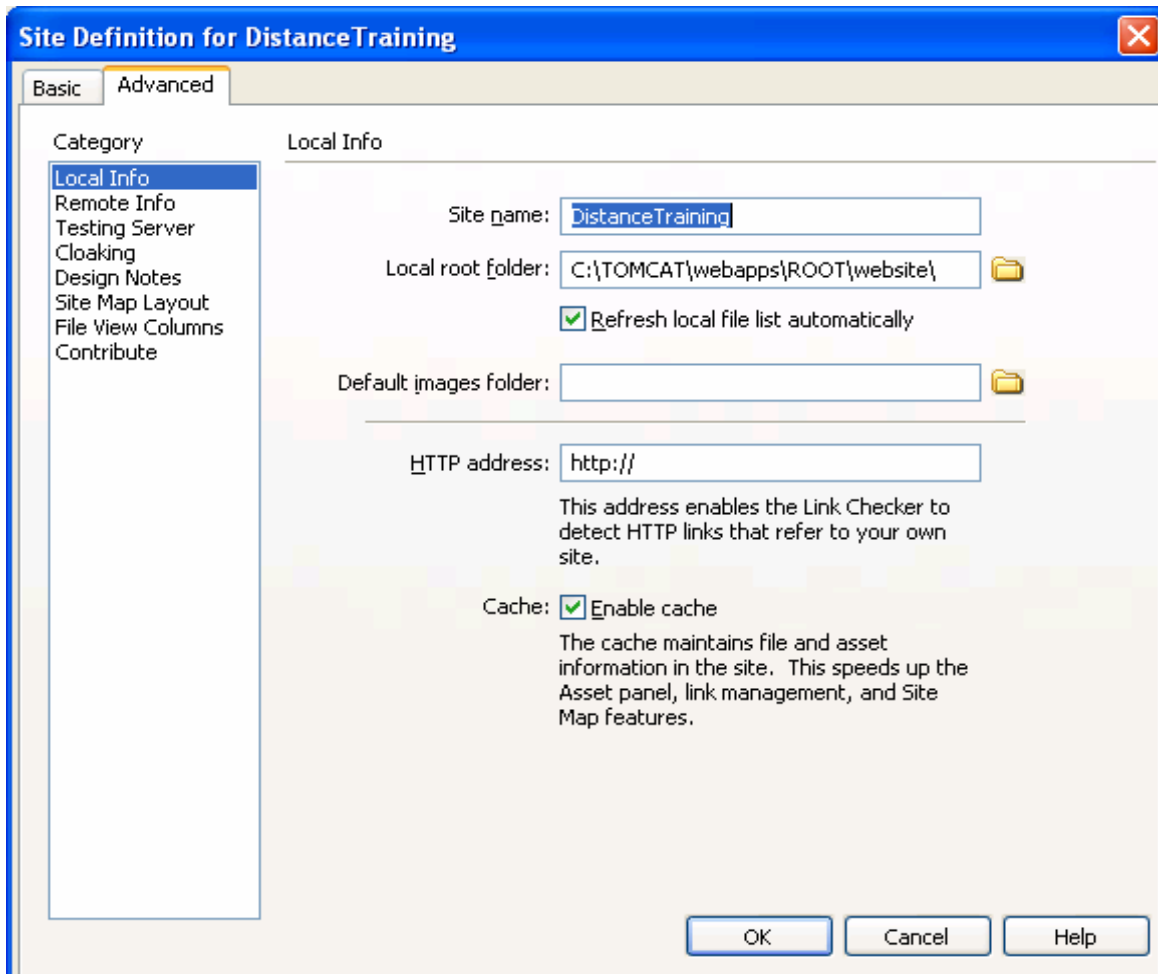


Figure 11. Site Definition-Local Info

This thesis will not describe Dreamweaver's user interface. Many books are available that can assist in learning Dreamweaver's components and features. Only its main components and tools that helped to build a data-driven web application are described. Besides, Dreamweaver was chosen in order to demonstrate the possibility of developing a Web product prototype quickly and correctly as long as a reliable and clean database model is built. Additionally, developing a static website, which is an application not interacting with any data source, is possible by using some other lightweight HTML text editors such as FrontPage, BBEdit or HomeSite.

The selection of the Testing Server from the Category list provides the next user interface:

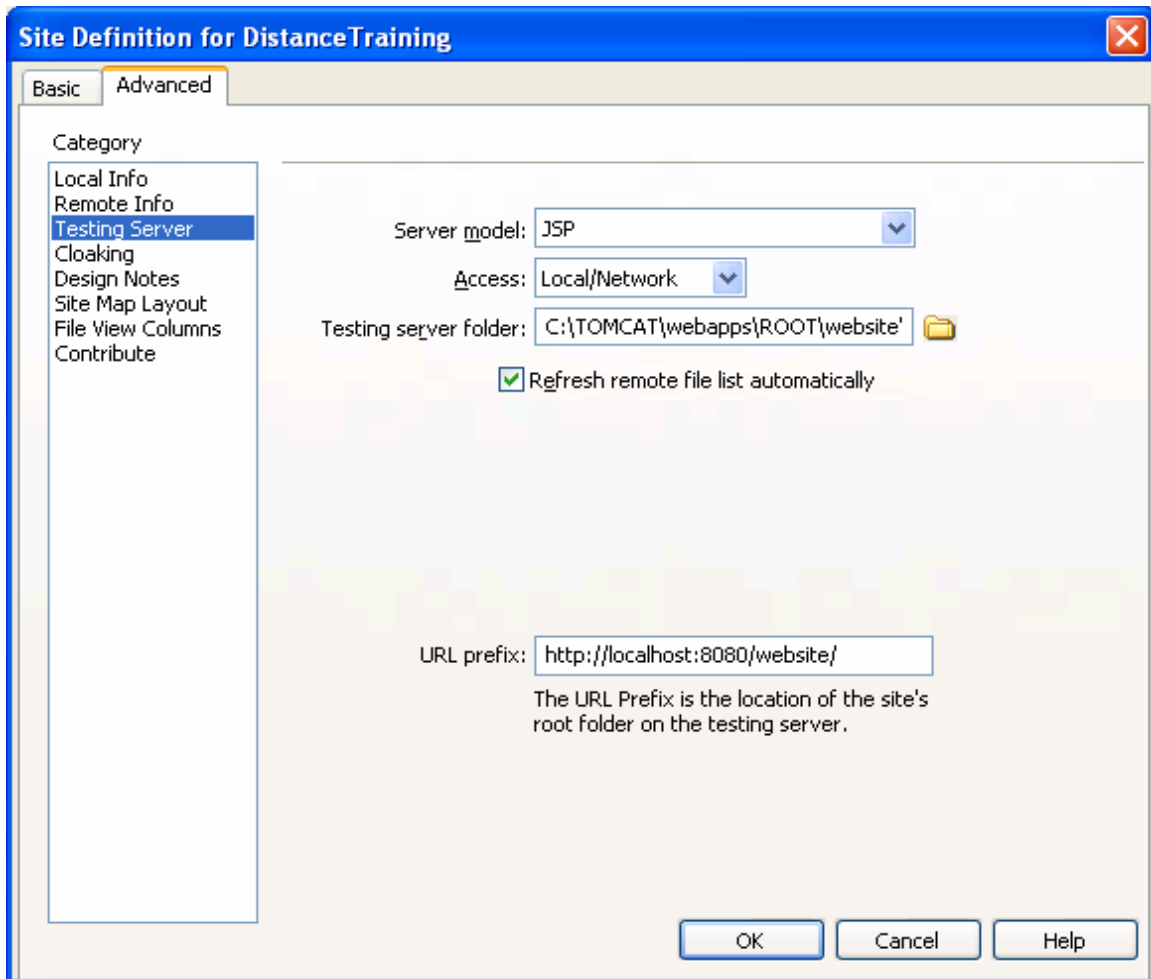


Figure 12. Site Definition-Setting the Testing Sever

The Testing Server enables Dreamweaver to test files after they have been processed on the server and thus verify that they actually work. From the first drop-down menu, the server model that will be used is selected, which is JSP for this project. In the Access drop-down menu, Local/Network is chosen because the application was developed on a computer with a local version of a standalone Tomcat installed. In the testing server folder textfield, the location of the server is indicated where the files are stored. When navigating the application, the web pages from this directory will be those served. The website's URL is entered in the URL prefix. The expression

“localhost:8080” is a shortcut that activates Tomcat on the machine on the specified port, and tells it to look in its root directory, which is ROOT for this project. Finally, before connecting to the database, it is necessary to handle the formatting of the web pages. This can be done using Cascading Style Sheets (CSS), which makes it possible to maintain the same appearance throughout the website without making formatting adjustments for every webpage in the website. An external style sheet was used, which is stored outside the web pages and is attached to every webpage in order to maintain the same formatting style on the web pages. In this project, this external style sheet file is named DTStylesheet.css.

4. JDBC Connector

JDBC, as with all Java APIs, is a set of classes and interfaces that work together to support a specific set of functionality, which in the case of JDBC, is database access. By using the JDBC API, it is possible to access a variety of SQL databases with the same Java syntax. Java combines the classes that form the JDBC API in the java.sql package, which is imported automatically in Dreamweaver as long as a connection is defined to the database. It is important to note that JDBC standardizes the approach for connecting to a RDBMS and does not attempt to impose a specific SQL syntax. Most of the classes in the java.sql package are interfaces. In other words, they do not provide implementation details. Individual database vendors provide the implementations of these interfaces in the form of a JDBC driver. The JDBC API makes it possible to do three things:

- Establish a connection with a database or access any tabular data source
- Send SQL statements
- Process the results

Figure 13 shows the JDBC architecture.

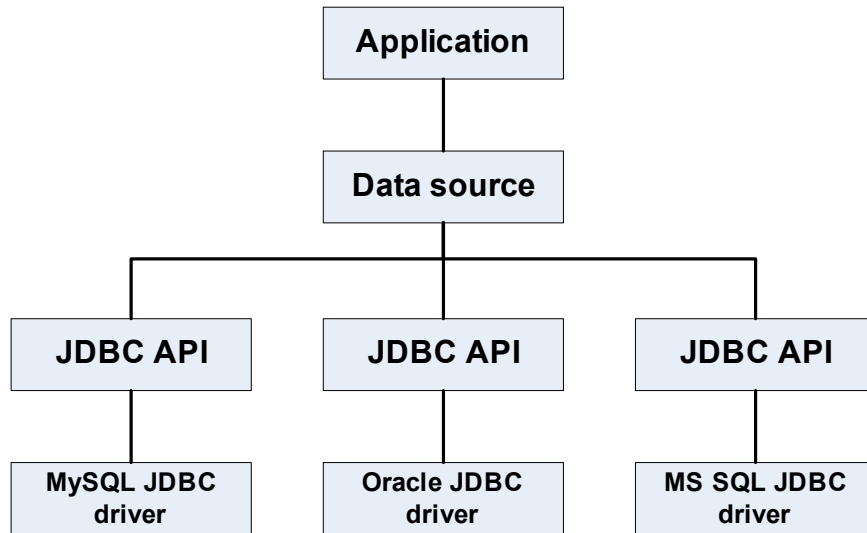


Figure 13. JDBC Architecture (From Ref. 1)

Figure 13 illustrates the general JDBC architecture from the application's perspective. From the application, methods of the JDBC API are called. The implementation written in those methods actually performs the database calls.

In order to connect the web pages with the MySQL database using Dreamweaver's interface, the Databases panel is used in the Application panel group to the right of the IDE, and the Connection (+) button is selected. Next, it is necessary to choose one connection type from among the other options.

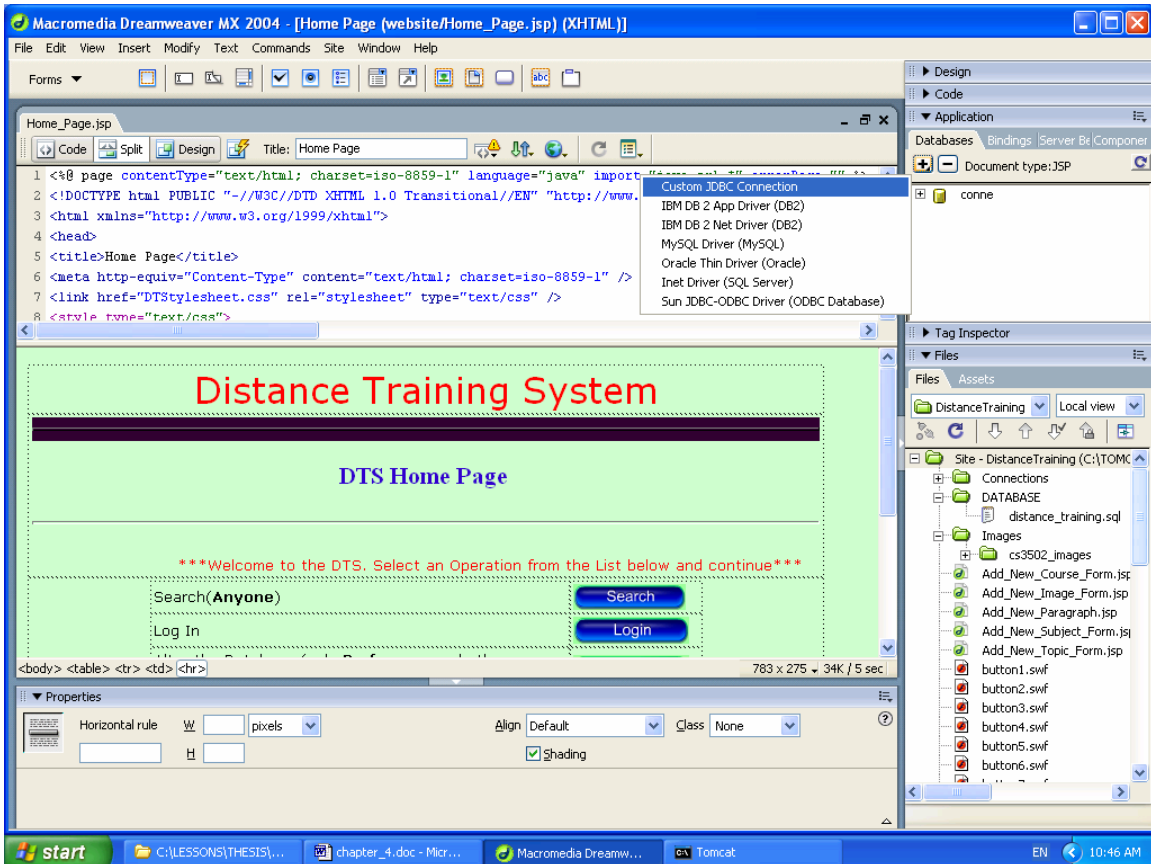


Figure 14. Connecting Our Web Pages to the Database Server

“MySQL Driver (MySQL)” is selected and the textfields of the window filled that return the necessary information, as shown below:

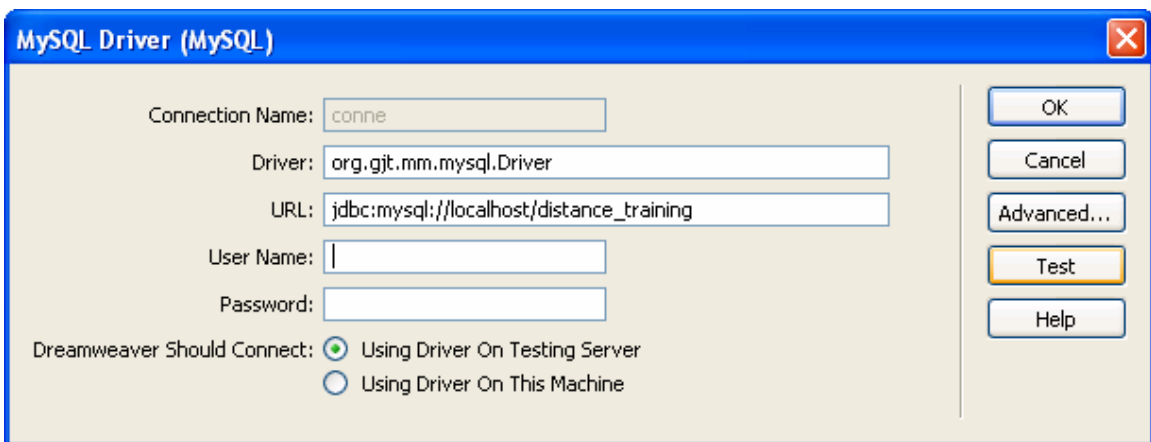


Figure 15. Setting Up the MySQL Driver

As seen, the connection name in the first textfield (conne) is passed. The GNU driver is selected with the implementation specified in the second textfield (Driver) from the DriverManager class of the java.sql package. MySQL also contains the Caucho and the twz driver types. This Driver provides the connection to the database based on the URL passed on the third textfield (URL). A JDBC URL appears in the form of jdbc:protocol:subprotocol. The protocol of the GNU Driver is mysql, whereas the subprotocol provides the implementation-specific connection data. Thus, the hostname (localhost) and the database name (distance_training) is passed. The port is also required, but in this case, the database engine is running on the default port (8080).

It is worth mentioning that it does not matter which page of the website is open when initially creating the connection. Dreamweaver sets the connection for the whole website creating a new folder in the website, called Connections, with a new file inside called conne.jsp. This file holds the information previously passed in the database window:

```
<%  
// FileName="mysql_jdbc_conn.htm"  
// Type="JDBC" ""  
// DesignTimeType="JDBC"  
// HTTP="true"  
// Catalog=""  
// Schema=""  
String MM_conne_DRIVER = "org.gjt.mm.mysql.Driver";  
String MM_conne_USERNAME = "";  
String MM_conne_PASSWORD = "";  
String MM_conne_STRING = "jdbc:mysql://localhost/distance_training";  
%>
```

B. PROJECT DESCRIPTION

1. The Distance-Training Application

In recent years, the field of educational technology has witnessed the emergence of many e-learning tools (tools for instruction that use the Internet) as well as many collaborative learning environments for online instruction. Basically, for economical and flexibility reasons, the Distance Learning model should be applied to each country's Armed Forces without discarding the traditional learning method. This achievement will make it possible to have a greater effectiveness and more learner-centric training. Although the data model is created to work as a distance learning application, it can also

be transformed to deliver standardized individual, self-development, and small group training to soldiers through the application of networked communication systems. This can be accomplished by following a different hierarchy, for instance, a battalion-company-platoon-troop-soldier. This adaptability is significant because never assume that what works well in education will also necessarily work well in training.

The conceptual schema works fine for short-term military schools for both officers and noncommissioned officers. Every Army branch supervision (e.g., signal corps) has the possibility to train its personnel while they remain assigned to their units. For familiarity reasons, the model was adapted to a university educational environment.

There are two paths to capture the information stored in the “section” and “image” entity classes. The first path is through users→ course→subject→ topic→section→image. This path can be used by professors responsible for the course or by students who have enrolled to attend one or more classes and they are familiar with the official education management system of the university. The second path, category→section→image, can be used by users not familiar with the navigation flow of the first path. External users are able to use key words to capture the desired information. Both types of users can use either path but only the users who belong to the professors’ user-group have permissions to insert, update, or delete information through forms.

A Learning Management System, such as NPS’s Blackboard, is appropriate for those student/users enrolled to attend specific classes. Users in the DTS do not need to take advantage of the full spectrum that a LMS such as Blackboard provides (grade reports, participation records, etc.). They simply want to retrieve their desired information by accessing the content without being necessarily part of the organization that uses the DTS.

2. UML Diagram

There are many ways to represent the conceptual schema. The fundamental way is the Entity- Relationship (E-R) model with the IDEF1X national standard and the UML as its variants. UML was selected because it is the basis of the object-oriented design.

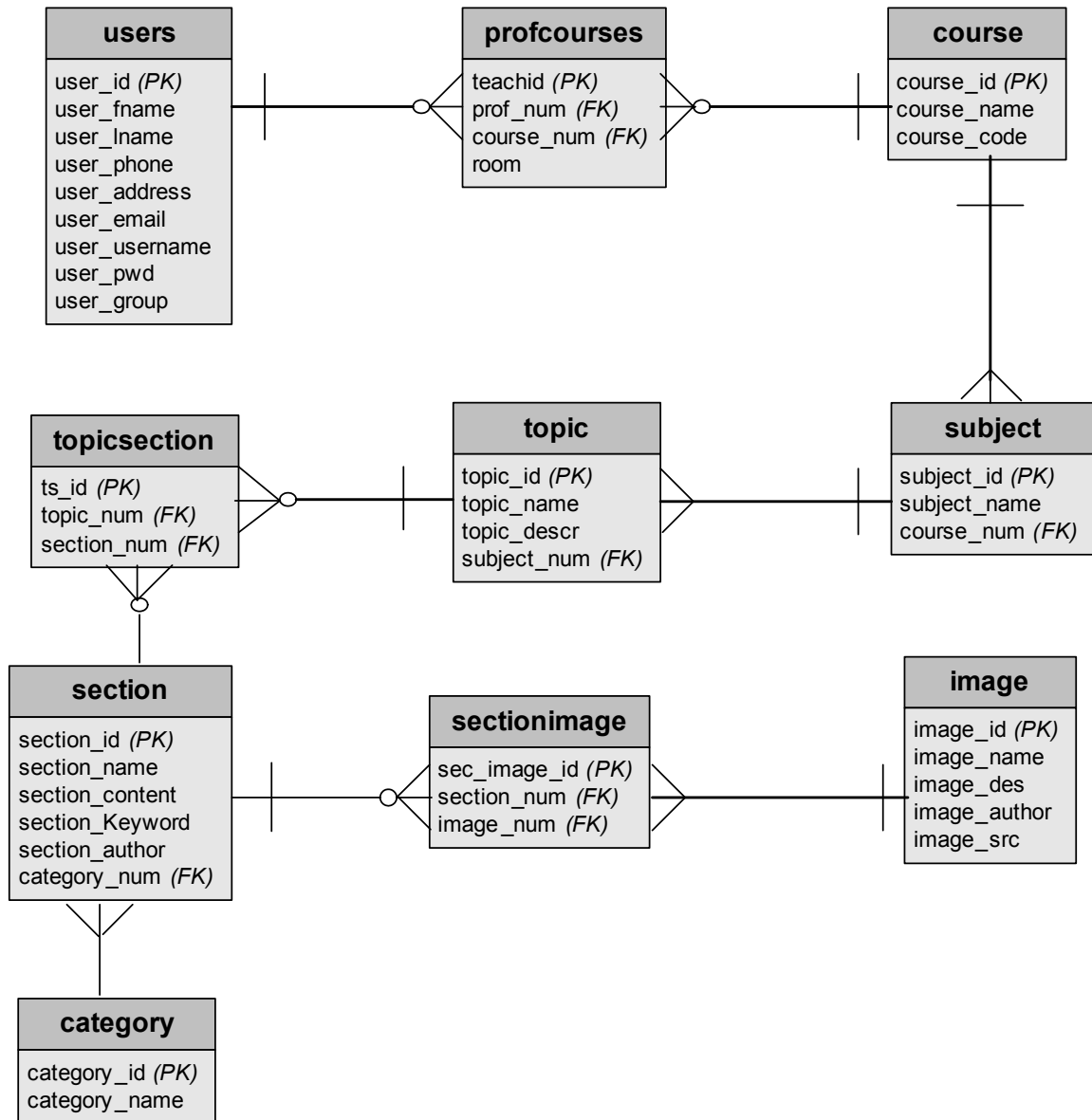


Figure 16. UML for the DTS Application

3. Relationships and Relation Schema

Many-to-Many.

- A user who belongs to the professor’s user group can teach many courses and one course can be taught by many professors. The join table profcourses was used to model this many-to-many relationship.
- A topic may include many sections and one section may be included in many topics. In other words, the same section can be used by different topics, and as a result, by different courses. Thus, different professors can

use the same section in their course. For instance, a professor that teaches databases in the IS department can use sections (paragraphs) from a database course taught in the CS department. The join table topicsection was used to model this many-to-many relationship.

- A section may have many images and an image can be included in many sections. The join table sectionimage was used to model this many-to-many relationship and transform it to a one-to-many.

One-to-Many

- A course contains many subjects but one subject is part of one course.
- A subject contains many topics but one topic is part of one subject.
- A category contains many sections but one section is part of one category.

Successively, the relation schema is described:

- users (user_id: INT, user_fname: VARCHAR(30), user_lname: VARCHAR(30), user_phone: CHAR(20), user_address: VARCHAR(30), user_username: CHAR(8), user_pwd: CHAR(10), user_group: CHAR(10)).
- course (course_id: INT, course_name: TEXT, course_code: TEXT).
- profcourses (teachid: INT, prof_num: INT (FK), course_num: INT (FK), room: CHAR(20)).
- subject (subject_id: INT, subject_name: CHAR(30), subject_descr: VARCHAR(50), course_num: INT (FK)).
- topic (topic_id: INT, topic_name: VARCHAR(30), topic_desc: VARCHAR(60), subject_num: INT (FK)).
- section (section_id: INT, section_name: CHAR(50), section_content: MEDIUMTEXT, section_keyword: CHAR(100), section_author: MEDIUMTEXT, category_num: INT (FK)).
- topicsection (ts_id: INT, topic_num: INT (FK), section_num: INT (FK)).
- category (category_id: INT, category_name: VARCHAR(30)).
- image (image_id: INT, image_name: CHAR(30), image_des: CHAR(30), image_author: MEDIUMTEXT, image_src: VARCHAR(100)).
- sectionimage (sec_image_id: INT, section_num: INT (FK), image_num: INT (FK)).

C. XML USAGE

A dilemma was faced in the beginning of this application. Is it better to store information in XML documents or use the relational model? Furthermore, since it was

necessary to have a database to store the data, could XML be used as the database? The answer to the last question is: “Sort of”. On the plus side, XML provides many of the things found in databases: storage (XML documents), schemas (DTDs, XML Schemas, and so forth), query languages (XQuery, XPath, XQL, etc.), and programming interfaces (SAX, DOM, JDOM). Conversely, it lacks many of the features found in real databases: efficient storage, indexes, security, transactions and data integrity, multi-user access, triggers, and queries across multiple documents. Thus, the first general reason leading to the adoption of the relational model is that while it may be possible to use an XML document or documents as a database in environments with small amounts of data, few users, and modest performance requirements, this will fail in most production environments with many users, strict data integrity requirements, and the need for good performance.

Another issue taken into consideration before starting was the type of data to handle: data-centric or document-centric data. Data-centric is the kind of data characterized by a fairly regular structure, fine-grained data and little or no mixed content. Examples of data-centric documents are sales orders, flight schedules, scientific data, and stock quotes. On the other hand, document-centric is the kind of data characterized by less regular or irregular structure, larger grained data and a large amount of mixed content. Examples are books, email, advertisements, and almost any hand-written XHTML document.

The above distinction is important because if the data is data-centric, a good solution is to store the data in a relational database with XML capabilities such as SQL-Server and Oracle, or in a relational database and use software to transfer the data between XML documents and the database. On the other hand, if the data is document-centric, a good solution is to store the data in a native XML Database. The data in this project is more document-centric than data-centric. A relational database with XML capabilities was not utilized because these products are not free and when they are upgraded (for instance, Oracle 8i to Oracle 9i), it is difficult and sometimes painful to transfer the information from one DBMS to the other. Additionally, a Native XML database was not used because of the lack of familiarity with the necessary software AG (Tamino), which allows someone to access and manipulate data in a XML database.

Nevertheless, depicting the application using XML can be provided in the following document edited with XMLSpy:

```
<?xml version="1.0" encoding="UTF-8" ?>
= <!--
MAJOR Nick Pogkas
    Description: This is an XML document that corresponds to one
    section of the DTS application

-->
= <Course courseCode="cs2900" courseName="Introduction to Java"
instructor="Otani, Thomas">
= <Contents>
= <Subject subjectName="Chapter 1: Introduction to Object-Oriented
Programming and Software Development">
= <Topic topicName="Classes and Objects">
= <Section sectionName="Object-Oriented Programming Basics">
    ![CDATA[
= <HTML>
= <HEAD>
= <TITLE>
= <b>Classes and Objects</b>
= </TITLE>
= </HEAD>
= <BODY>
= <p>
= <b>Object-Oriented Programming Basics</b>
= </p>
= <p>The two most important concepts in object-oriented programming are
the class and the object. In the broadest term, an object is a thing, both
tangible and intangible, that we can imagine. A program written in object-
oriented style will consist of interacting objects. For a program to keep
track of student residents of a college dormitory, we may have many
Student, Room, and Floor objects. For another program to keep track of
customers and inventory for a bicycle shop, we may have Customer, Bicycle,
and many other types of objects. An object is comprised of data and
operations that manipulate these data. For example, a Student object may
consist of data such as name, gender, birth date, home address, phone
number, and age and operations for assigning and changing these data
values. We will use the notation shown in Figure 1.1 throughout the book to
represent an object.</p>
= <p>
= <image src="Images/cs2900_images/Figure1.gif" />
= </p>
= <p>Inside a program we write instructions to create objects. For the
computer to be able to create an object, we must provide a definition, called
a class. A class is a kind of mold or template that dictates what objects can
and cannot do. An object is called an instance of a class. An object is an
instance of exactly one class. An instance of a class belongs to the class.
The two Bicycle objects Moto-1 and Moto-2 are instances of the Bicycle
```

class. Once the class is defined, we can create as many objects of the class as a program requires.

```
</BODY>
</HTML>
]]
</Section>
</Topic>
<Topic topicName="Messages and Methods" />
<Topic topicName="Class and Instance Data Values" />
<Topic topicName="Inheritance" />
<Topic topicName="Software Engineering and Software Life Cycle" />
</Subject>
<Subject subjectName="Chapter 2: Getting Started with Java" />
<Subject subjectName="Chapter 3: Numerical Data" />
<Subject subjectName="Chapter 4: Defining Your Own Classes" />
<Subject subjectName="Chapter 5: Selection Statements" />
<Subject subjectName="Chapter 6: Repetition Statements" />
<Subject subjectName="Chapter 7: Event-Driven Programming and Basic
GUI Objects" />
<Subject subjectName="Chapter 8: Exceptions and Assertions" />
<Subject subjectName="Chapter 9: Characters and Strings" />
<Subject subjectName="Chapter 10: Arrays" />
<Subject subjectName="Chapter 11: Sorting and Searching" />
<Subject subjectName="Chapter 12: File Input and Output" />
<Subject subjectName="Chapter 13: Inheritance and Polymorphism" />
<Subject subjectName="Chapter 14: Advanced GUI" />
<Subject subjectName="Chapter 15: Recursive Algorithms" />
</Contents>
</Course>
```

In conclusion, although native XML databases offer the advantage of speed over traditional databases, it is too new to be of practical use at this stage. XML is not just an extension of HTML. The complexities of this emerging technology require extensive training. A year's worth of additional courses in XML or XML-oriented topics would be helpful and necessary to employ the rich potential of XML. It is beyond the focus of this thesis to expound further upon the strengths and weaknesses of employing purely XML databases.

V. APPLICATION FILE ANALYSIS

This section describes the main files constituting the application and examines some of the most important Dreamweaver features that facilitated the work on this project.

A. USER AUTHENTICATION INTERFACE

One of the most common tasks for web developers is the implementation of a framework that allows users to register/log into a web site. Pages in a website are divided into those that are publicly accessible and those that require log-in by users to.

When a user wants to access the website, the default page appears, which is the “Home_Page.jsp”. From this point, in order to proceed, it is necessary to log-in or register if this is the first log-in in order to access the site’s information.

1. Home_Page.jsp

The default page of this application is the Home_Page.jsp. It is mainly a static page that consists of four buttons (flash objects). An event (a new page) is generated upon pressing any of these buttons. Each button is registered to a specific page which opens a path to a unique operation (search, log in, alter and registration). The other features illustrated in this page (current time, type of server and counter) are JSP Expression, scriptlet and Declaration JSP elements, respectively that are described previously in Chapter III, JSP SYNTAX BASICS.

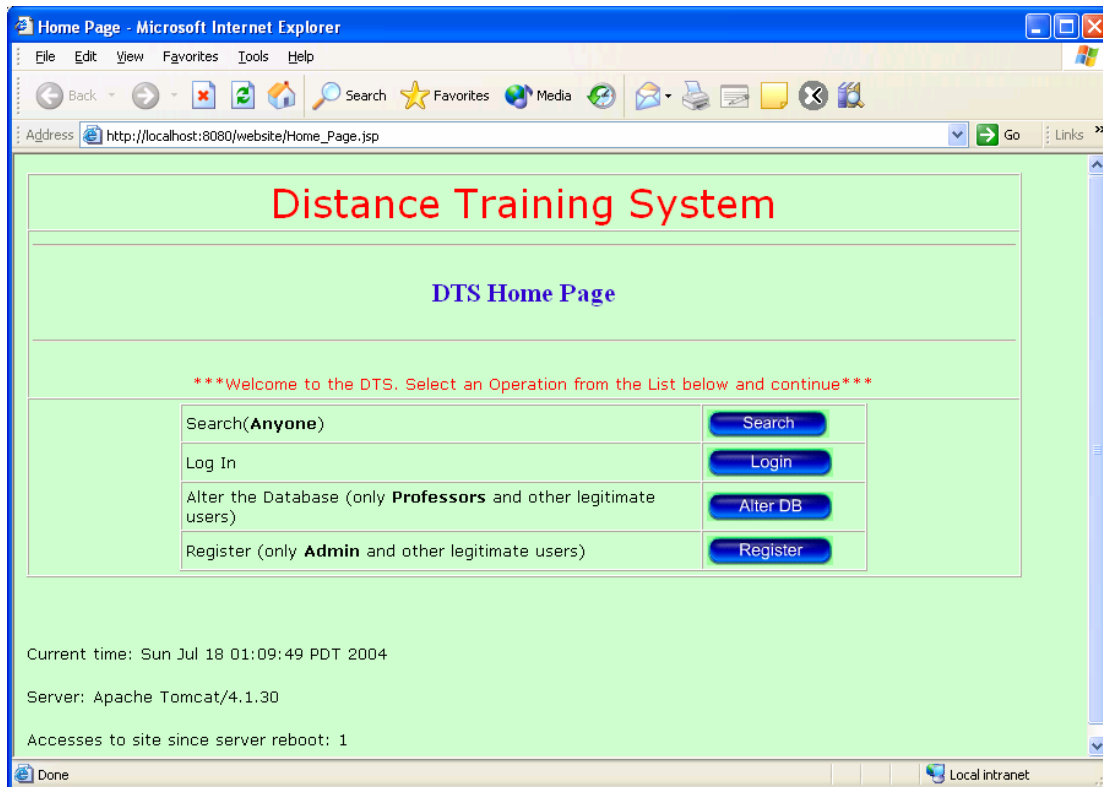


Figure 17. Home (Default) Page

It is obvious that the capabilities of the default page can be extended by adding more buttons and dynamic content but these operations are basic and the most usual in every content management website.

2. Registration.jsp

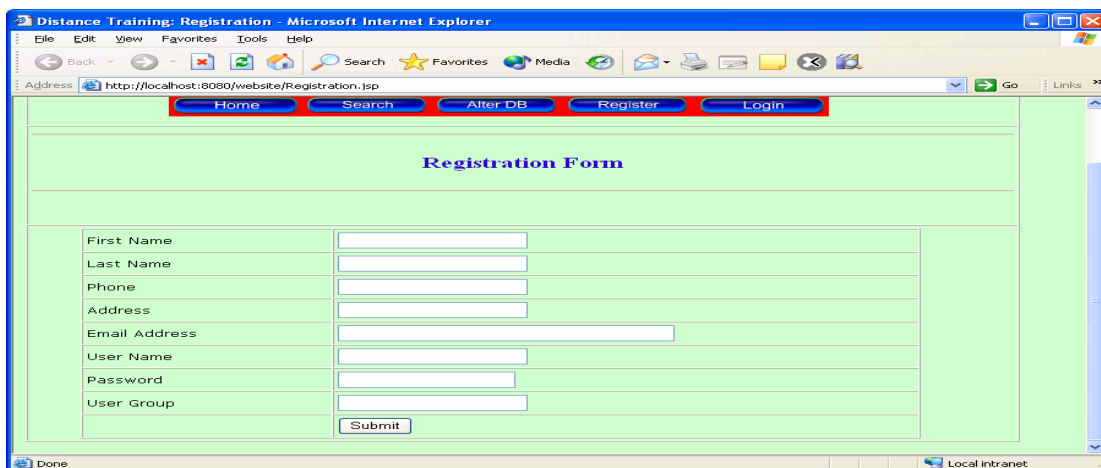
If a user has not visited the site previously, it is necessary register. The Registration.jsp and Login.jsp pages are the main pages that constitute the user authentication part of the application. User authentication is required in order to access any part of the website because four groups of users are distinguished:

- The administrator authorized to maintain the normal operation of the site, register new users and so forth.
- The professors responsible for the site content (insert, update or delete course material).
- The students registered to attend a class and use the site's content to learn specific information about a subject of this course or learning material included in other courses.

- Other legitimate users interested in learning information about a specific topic.

This is not completely correct because unregistered users cannot determine in advance if they are interested in the information provided by the DTS. However, registration is free, and DTS only uses the information for marketing and promotional reasons to learn more about the users.

Since the website consists entirely of restricted pages, the users can access them as long as they have successfully logged in. The log-in process presupposes the registration process. The registration process in this application is accomplished by creating a registration form where the user can insert information to the database as shown below.



The image shows a screenshot of a Microsoft Internet Explorer browser window. The title bar reads "Distance Training: Registration - Microsoft Internet Explorer". The address bar shows "http://localhost:8080/website/Registration.jsp". Below the address bar, there is a navigation menu with buttons for "Home", "Search", "Alter DB", "Register", and "Login". The main content area has a light green background and is titled "Registration Form". The form contains several text input fields: "First Name", "Last Name", "Phone", "Address", "Email Address", "User Name", "Password", and "User Group". A "Submit" button is located at the bottom of the form. The status bar at the bottom of the browser window shows "Done" and "Local Intranet".

Figure 18. Registration Page

The data passed in the text fields of the registration form update the “users” relation of the database by adding a record to it. This is a matching activity. One item of data from a form is matched to one field in the destination table, which is accomplished by applying a Server behavior to the registration form by using the “Insert Record” of Dreamweaver’s Server Behaviors panel.

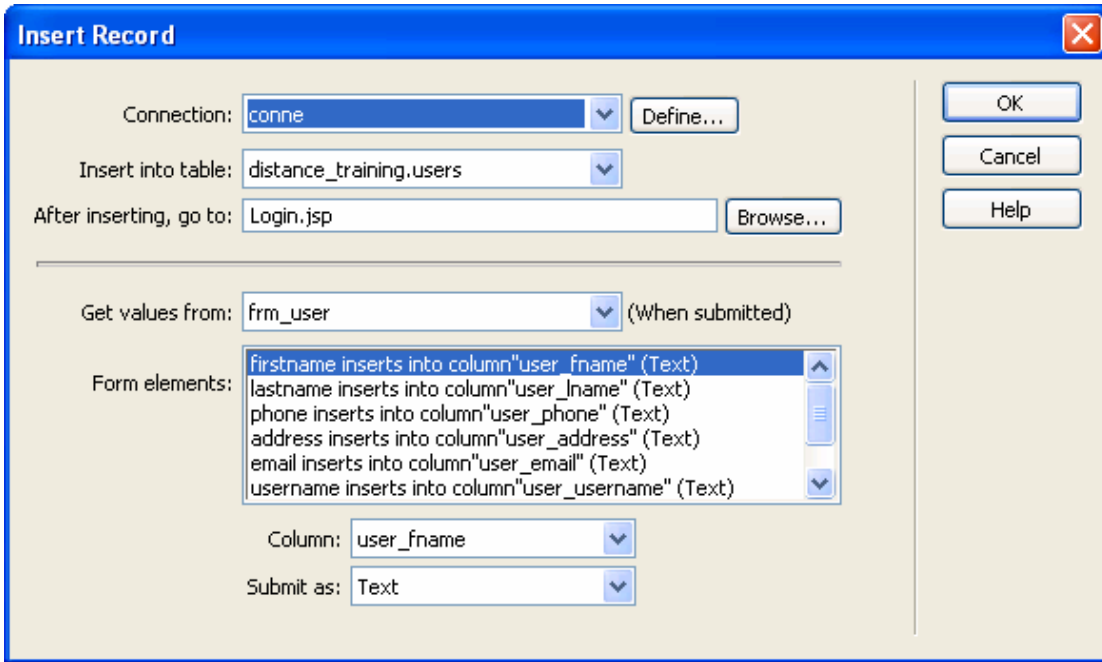


Figure 19. The “Insert Record” Dialog Window

The second step is to ensure that the entered username is unique by using the “Check New Username” server behavior as shown below.

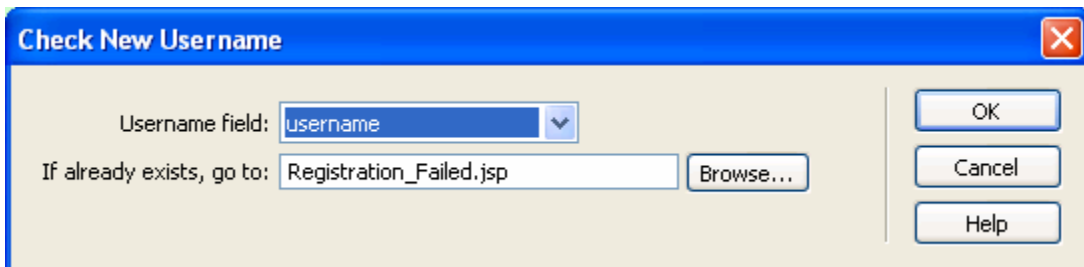


Figure 20. Determines the Uniqueness of the Entered Username

If the registration fails, the redirect is to the Registration_Failed.jsp page, which prompts the user to use a different username.

After creating a functioning registration page, the next step is to build the log-in page. The role of the log-in page is to obtain the entered username and password. Then it compares these values with the user_username and user_pwd with the “users” table. If there is a match, a log-in script sets a session variable indicating that the user is logged in. If there is no match, the user is redirected again to the Login.jsp page.

```

String MM_valUsername=request.getParameter("username");
if (MM_valUsername != null) {
    String MM_fldUserAuthorization="user_group";
    String MM_redirectLoginSuccess="Home_Page.jsp";
    String MM_redirectLoginFailed="Login_Failed.jsp";
    String MM_redirectLogin=MM_redirectLoginFailed;
    Driver MM_driverUser =
(Driver)Class.forName(MM_conne_DRIVER).newInstance();
    Connection MM_connUser =
DriverManager.getConnection(MM_conne_STRING,MM_conne_USERNAME,MM_conne
_PASSWORD);
    String MM_pSQL = "SELECT user_username, user_pwd";
    if (!MM_fldUserAuthorization.equals("")) MM_pSQL += "," +
MM_fldUserAuthorization;
    MM_pSQL += " FROM distance_training.users WHERE
user_username=\'" + MM_valUsername.replace('\', ' ') + "\' AND
user_pwd=\'" +
request.getParameter("password").toString().replace('\', ' ') + "\'";
    PreparedStatement MM_statementUser =
MM_connUser.prepareStatement(MM_pSQL);
    ResultSet MM_rsUser = MM_statementUser.executeQuery();
    boolean MM_rsUser_isNotEmpty = MM_rsUser.next();
    if (MM_rsUser_isNotEmpty) {
        // username and password match - this is a valid user
        session.putValue("MM_Username", MM_valUsername);
        if (!MM_fldUserAuthorization.equals("")) {
            session.putValue("MM_UserAuthorization",
MM_rsUser.getString(MM_fldUserAuthorization).trim());
        } else {
            session.putValue("MM_UserAuthorization", "");
        }
        if ((request.getParameter("accessdenied") != null) && true)
{
            MM_redirectLoginSuccess =
request.getParameter("accessdenied");
        }
        MM_redirectLogin=MM_redirectLoginSuccess;
    }
    MM_rsUser.close();
    MM_connUser.close();

Response.sendRedirect(response.encodeRedirectURL(MM_redirectLogin));
return;
}

```

Each page that restricts access needs to check for the presence of this session variable in order to determine whether to grant access to the page or redirect the user to a different page. For example, consider the following code listing from the Search.jsp and Course_Master_Form.jsp pages appearing at the beginning of each page.

```

<%
// *** Restrict Access To Page: Grant or deny access to this
page
String MM_authorizedUsers="professor,admin";
String MM_authFailedURL="Login.jsp";
boolean MM_grantAccess=false;
if (session.getValue("MM_Username") != null &&
!session.getValue("MM_Username").equals("")) {
    if (false || (session.getValue("MM_UserAuthorization")=="" ||
(MM_authorizedUsers.indexOf((String)session.getValue("MM_UserAuthoriza
tion")) >=0)) {
        MM_grantAccess = true;
    }
}
if (!MM_grantAccess) {
    String MM_qsChar = "?";
    if (MM_authFailedURL.indexOf("?") >= 0) MM_qsChar = "&";
    String MM_referrer = request.getRequestURI();
    if (request.getQueryString() != null) MM_referrer =
MM_referrer + "?" + request.getQueryString();
    MM_authFailedURL = MM_authFailedURL + MM_qsChar +
"accessdenied=" + java.net.URLEncoder.encode(MM_referrer);

response.sendRedirect(response.encodeRedirectURL(MM_authFailedURL));
return;
}
%>

```

B. SEARCH INTERFACE

This database features two paths by which to capture the information that resides in the subsections. The first path is through course → subject → topic → subsection and the other is by using keywords. Either of them can be used by any user group.

1. Search.jsp

This page can be used by any legitimate user granted access to the website. The page layout is shown below.

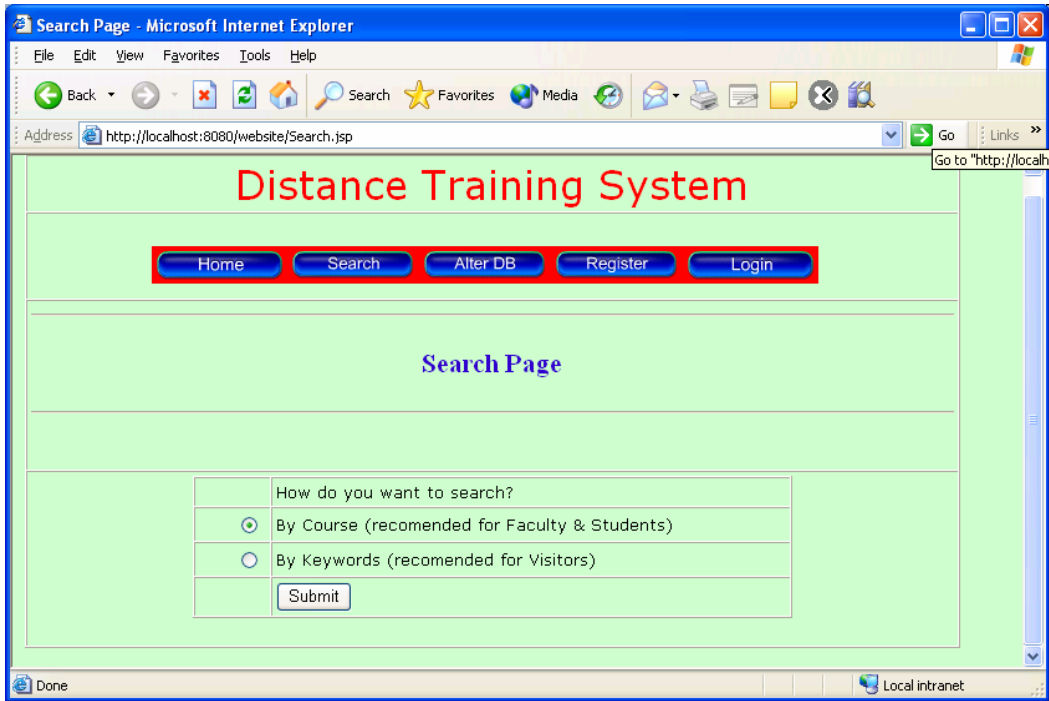


Figure 21. Search Page

Two radio buttons were used to implement the “Search” operation, giving the first one (By Course) the value 0 and the other one the value 1. If the user chooses to proceed searching by course, `Course_Request.jsp` appears.

2. `Course_Request.jsp`

The `Course_Request.jsp` page has the following layout.

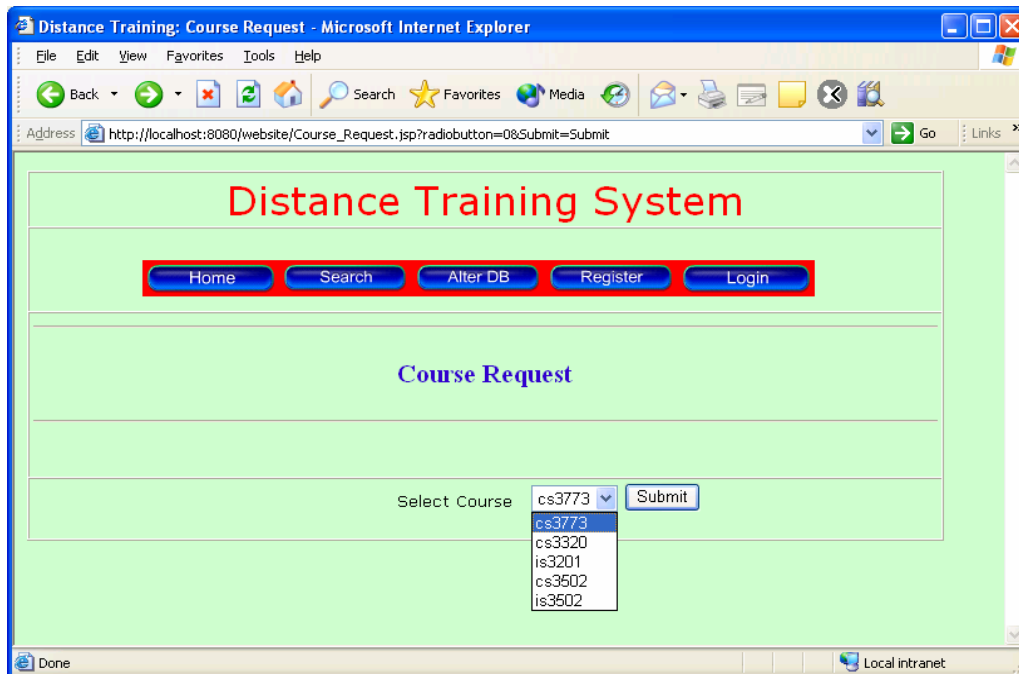


Figure 22. Course Request

A drop-down menu was used because the users are able to select from a finite number of options for courses that the developer specifies. The following options result from querying the database.

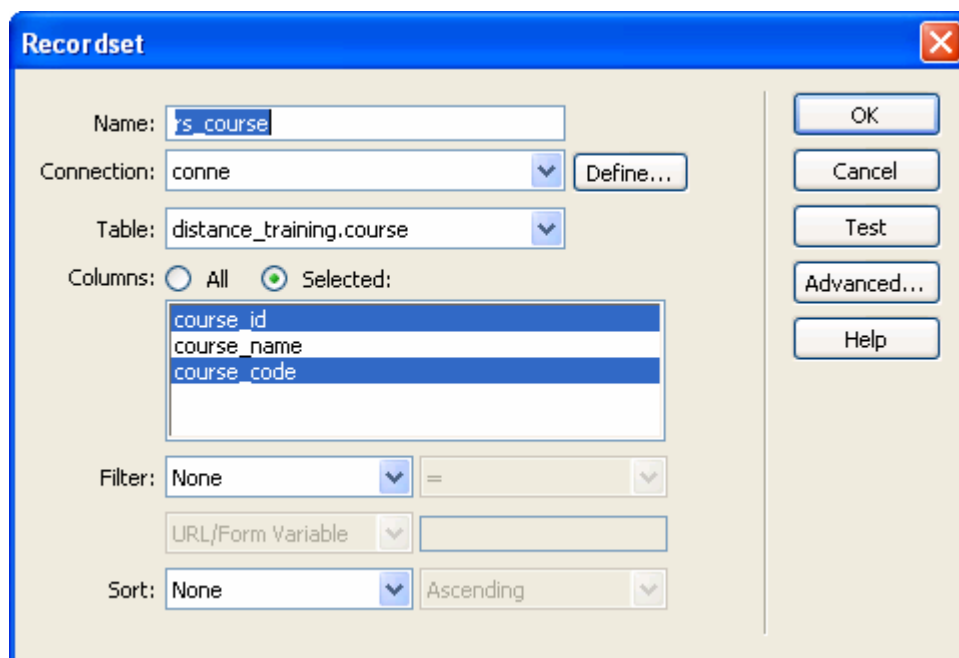


Figure 23. The "rs_course" Recordset

Dreamweaver also provides the option to verify the results of the query by clicking the Test button.

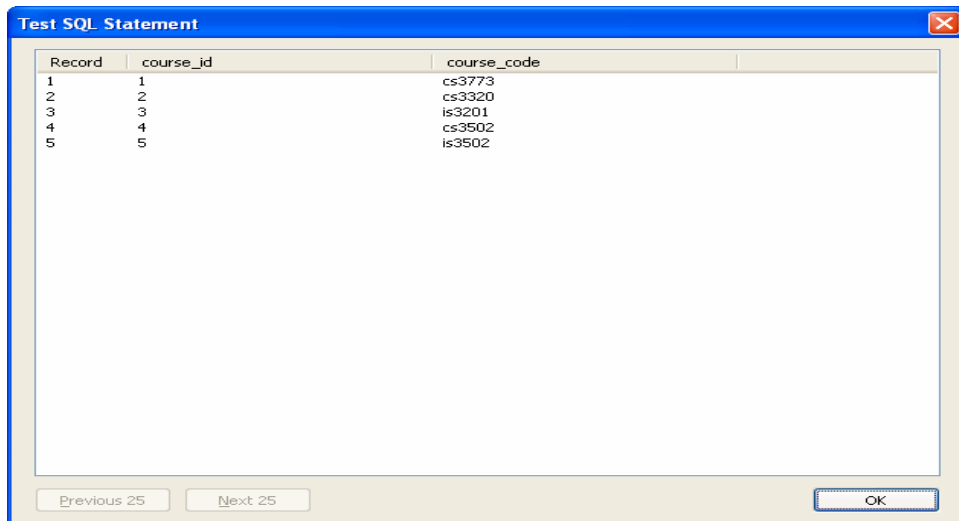


Figure 24. Testing the Query

Each entry in a form menu has two attributes that need to be set: the label (the part users read, or the course_code in this case not submitted with the form) and the data (course_id here) submitted with the other form elements. The course_id is needed because this value is used as a foreign key in the subject relation and it specifies the subjects associated with this passed course_id.

Dreamweaver automatically binds the data to the menu using the following Dynamic List/Menu dialog.

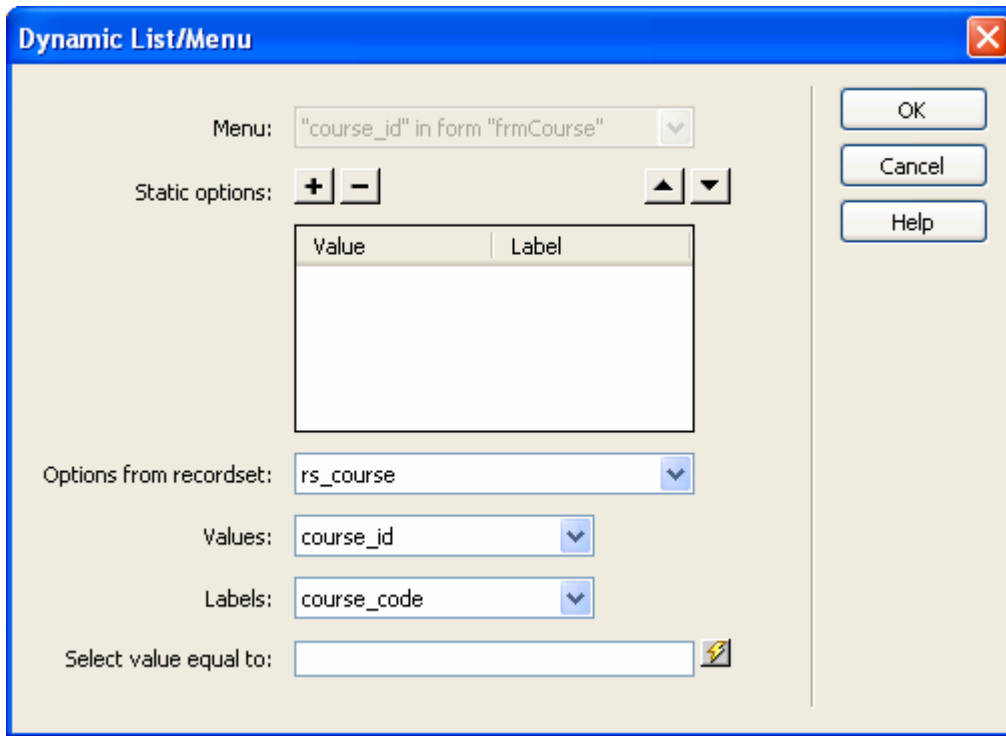


Figure 25. The “Dynamic/List” Dialog Window

This feature is very useful because, if for any reason a change the database is required, the menu field is automatically and instantly updated. In general terms, as long as the database is maintained, web maintenance will happen automatically.

Another characteristic of this page not visible in the page layout is the implementation of the Search’s page radio buttons:

```
<%
int searchMethodInt=1;
String searchMethodStr=request.getQueryString();
if((searchMethodStr.equals("radiobutton=1&Submit=Submit"))){
    response.sendRedirect("Keyword_Request.jsp");
}
%>
```

The flow navigation methodology developed from the Course_Request.jsp page to the Subject_Request.jsp is exactly the same as that applied from Subject_Request.jsp to the Topic_Request.jsp.

3. Topic_Request.jsp

The Topic_Request.jsp is a simple web page that includes one drop-down menu with all the topics associated with the passed subject_id. The topics appeared by executing the following query.

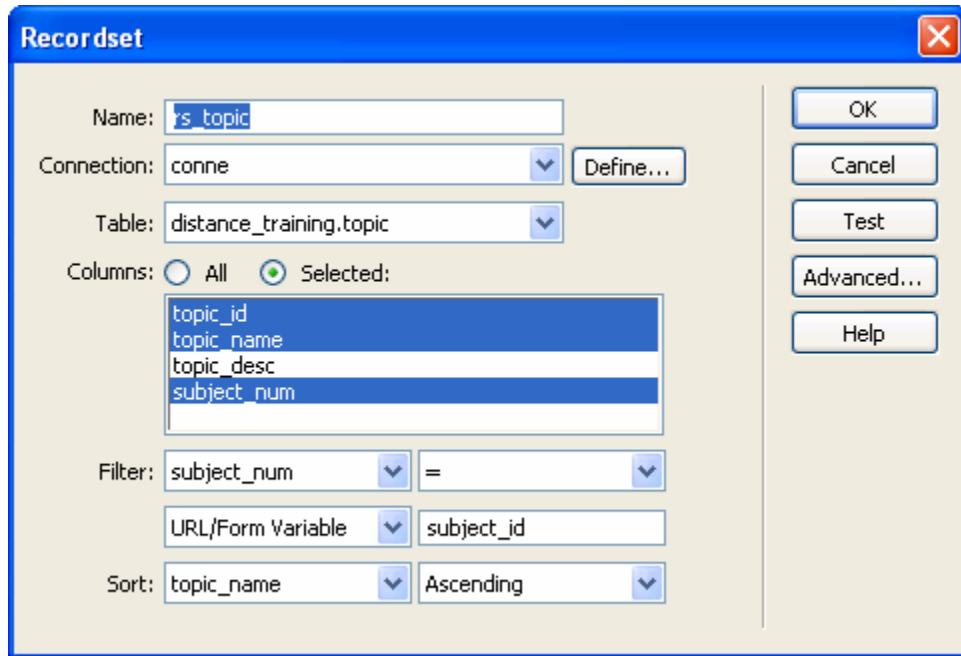


Figure 26. The “rs_topic” Recordset

In this case, the simple recordset dialog was used as in the previous paragraph because the results were obtained from only one table. The next step is to bind the recordset results to the menu.

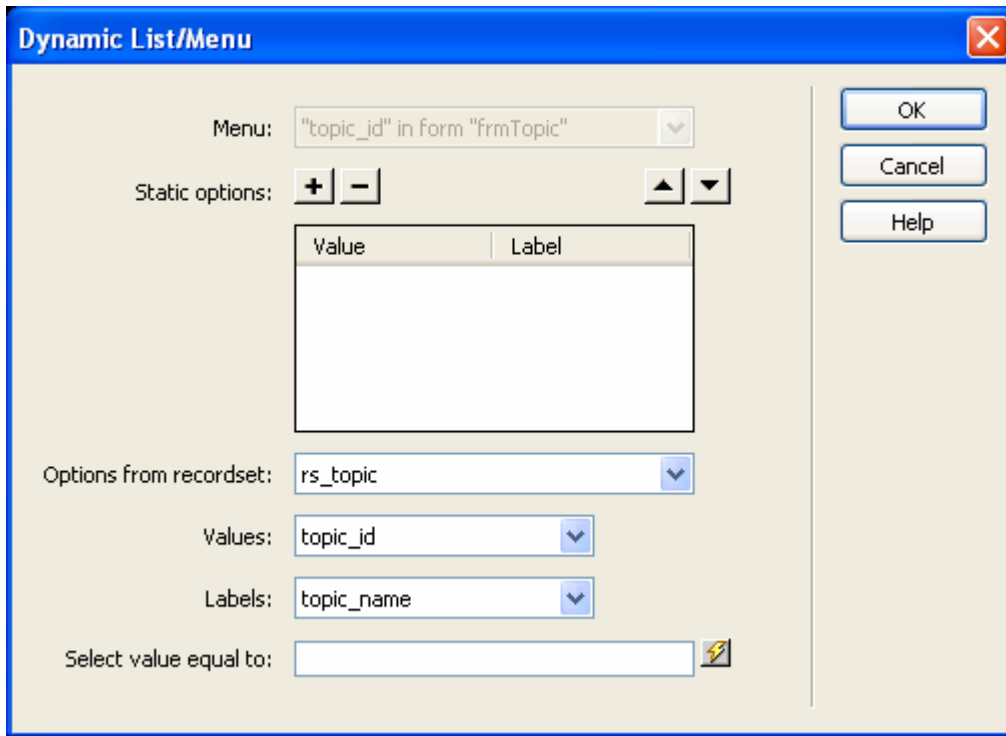


Figure 27. Collecting the Topic Names

4. Subsection_Request.jsp

As mentioned previously in this chapter, one topic may include many subsections and one subsection may be included in many topics. This is a Many-to-Many relationship. In the database design, this situation was handled by creating the join table “topicsection”. In order to obtain the subsections associated with a specific topic, the following query was executed.

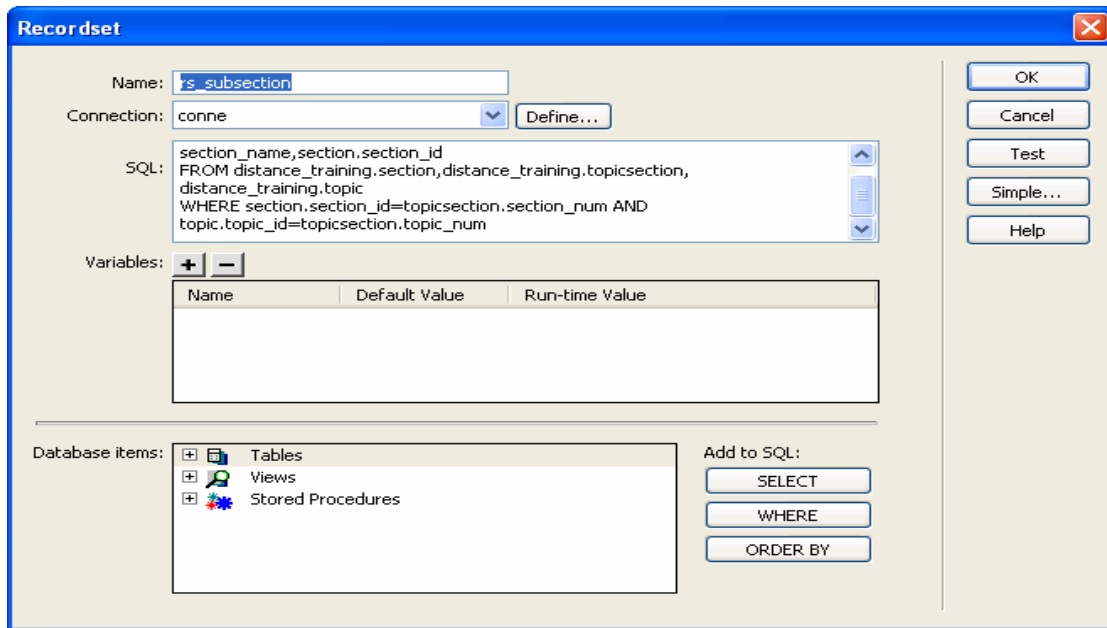


Figure 28. The “rs_subsection” recordset

In this case, the advanced recordset dialog was used because information came from three tables. Dreamweaver generates the code fragment shown below when successfully running the query.

```
<%
    Driver Driversubsection =
    (Driver)Class.forName(MM_conne_DRIVER).newInstance();
    Connection Connrs_subsection =
    DriverManager.getConnection(MM_conne_STRING,MM_conne_USERNAME,MM_conne
    _PASSWORD);
    PreparedStatement Statementrs_subsection =
    Connrs_subsection.prepareStatement("SELECT
    topicsection.section_num,topicsection.topic_num,section.
    section_name,section.section_id FROM
    distance_training.section,distance_training.topicsection,
    distance_training.topic WHERE
    section.section_id=topicsection.section_num AND
    topic.topic_id=topicsection.topic_num ");
    ResultSet rs_subsection = Statementrs_subsection.executeQuery();
    boolean rs_subsection_isEmpty = !rs_subsection.next();
    boolean rs_subsection_hasData = !rs_subsection_isEmpty;
    Object rs_subsection_data;
    int rs_subsection_numRows = 0;
%>
```

Dreamweaver produces the following code fragment upon binding the query results to the menu.

```
while (rs_subsection_hasData) {
    %>
        <option
value="<%= (rs_subsection.getObject("section_id") != null) ?
rs_subsection.getObject("section_id") : "" %>">
    <%= (rs_subsection.getObject("section_name") != null) ?
rs_subsection.getObject("section_name") : "" %></option>
        <%
rs_subsection_hasData = rs_subsection.next();
    }
}
```

In this case, instead of illustrating the “Dynamic List/Menu” dialog window to bind the SQL results to the menu as done previously, this dialog window demonstrates what goes on behind the scenes. The JSP engine goes through each section_id/section_name pairing in the recordset and adds it to the menu item.

The form data of this page will be processed by the Subsection_Results.jsp (as the “Action” attribute specifies) and they will be transmitted to the Server using the GET method (as the “Method” attribute specifies).

5. Subsection_Results.jsp

Both Subsection_Results.jsp and Image_Result_All.jsp constitute the last level of the Content Management System hierarchy. The Subsection_Results.jsp reveals the content requested from the Subsection_Request.jsp. The page layout is shown below.

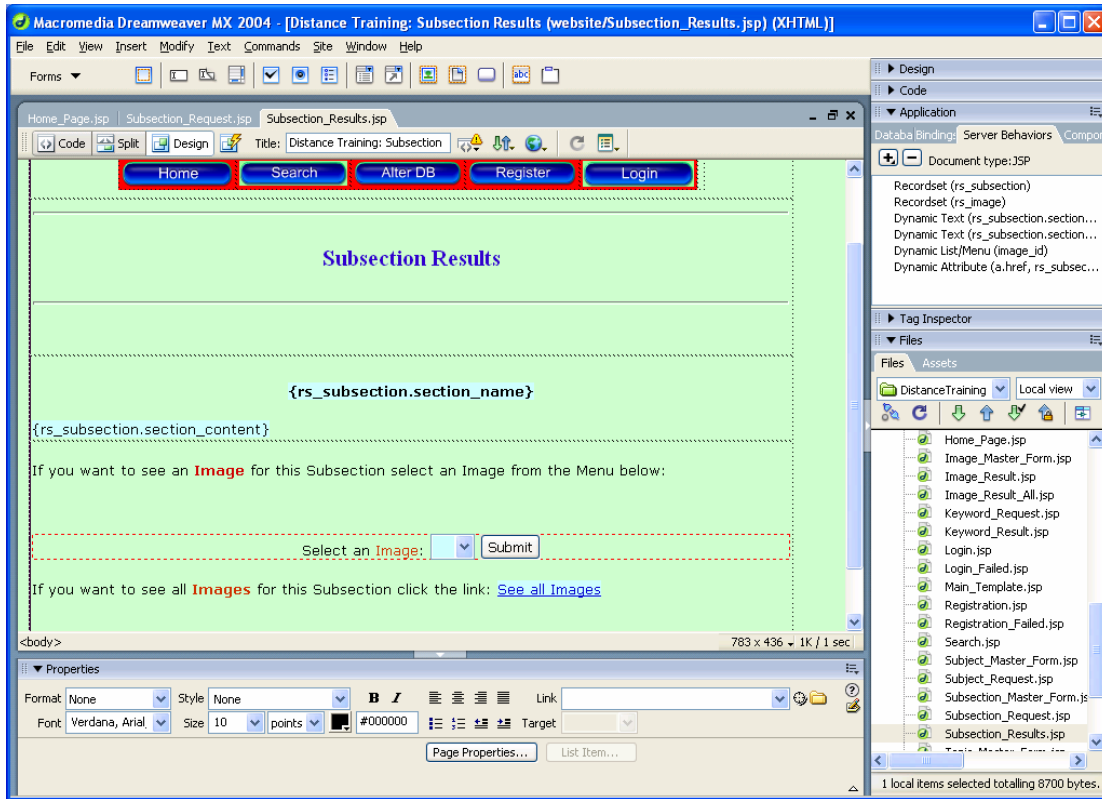


Figure 29. The “subsection results” Page

The necessary information for the subsection name and content was pulsed using the SQL shown below.

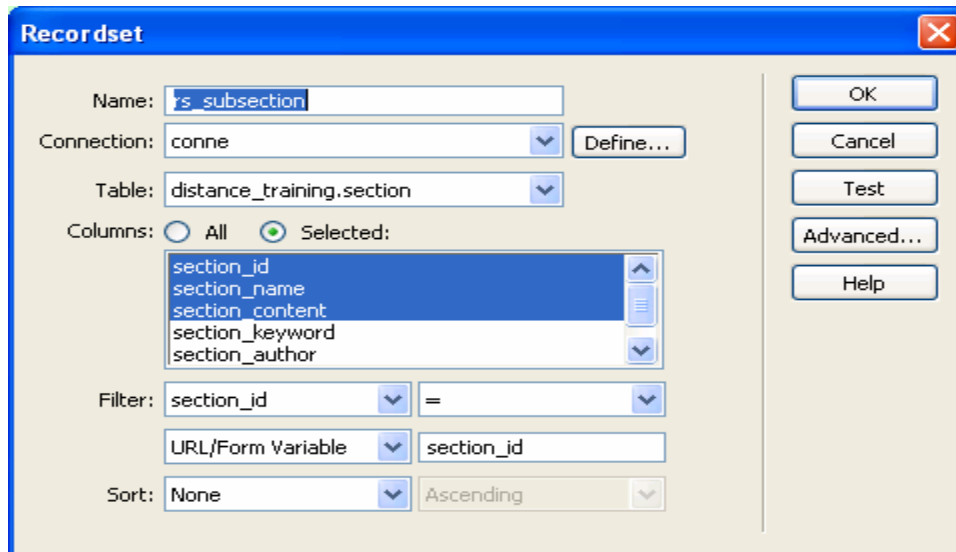


Figure 30. The “rs_subsection” Recordset

By sending section_id from the subsection request (the previous page), it is possible to retrieve the subsection name and content associated with that specific section_id using the “Dynamic Text Field” of the Dreamweaver’s Server Behaviors shown below.

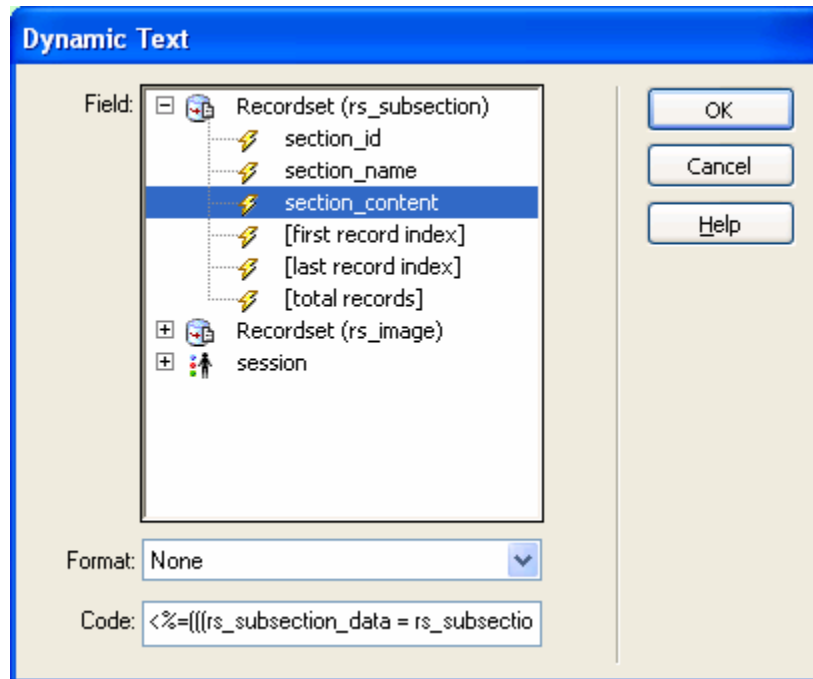


Figure 31. Retrieving Text Using the “Dynamic Text” Dialog Window

For instance, the code that Dreamweaver generates for the section_content binding is:

```
<%=(((rs_subsection_data =  
rs_subsection.getObject("section_content"))==null ||  
rs_subsection.isNull())?"":rs_subsection_data)%>
```

Every subsection includes zero, one or more images. In order to associate each subsection with an image the following SQL was performed.

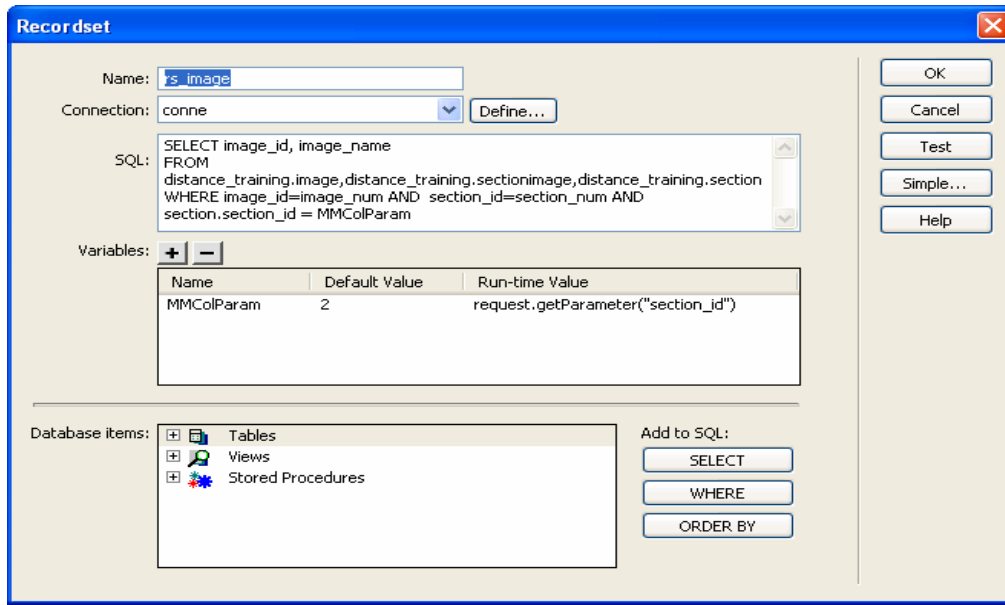


Figure 32. The “rs_image” Recordset

In succession, a drop-down menu was created and by using the “Dynamic List/Menu” dialog window, each image was bound to the menu. This page was linked to the Image_Result_All.jsp page so that it was possible to see all the images associated with a specific subsection.

6. Image_Result_All.jsp

As mentioned previously (Database design), a subsection may include one or more images and each image belongs to one or many subsections. This is a Many-to-Many relationship, which was handled by creating the “sectionimage” join table. The following query retrieved the images appearing in a subsection.

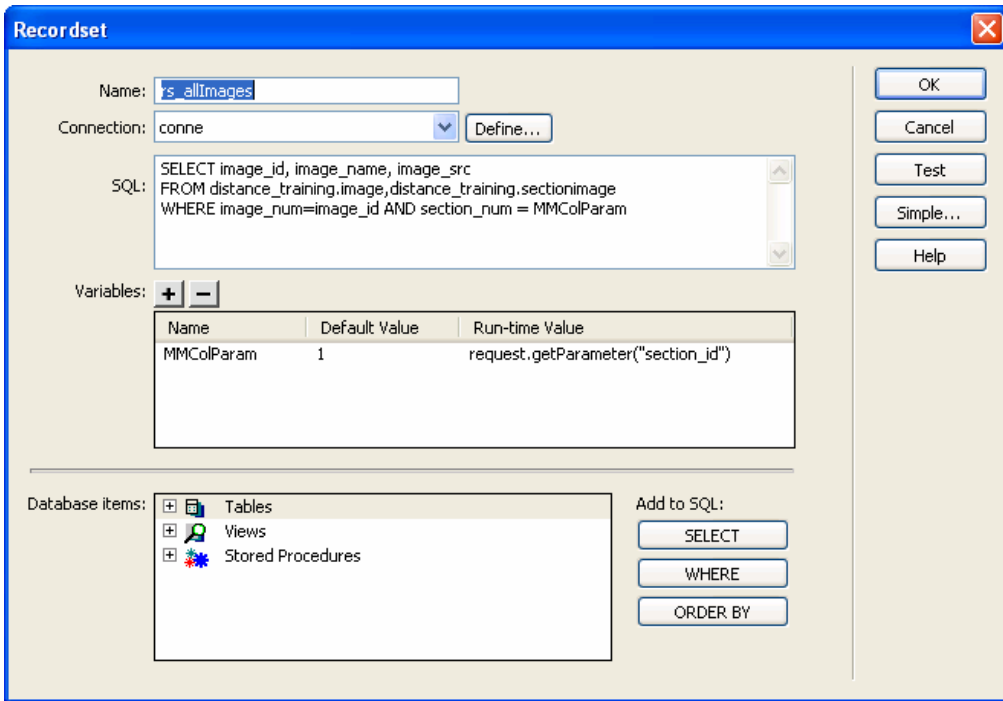


Figure 33. The “rs_allimages” Recordset

The images in this page were inserted using the “Select Image Source” dialog window that makes it possible to use the string of the “image_src” field.

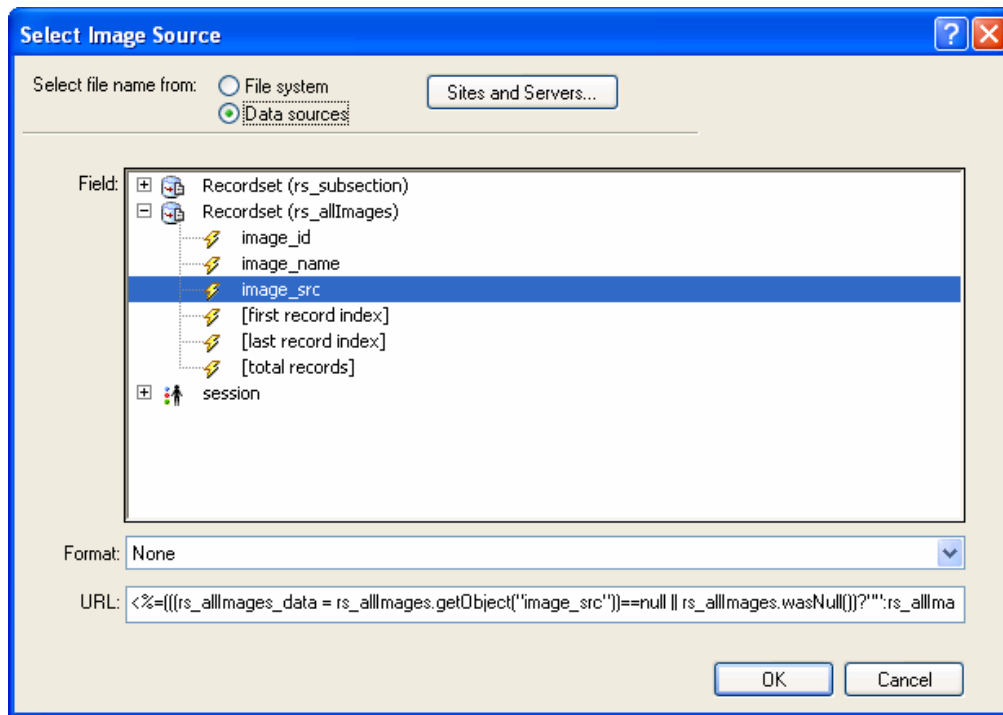


Figure 34. Inserting Images Using the “Select Image Source” Dialog Window

When inserting a dynamic image, what is really inserted is a dynamic string, which consists of a URL path pointing to an image inside of an element.

```
<p><img src=""<%=((rs_allImages_data =  
rs_allImages.getObject("image_src"))==null ||  
rs_allImages.isNull())?"":rs_allImages_data)%>" /></p>
```

The last characteristic of this page is the “Repeat Region” behavior, which ensures that all the specified records, rather than just the first one, will be displayed.

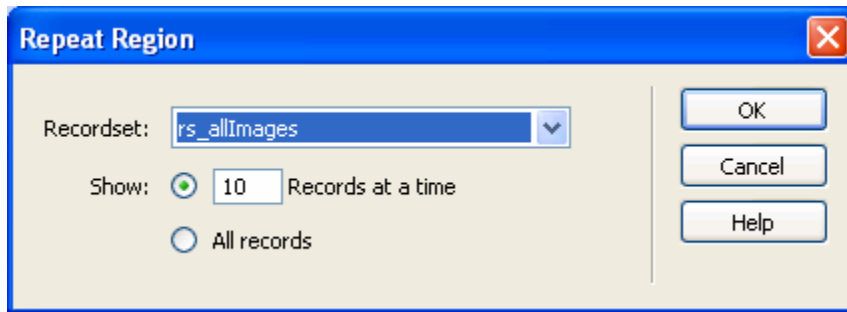


Figure 35. Determining the Number of Images Per Page

7. Keyword_Result.jsp

The other “Search” option available to a user is to search the site using keywords. The Keyword_Result.jsp page was created to process the data of the Keyword_Request.jsp and generate the result as shown.

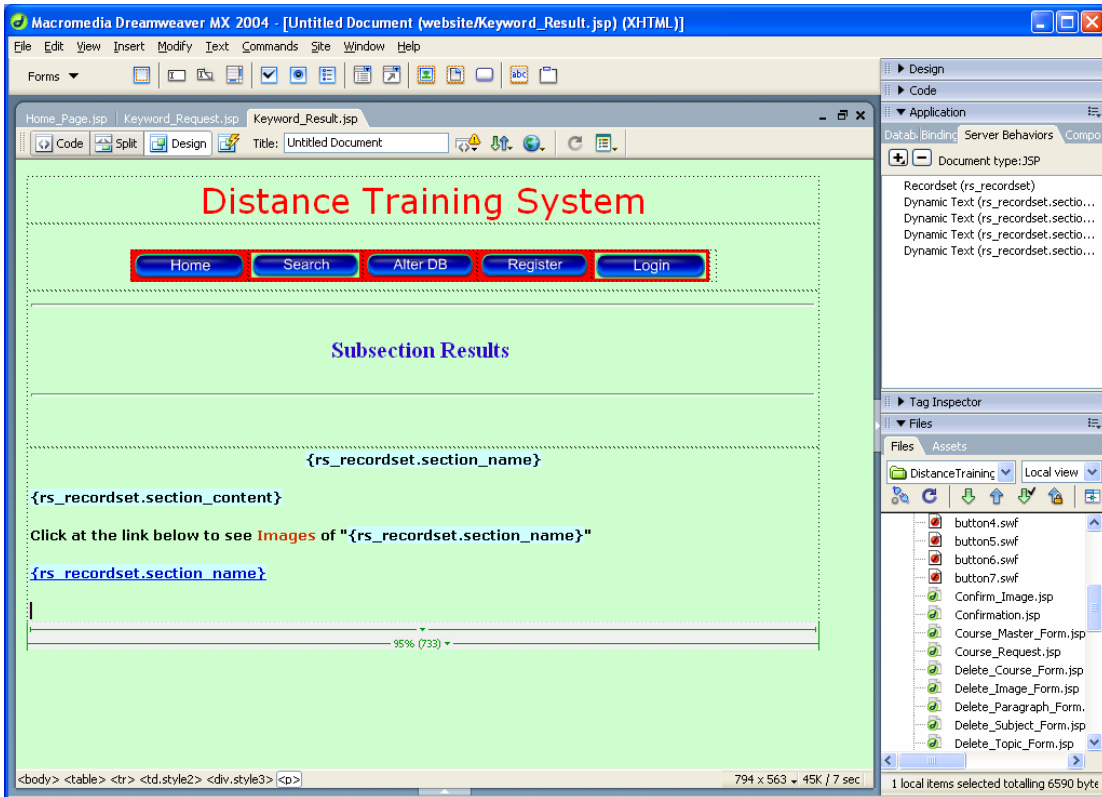


Figure 36. The Keyword Results Page (Design View)

The following query was executed to retrieve the data required for this page:

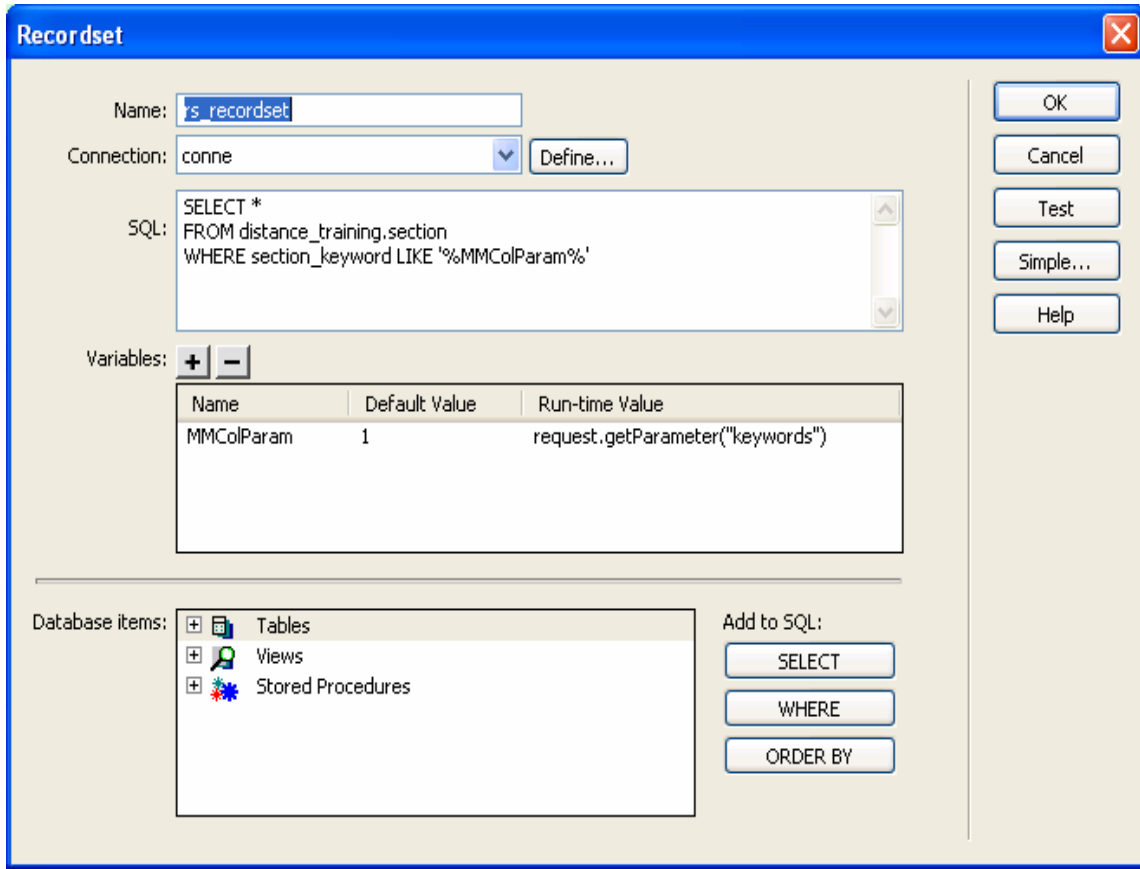


Figure 37. Retrieving a Paragraph Specified by the Passed Keyword

The above SQL statement indicates that all the fields from the section table are desired where the column value (section_Keyword) matches any arbitrary number of characters passed from the previous page using the “MMColParam” variable.

It is possible to generate the content and the images for this subsection using the “Dynamic Text” behavior with this desired recordset.

The curly braces are Macromedia’s specific pseudocode expressions that indicate the presence of dynamic content.

C. ALTER DATABASE INTERFACE

The “AlterDB” operation is slightly more complex than the previous two operations of “User Authentication” and “Search”. It can be used only by the professors and the Administrator of the site. This navigation flow is a combination of the “master” and “detail” pages. In general terms, the master-page lists many records in a summary

format whereas the detail-page contains detailed information about a specific record that has been selected by the user from the master-page. The files that constitute the “AlterDB” operation are described successively.

1. Course_Master_Form.jsp

The top level of the content management system hierarchy is “course”. After a professor logs-in, the Course_Master_Form.jsp page appears, which provides the actions illustrated in the page:

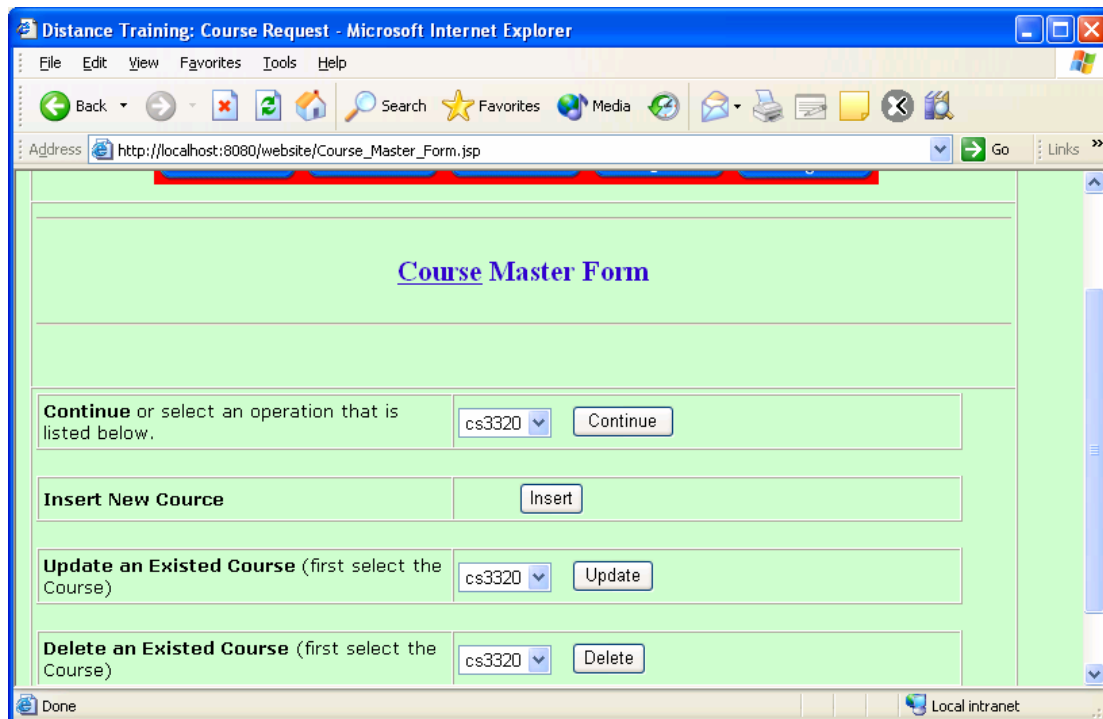


Figure 38. Course Master Page

From this point on, the professor can select to continue to the other master page (Subject_Master_Form.jsp) using the “Continue” button or perform modifications to this page by inserting, updating or deleting a course. In order to insert data, the table is identified and which data to write to which fields in that table specified. In order to update a specific record, the same procedure is applied to a particular, existing record Information is not appended to the end of the relation. The “UPDATE” SQL command assists in the accomplishment of this task. Besides, Dreamweaver has the “Update Record” behavior that makes it even easier. As far as the “Delete” action is concerned, it

is a pretty straightforward action as described later in this section. All the above four actions are submitted by four separate forms (one for each operation) to four different web pages specified by the Action attribute.

Before performing any query on this page, the users authenticated to access this page must be specified. This is done by using the “Restrict Access To Page” server behavior as shown below.

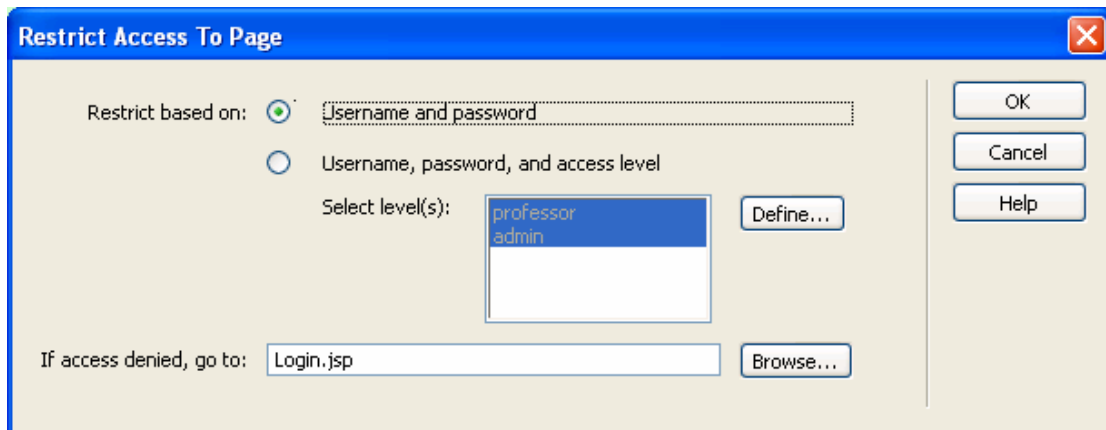


Figure 39. Restricting the Access to the Specified User Groups

The next step is to perform a query in order to obtain the available courses from the database, and then using the “Dynamic List/Menu” dialog match each value (course_id) with the corresponding course_code in order to populate the drop-down menus.

2. Add_New_Course_Form.jsp

When a professor presses the “Insert” button of the Course_Master_Form.jsp page, the Add_New_Course_Form.jsp page appears. It is then possible to insert a new course by entering the course code and name using the following interface.

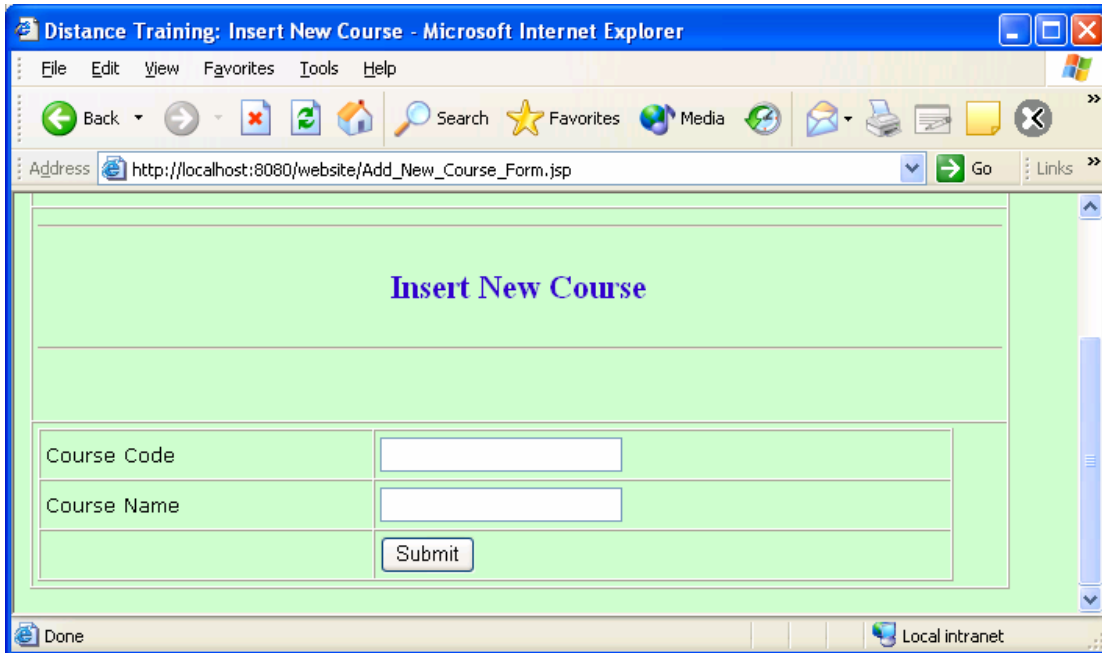


Figure 40. Insert a New Course Name

The "Insert Record" behavior was used to insert data into the database.

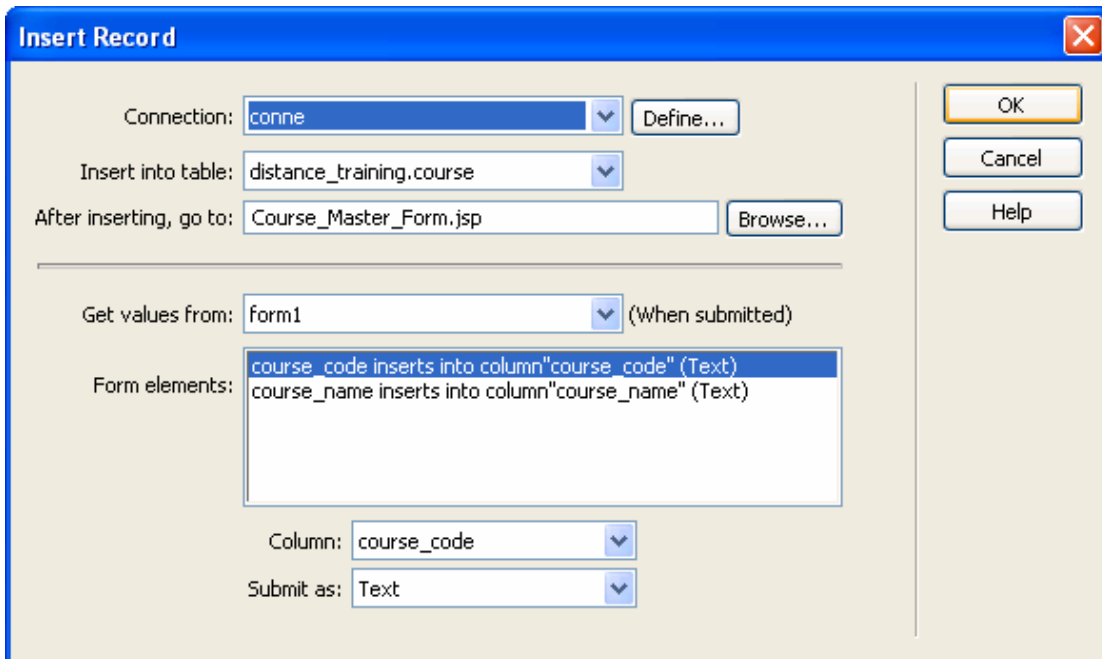


Figure 41. "Insert Record" Behavior

The Insert Record behavior matches data entered in the form to fields in the database, creating a new record in the database and populating it with the user-entered data. The “course_code” and “course_name” to the left of the “Form Elements” subwindow in the above dialog are the names given to the corresponding textfields of the web page whereas the “course_code” and “course_name” to the right indicate fields of the “course” relation. The other attributes of the above dialog are self-explanatory.

3. Update_Course.jsp

When the “Update” button is pressed, the instructor has the capability to modify or correct the course code or class name using an interface identical to that presented in the Add_New_Course_Form.jsp page.

The first step is to perform a simple SQL query in order to obtain the course name and code specified by the course_id passed from the Add_New_Course_Form.jsp page.

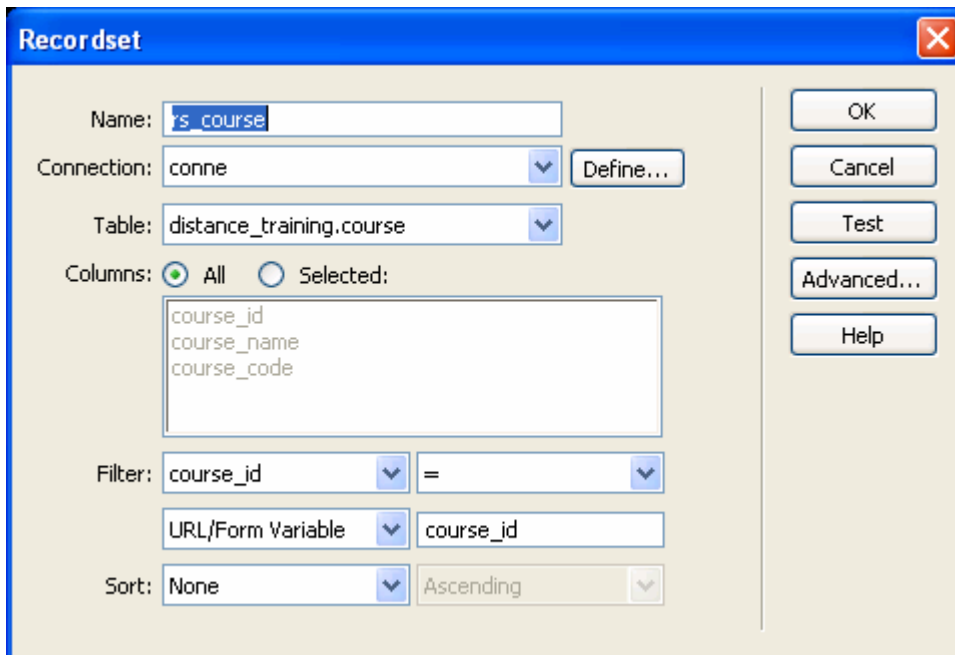


Figure 42. The “rs_course” Recordset

It is worth mentioning that when testing this query, a test value is specified because the query needs a value to be sent from the form.

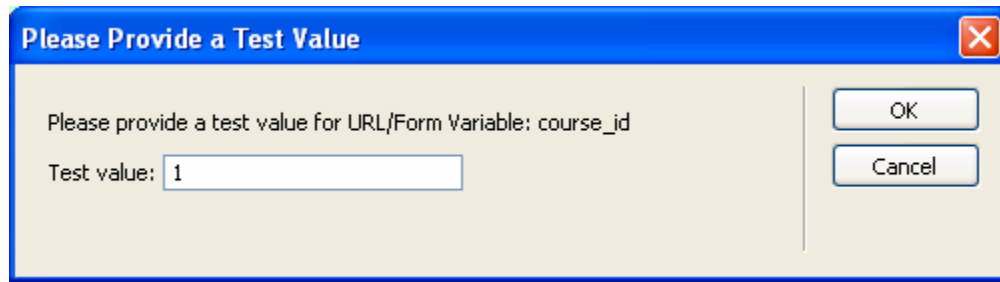


Figure 43. Passing Test Value for the Query

At the next step, for each textfield (course code and course name), the corresponding values obtained from the recordset using the “Dynamic Text Field” behavior are set.

After finishing the textfield bindings with the results of the query, the “Update Record” server behavior was applied as shown below.

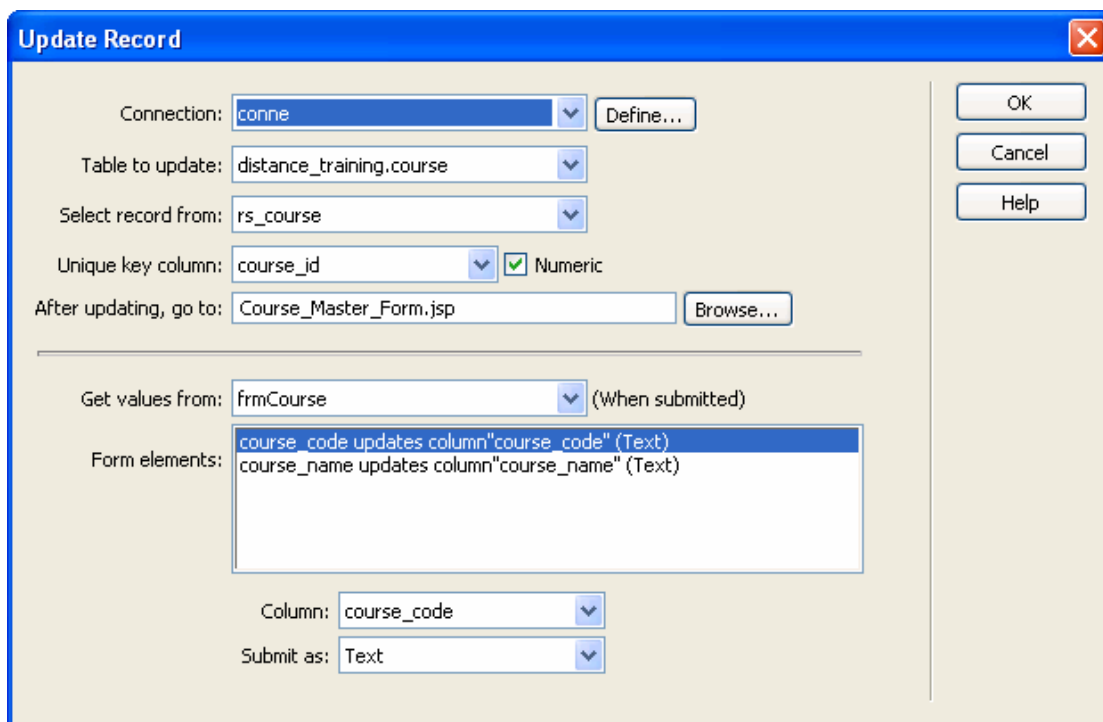


Figure 44. The “Update Record” Window

The last observation is that Dreamweaver generated two hidden fields when applying the update behavior.

```
<input type="hidden" name="MM_update" value="frmCourse">
<input type="hidden" name="MM_recordId"
value="<%=((rs_course_data = rs_course.getObject("course_id"))==null
|| rs_course.isNull())?"":rs_course_data)%>">
```

Hidden fields are used in forms to pass predetermined data when the form is submitted. In this case, Dreamweaver automatically passed the form name (frmCourse) along with the “course_id”. As shown later in this chapter, it is necessary to create specific hidden fields, especially when Many-to-Many relationships must be manipulated.

4. Delete_Course_Form.jsp

The last option of the Course_Master_Form.jsp page is the deletion of an existing course. When an instructor presses the Delete button, the Delete_Course_Form.jsp page appears as shown below.

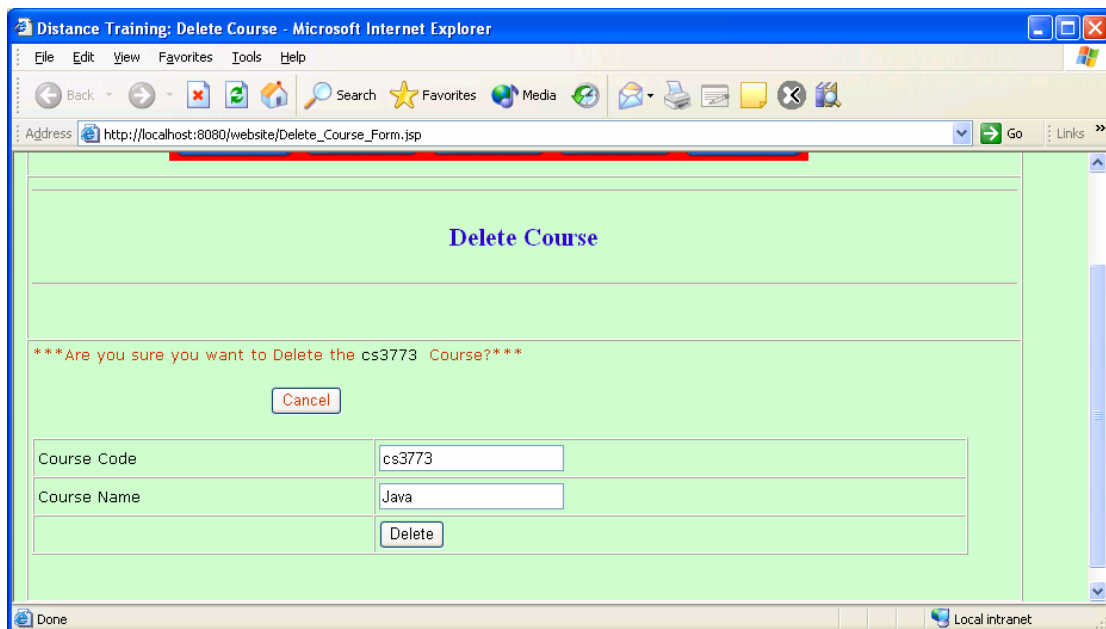


Figure 45. The “Delete Course” Page

The only difference from the previous page (Update_Course.jsp) methodology is the implementation of the “Delete Record” server behavior.

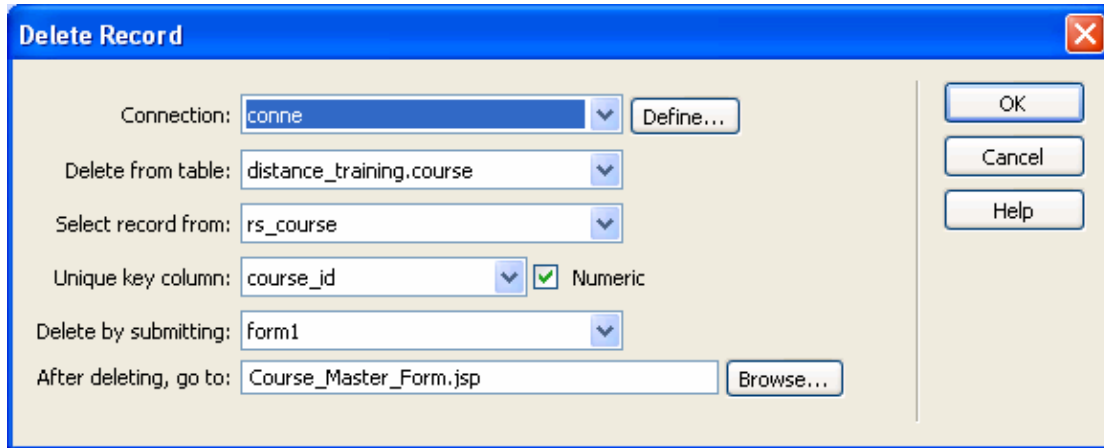


Figure 46. The “Delete Record” Behavior

Two hidden fields are generated as in the “Update Record” behavior when applying the “Delete Record” behavior.

```
<input type="hidden" name="MM_delete" value="form1">
<input type="hidden" name="MM_recordId"
value="<%=(((rs_course_data = rs_course.getObject("course_id"))==null
|| rs_course.isNull())?"":rs_course_data)%>">
```

5. Subject_Master_Form.jsp

If the user chooses to continue from the course master page by selecting a specific course from the first drop-down menu, the Subject_Master_Form.jsp page appears with the option to select one among many other subjects included in that course. The design view appears below.

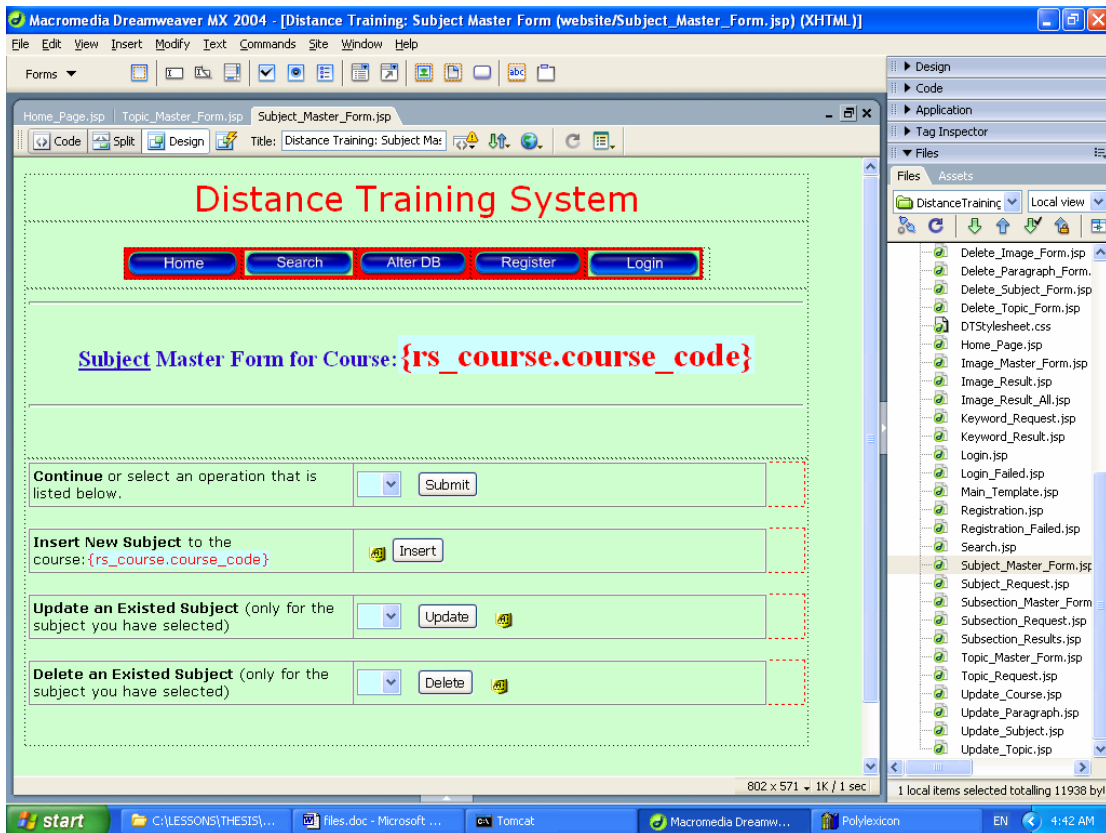


Figure 47. The Subject Master Page (Design View)

The structure of this page was begun by restricting its access to legitimate users (professors and admin) as with the course master page using the “Restrict Access To Page” server behavior.

Two queries were performed in succession. One query is needed to retrieve the course code (rs_course).

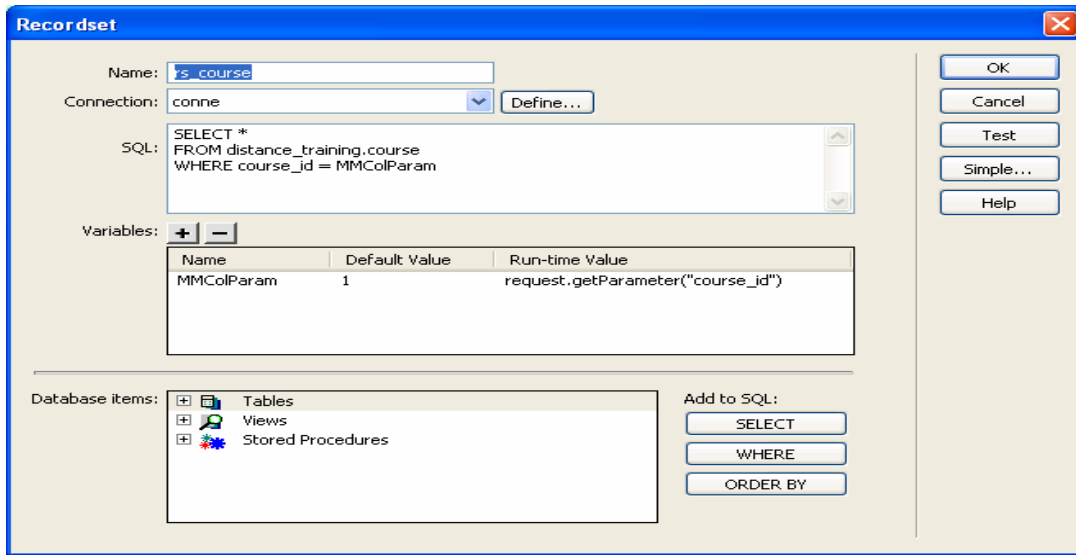


Figure 48. The “rs_course” Recordset

The other query (rs_subject) is used to retrieve the subject names for the drop-down menus.

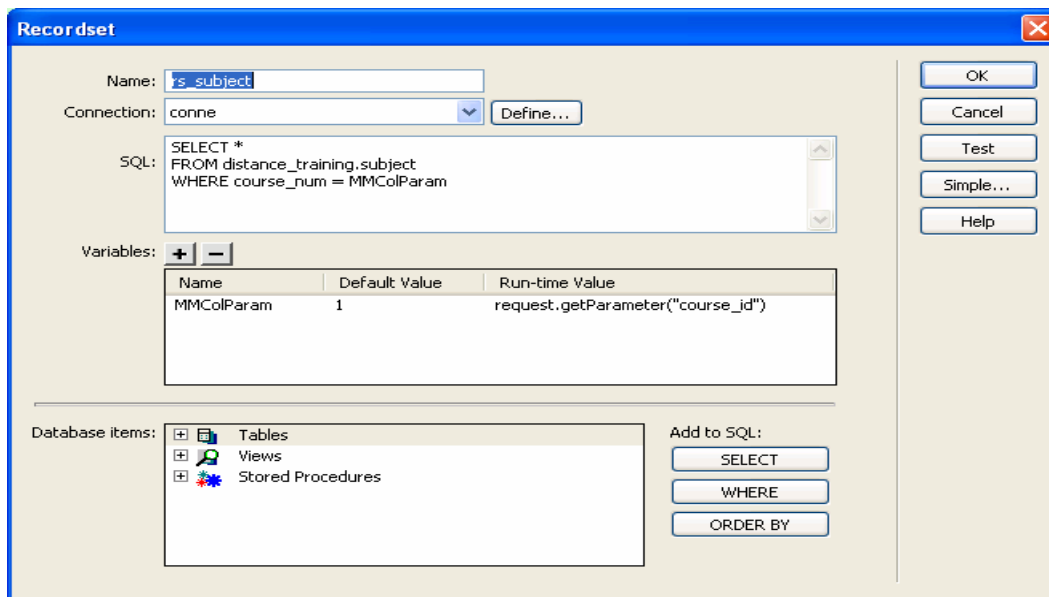


Figure 49. The “rs_subject” Recordset

Three hidden fields were used to request the course_id for the insert, update and delete operations, as shown in the design view of this page at the beginning of this section, using the following dialog window.

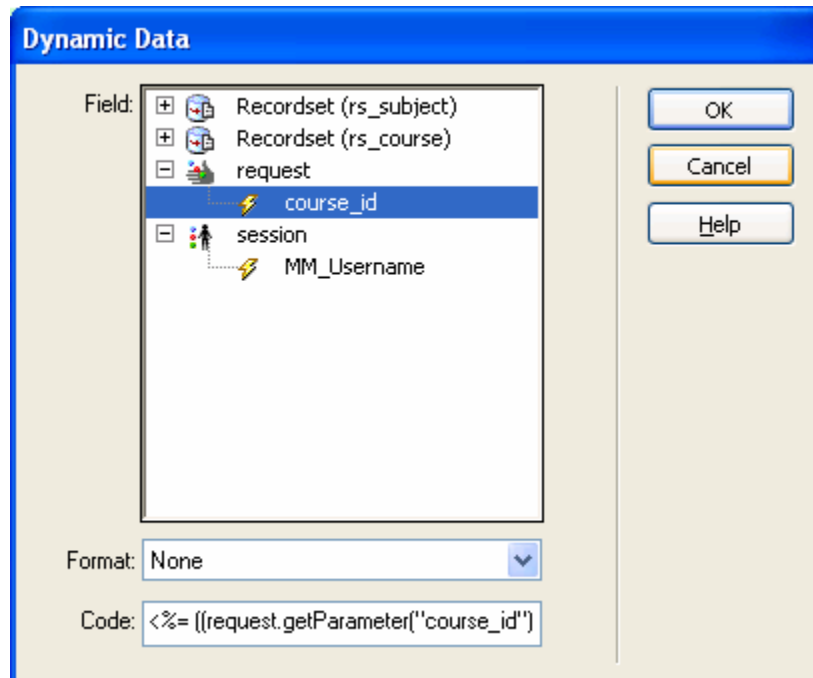


Figure 50. Keeping Track of the “course_id” Using the “Dynamic Data” Window

This is necessary because of the desire to keep track of the subjects specified by the passed course_id. For the same reason, when building the detail pages (insert, update and delete), the course_id is passed as a hidden field for each of those pages.

6. Topic_Master_Form.jsp

The topic master page has the following layout.

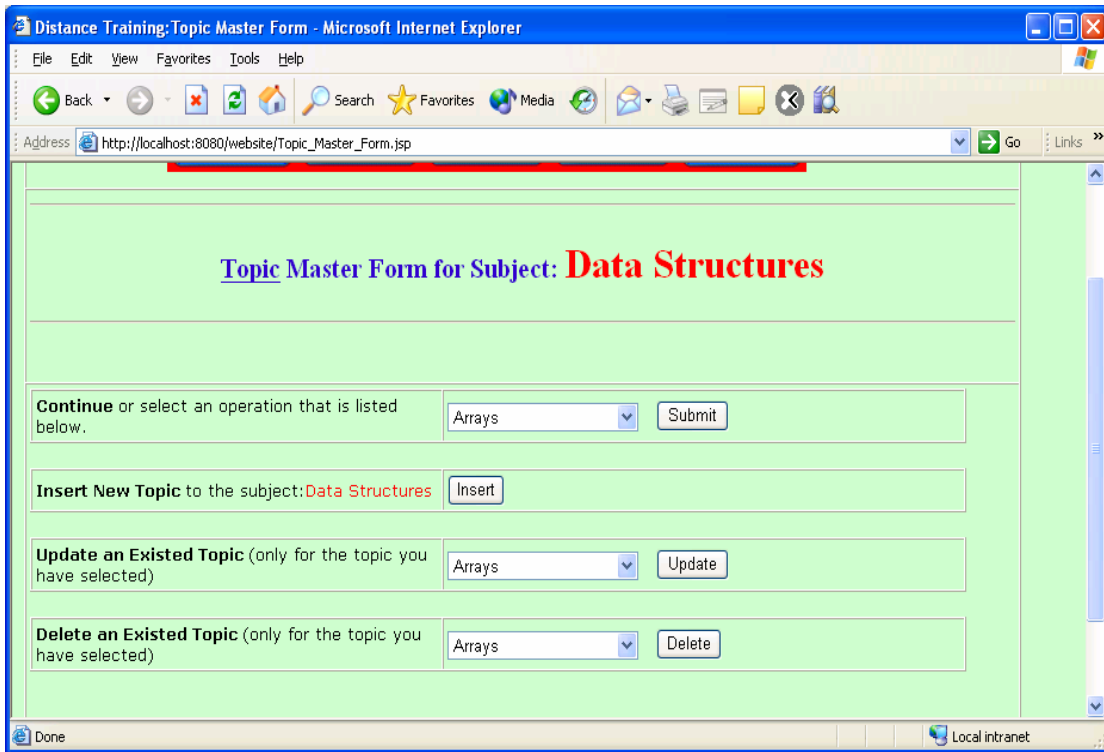


Figure 51. The Topic Master Page

In order to build this master page and its corresponding detail pages, the same methodology as that of the subject master page was applied. The only difference is that the subject_id was passed as a hidden field in the insert, update and delete forms of the master page.

7. Subsection_Master_Form.jsp

Before continuing with the description of the subsection master page and in order to avoid terminology confusion, note that the terms “subsection” and “paragraph” are used interchangeably throughout this thesis because they refer to the same meaning.

The layout of this page does not differ from the other master pages layout. Thus, it includes four forms; one to continue and display the subsection’s content, and the other three for insertion, update and deletion.

After restricting access to this page only to legitimate users, as done with the other master pages, a query was performed (obtaining the recordset rs_course) in order to select the topic (illustrated at the beginning of the page) specified by the topic_id passed to the current page from the topic master page.

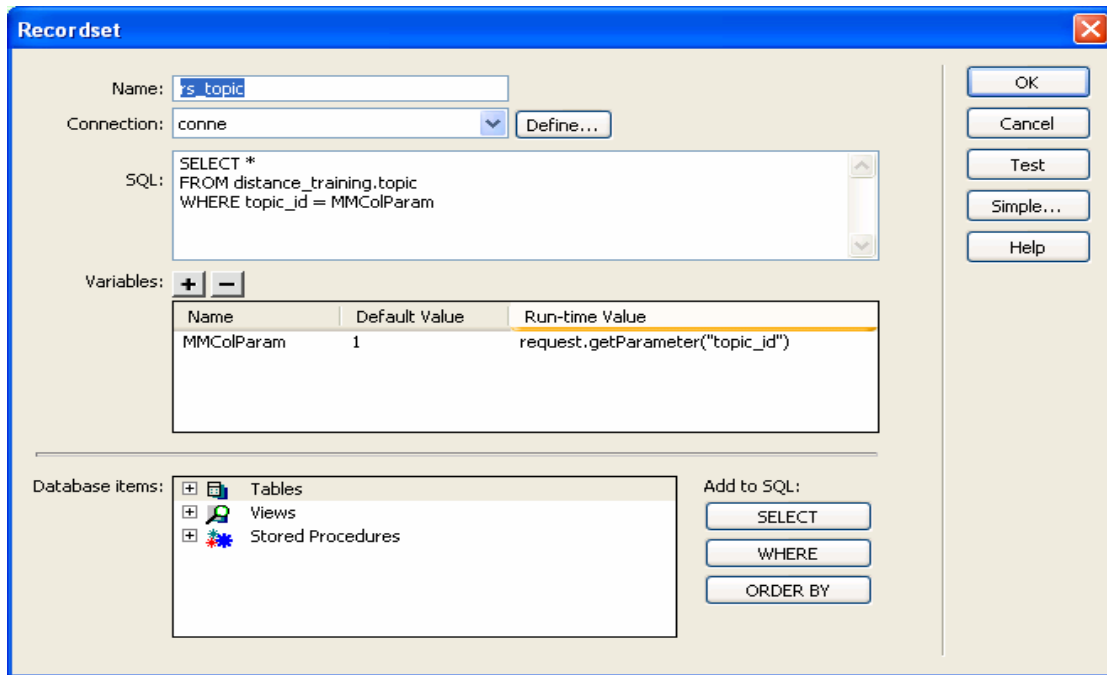


Figure 52. The “rs_topic” Recordset

The next step was to ascertain a way to populate the drop-down form menus with the data of the subsection table specified by the passed topic_id. As indicated in the database design section, a topic may include many subsections and one subsection may be included in many topics (M:N relationship). This was achieved by performing the following SQL, where topicsection is the join table between the “topic” and “section” tables.

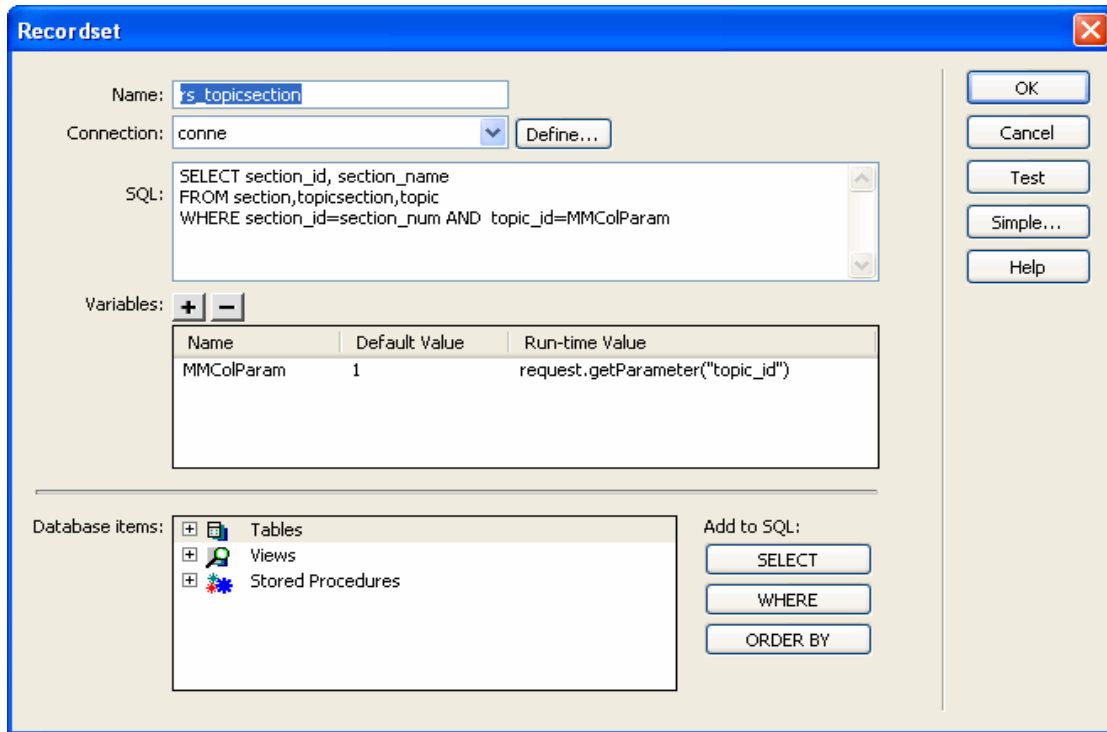


Figure 53. The “rs_topicsection” Recordset

Finally, in order to keep track of the topic where it is desired to insert a new paragraph, modify or delete an existing paragraph, the topic_id was passed as the hidden field to each of those forms.

8. Add_New_Paragraph.jsp

If an instructor wants to insert a new subsection in a specific topic, it is possible to use the following web page.

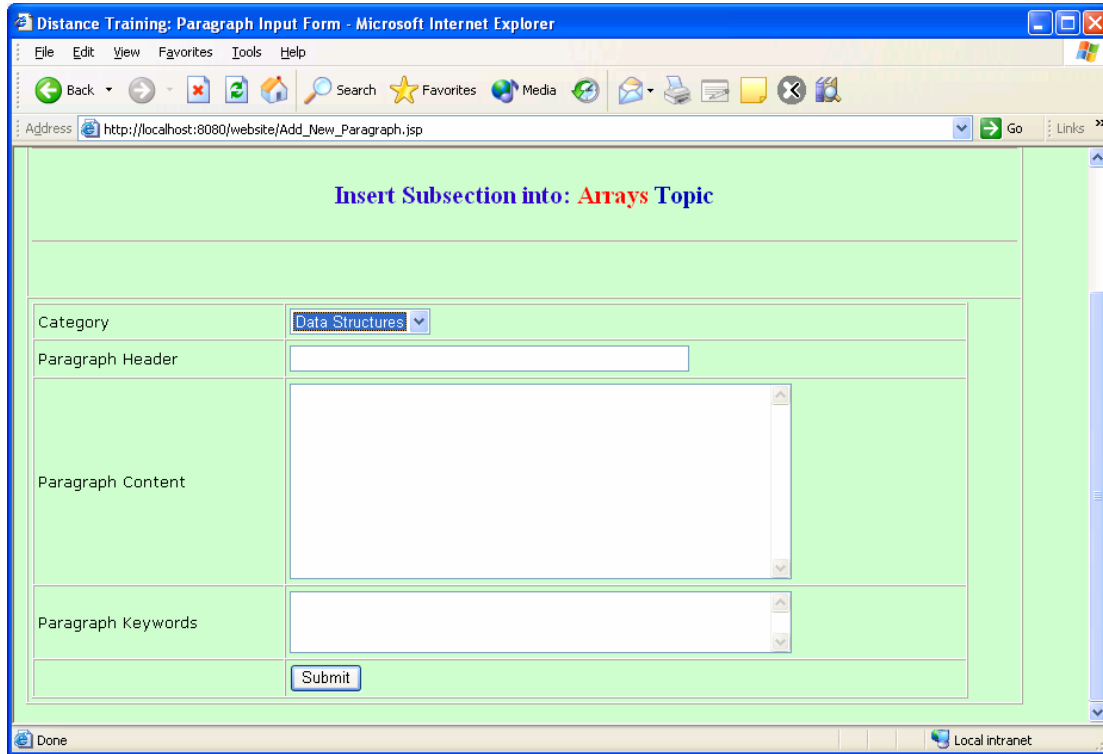


Figure 54. The “Add New Paragraph” Page

The “Category” drop-down menu determines the area of interest to which the inserted paragraph belongs. The “Category” entity was used for grouping courses that pertain to one broadband subject. For example, “Ethernet”, “LAN topologies” and “WAN” may be included in the “Networks” Category.

The other three important attributes used by the professor for adding a new subsection are the paragraph header (textfield) and the paragraph content - keywords (textareas).

In order to select the topic to which the inserted paragraph belongs, the following recordset was created:

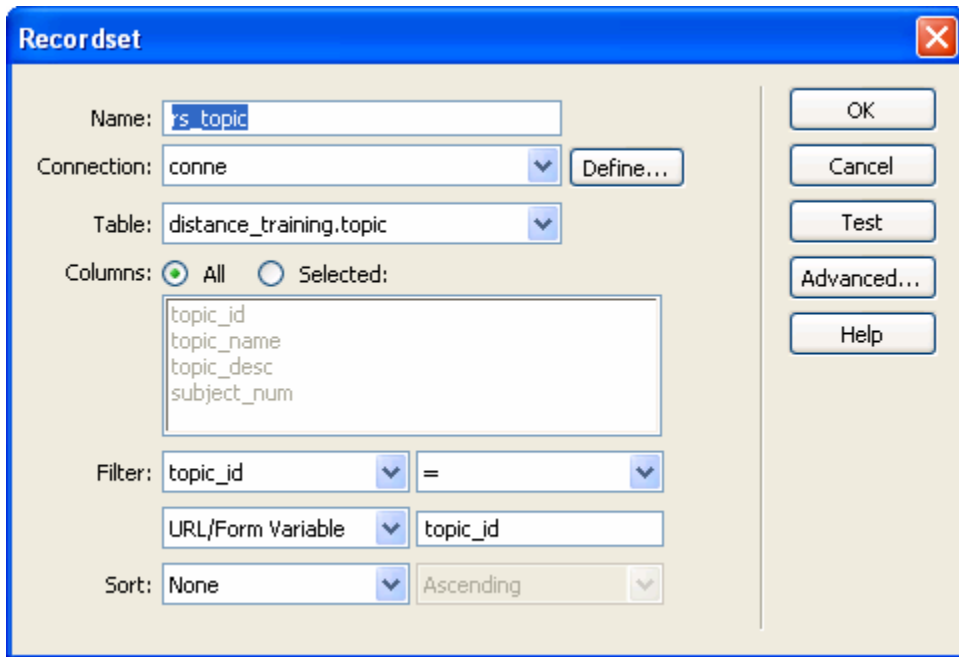


Figure 55. The “rs_topic” Recordset

The “Insert Record” behavior was used successively.

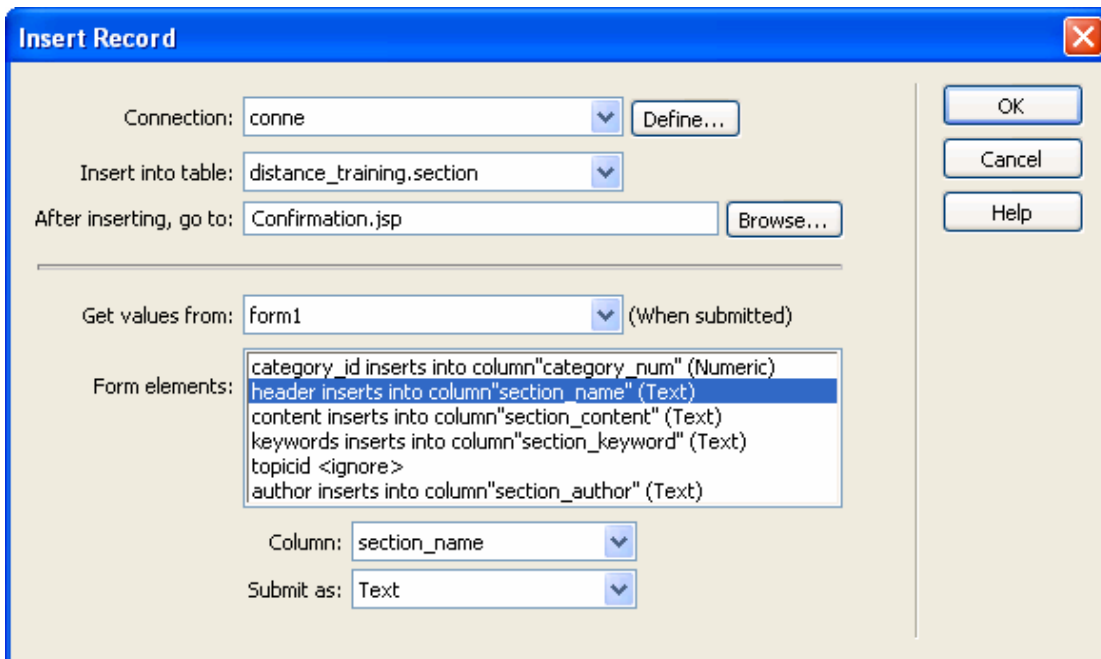


Figure 56. The “Insert Record” Behavior

The last step is to create two hidden fields: one for the “topic_id” and one for the “author”. Both hidden fields are very important to the correctness of the application. The topic_id is necessary in order to keep track of the topic in the join table “topicsection”. The next section explains the usage of the “author” as a hidden field.

9. Confirmation.jsp

After an instructor presses the “Submit” button in the Add_New_Paragraph.jsp page, the Confirmation.jsp appears.

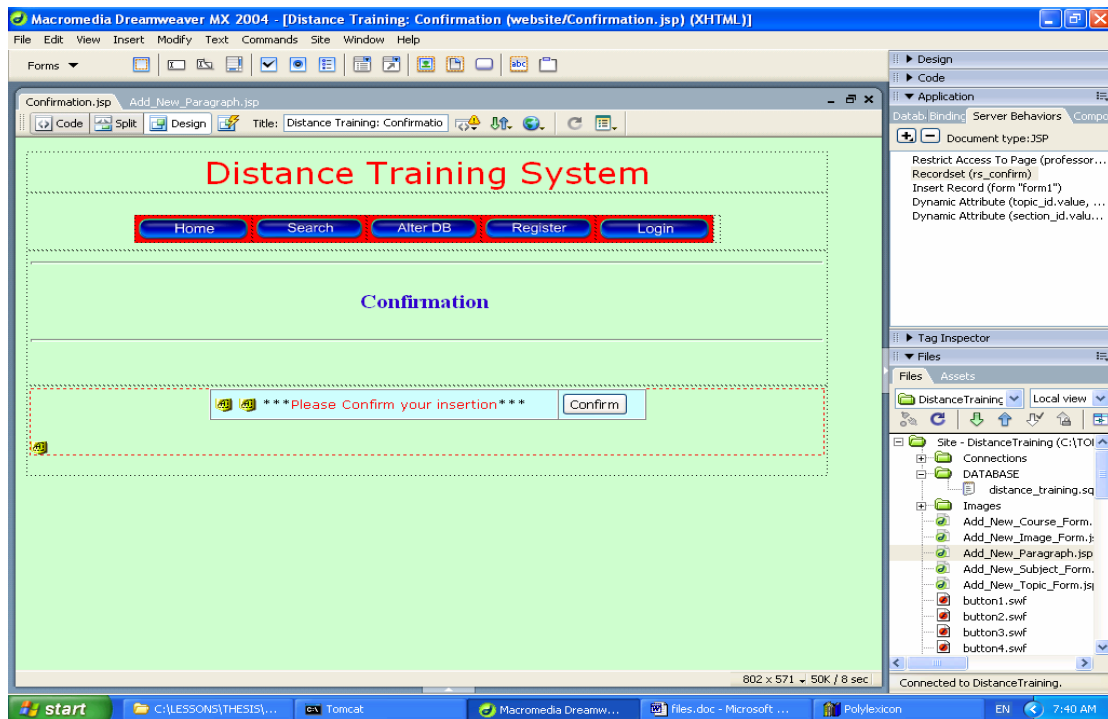


Figure 57. The Confirmation Page When We Insert A Record

This page consists of only one form and three hidden fields. The hidden field from the table is generated by applying the “Insert Record” behavior. The other two are the “topic_id” from the previous page and the “section_id”. They are created in order to update the join table “topicsection” as seen below in the “Insert Record” behavior of this page.

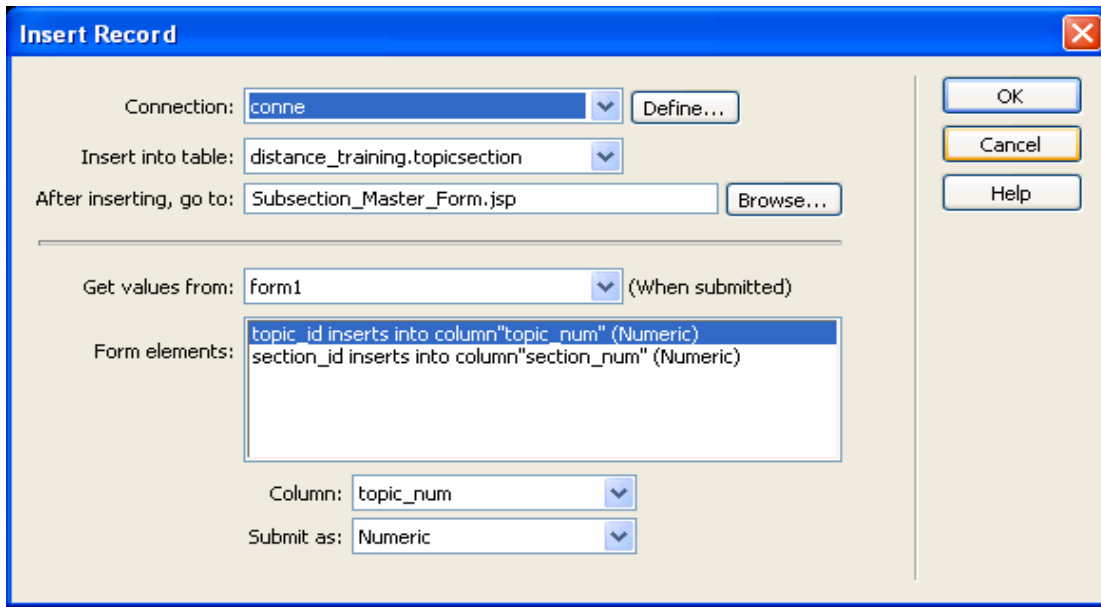


Figure 58. Inserting a Record

The “topic_id” from the Add_New_Paragraph.jsp page is passed as hidden. The next task now is to obtain the “section_id”. The following query is performed to achieve this.

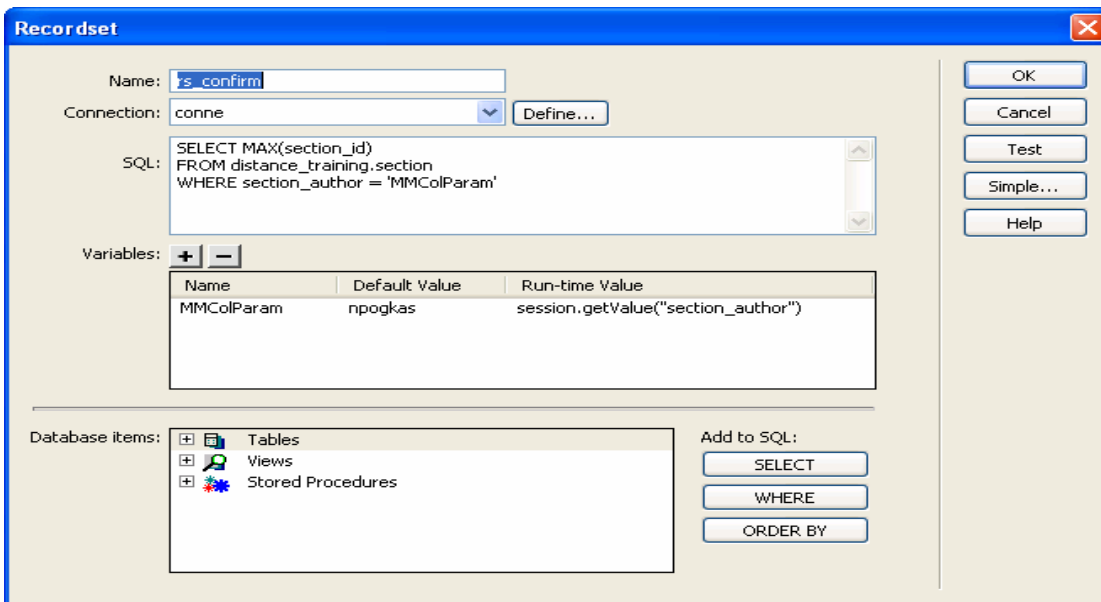


Figure 59. The “rs_confirm” Recordset

As seen from the above query, the maximum “section_id” is actually obtained that identifies the most current inserted paragraph.

The other hidden field passed from the previous page is “author”. Actually, it is not possible to use it but what would happen if, at the same time, another professor was inserting another subsection? The section_id that is written by the database is not known in advance. Thus, by using the passed “section_author” in this query, firstly it is possible to identify the paragraph’s author, and secondly, the maximum section_id for this specific author is obtained.

In conclusion, using the section_author as the hidden field in the “Confirmation.jsp” page takes advantage of all the attributes included in the subsection relation, and as a result, increases the robustness of this application.

10. Update_Paragraph.jsp

The “update” and “delete” constitute the last two detail pages of the subsection master page. This section describes the Update_Paragraph.jsp. Exactly the same methodology is applied to the delete detail page as well. The page layout is similar to the Add_New_Paragraph.jsp (design view)

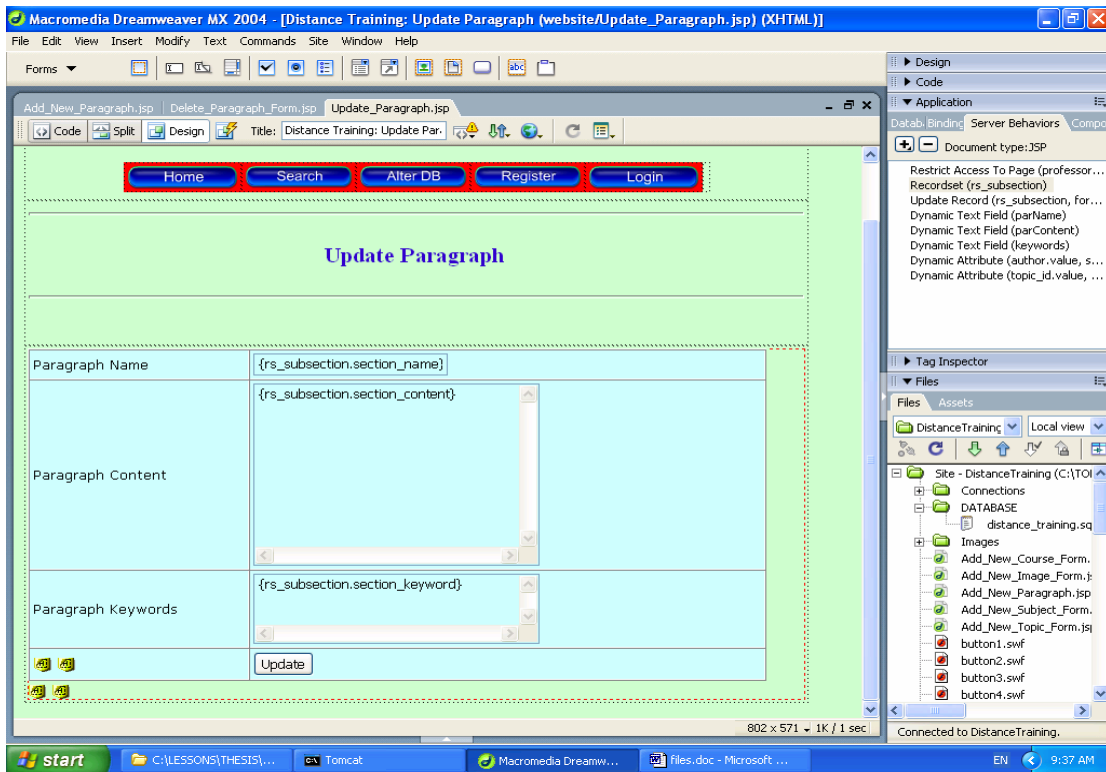


Figure 60. The “Update Paragraph” Page

At the beginning, two hidden fields were created. One was for the author and the other for the topic for identification reasons. The exact same procedure was done for the delete detail page.

The results of the following query were used successively.

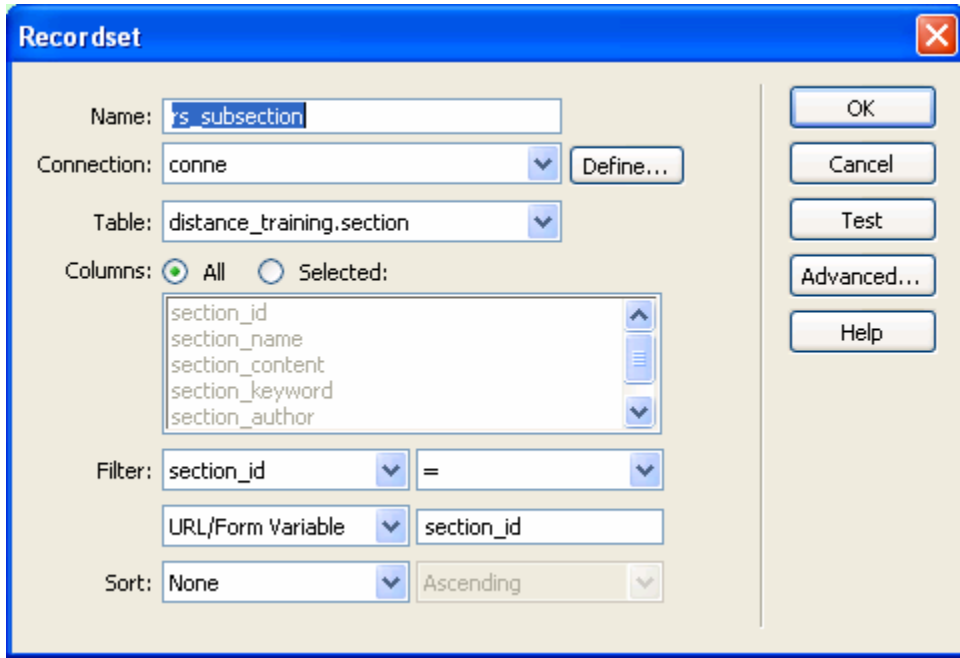


Figure 61. The “rs_subsection” Recordset

As shown, all the columns of the subsection table appeared where the “section_id” is equal to the value passed from the subsection master page. Finally, the “Update Record” dialog window was used in order to modify the specified record.

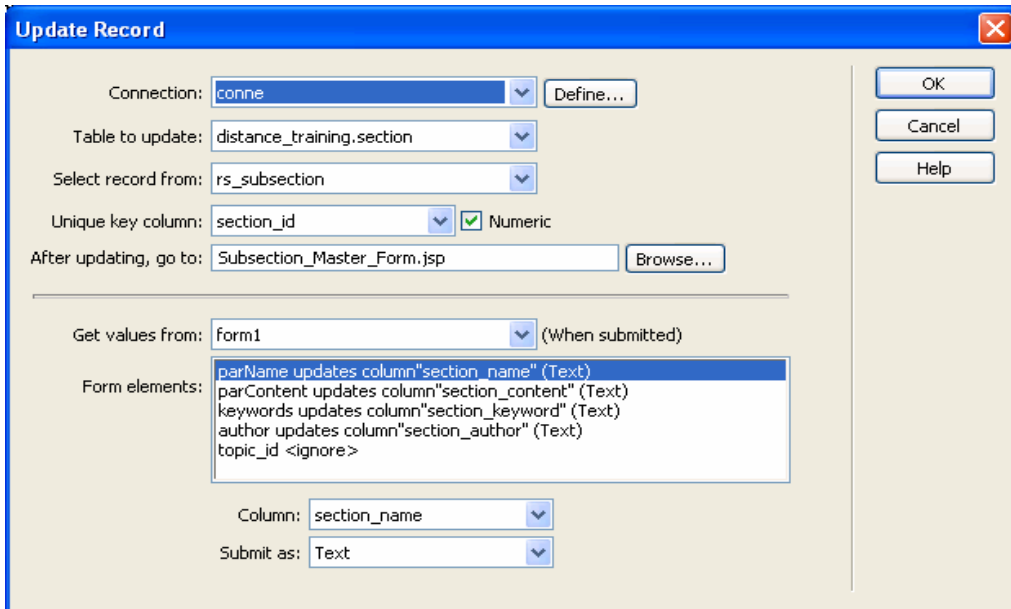


Figure 62. The “Update record” Server Behavior

11. Image_Master_Form.jsp

An instructor can select to see an image related to the current subsection by pressing the “Continue” button of the subsection master page. In the same form, a drop-down menu is included called “subsectionid”. Proceeding in this manner causes the image master page to appear.

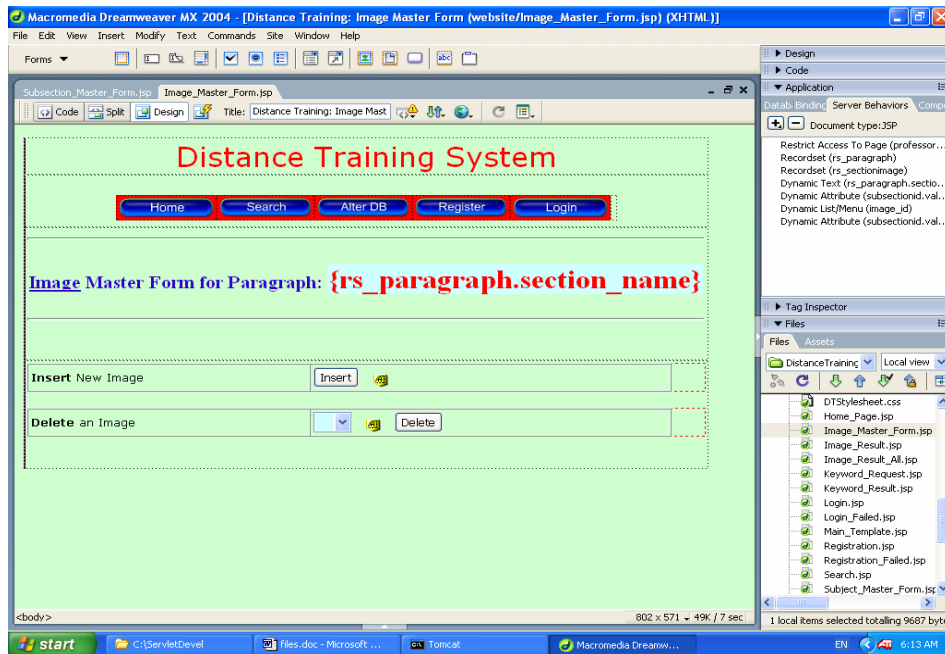


Figure 63. The Image Master Page

Two forms were added to this page. One is for inserting and one for deleting an image. The following query is performed to specify the paragraph name to which the inserted or deleted image is related:

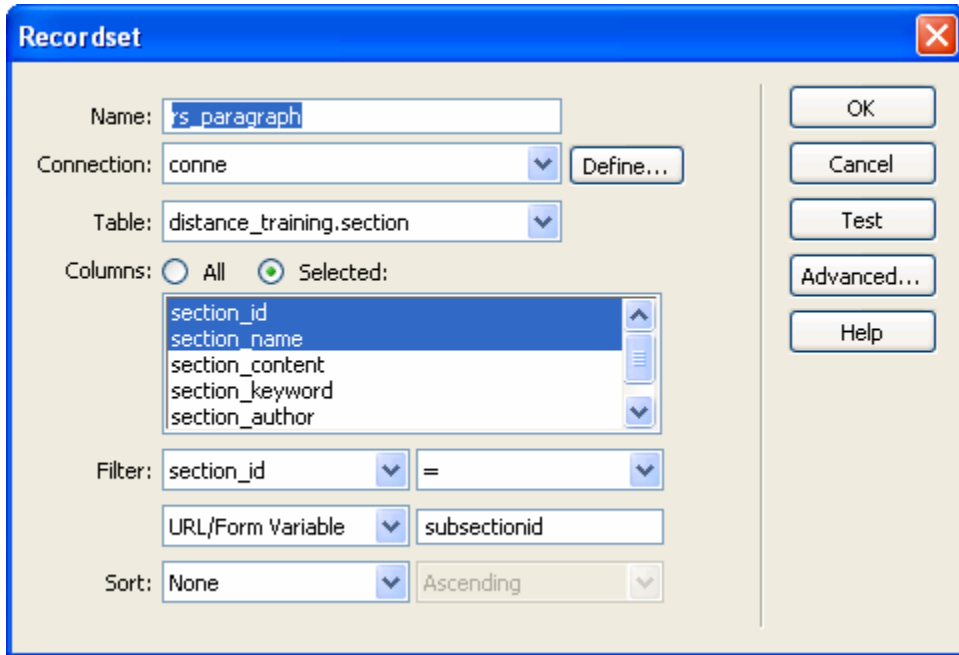


Figure 64. The “rs_paragraph” Recordset

The “subsectionid” filter used in the above query is the value passed from the drop-down menu of the subsection master page. In addition, in order to keep track of this value, two hidden fields were created in the image master page as shown in the first screenshot of this section. The label “subsectionid” was also applied because it is the value expected from the previous page.

```
<%= ((request.getParameter("subsectionid")!=null)?
request.getParameter("subsectionid"): "") %>
```

A second SQL call is also needed in order to obtain the image name to be deleted. As indicated earlier, a subsection may include many images and one image may be included in many subsections. This task is accomplished by performing the following SQL, where “sectionimage” is the join table between the “image” and “subsection” tables.

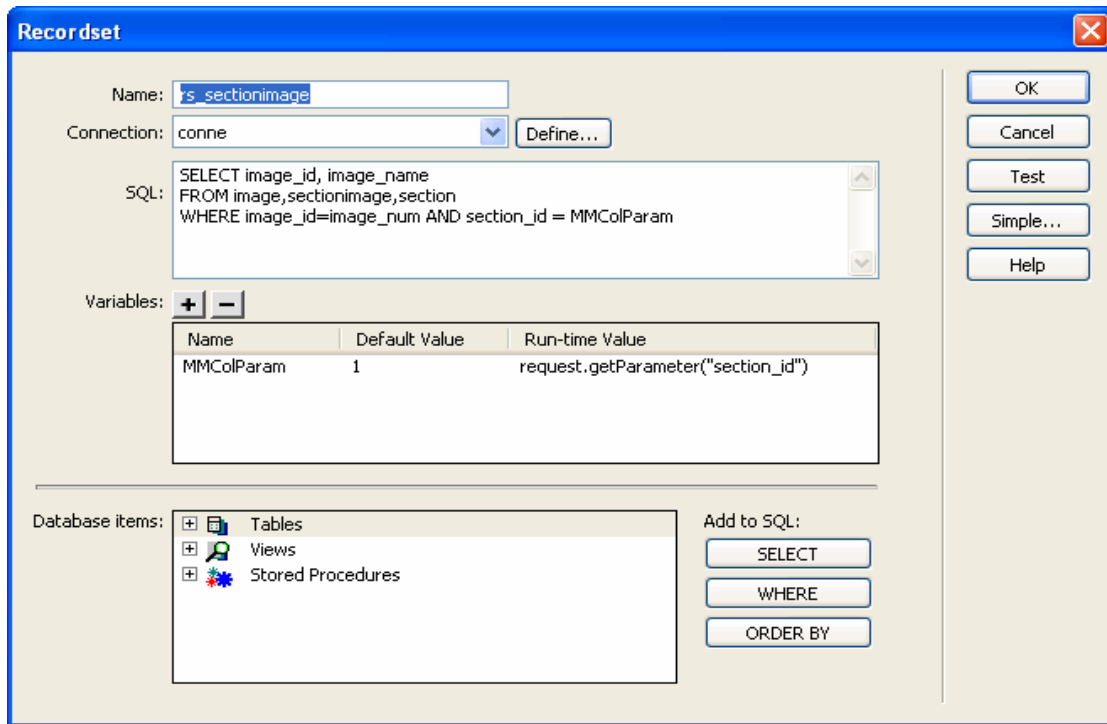


Figure 65. The “rs_sectionimage” Recordset

12. Confirm_Image.jsp

In the subsection master form, when inserting a new paragraph, the “Confirmation” page appears. The role of this page is to update the join table “topicsection” returning the maximum “section_id” for a specific professor at the time of insertion. The same reasons led to the implementation of that idea for the image insertion. At the “Confirmation.jsp” page, two hidden fields were created. One was for the topic (topic_id) and the other for the subsection (section_id). Likewise, in the current page, two hidden fields were also created. One was for the subsection (section_id) and the other for the image (image_id).

The query performed in order to obtain the maximum “image_id” appears below:

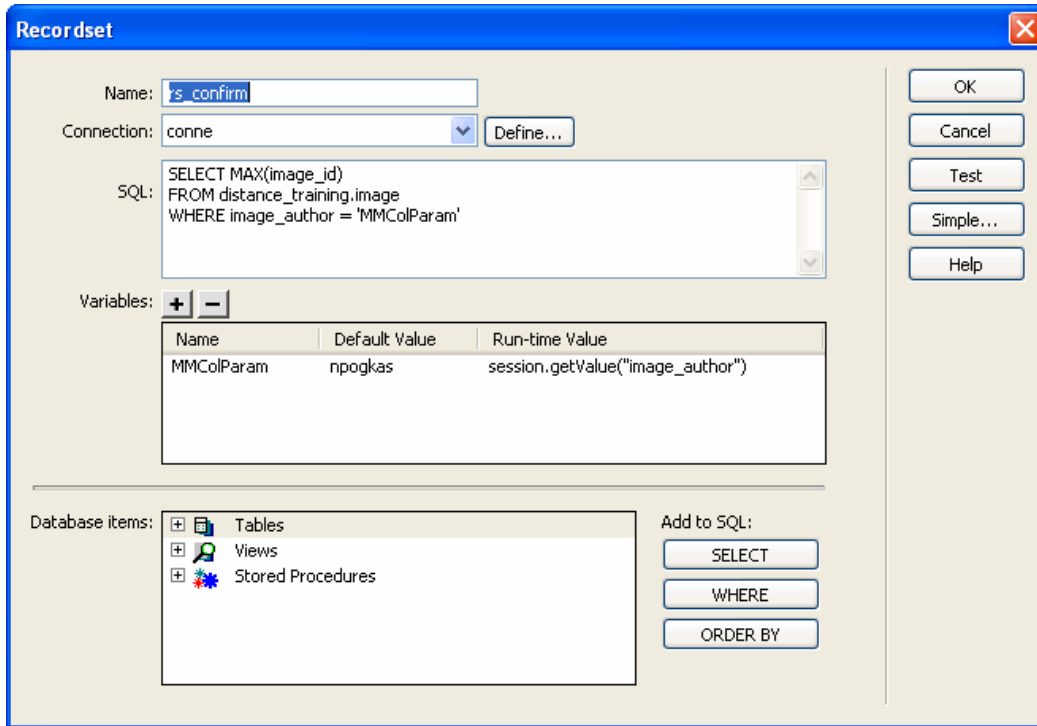


Figure 66. The “rs_confirm” Recordset

Using the “Insert Record” behavior, the data entered in the form were matched (the hidden fields “section_id” and “section_id”) to fields in the database, which created a new record in the “image” table.

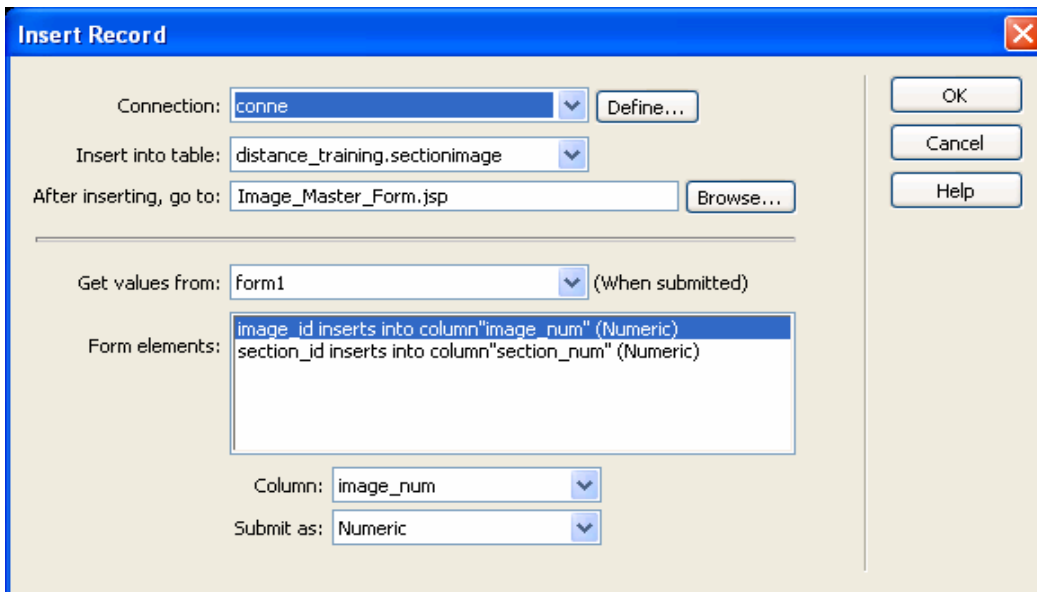
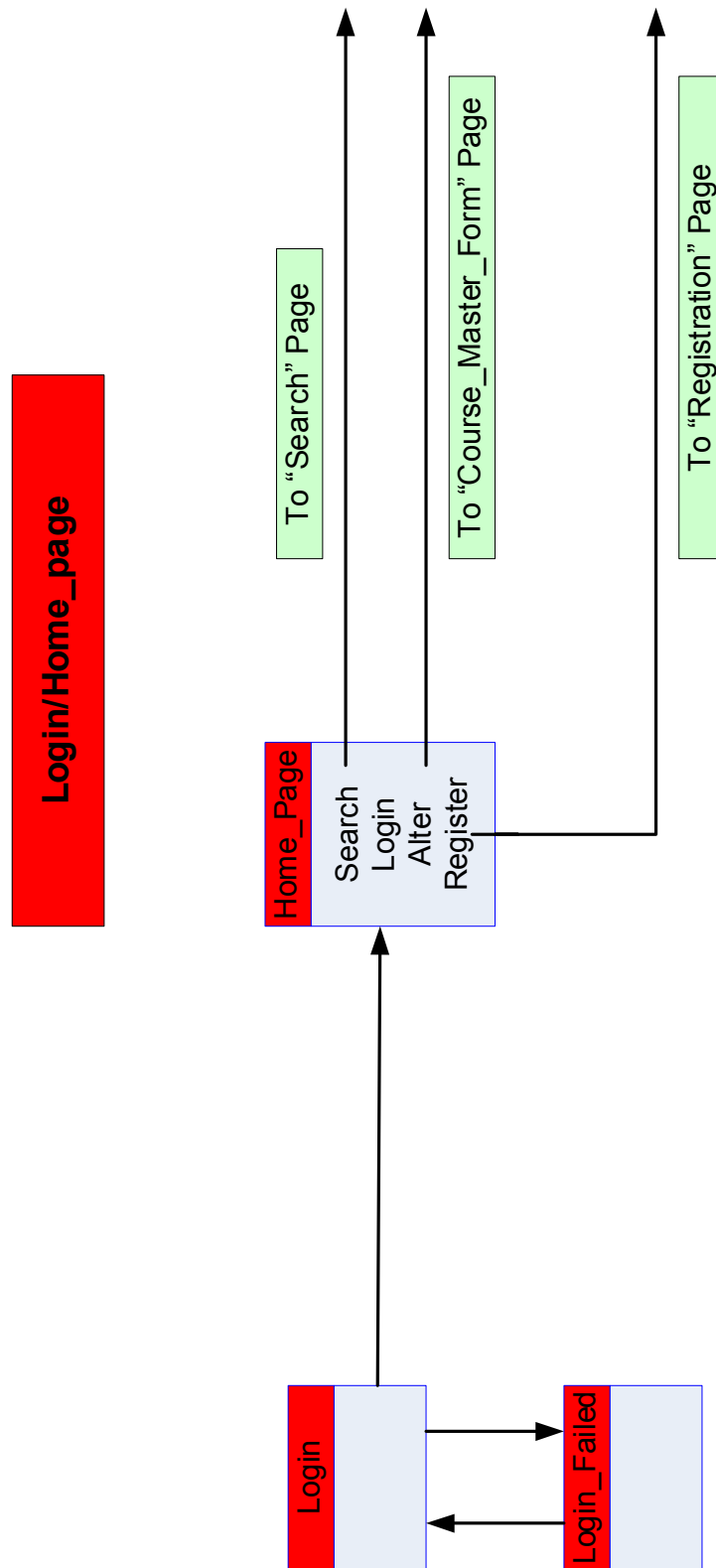
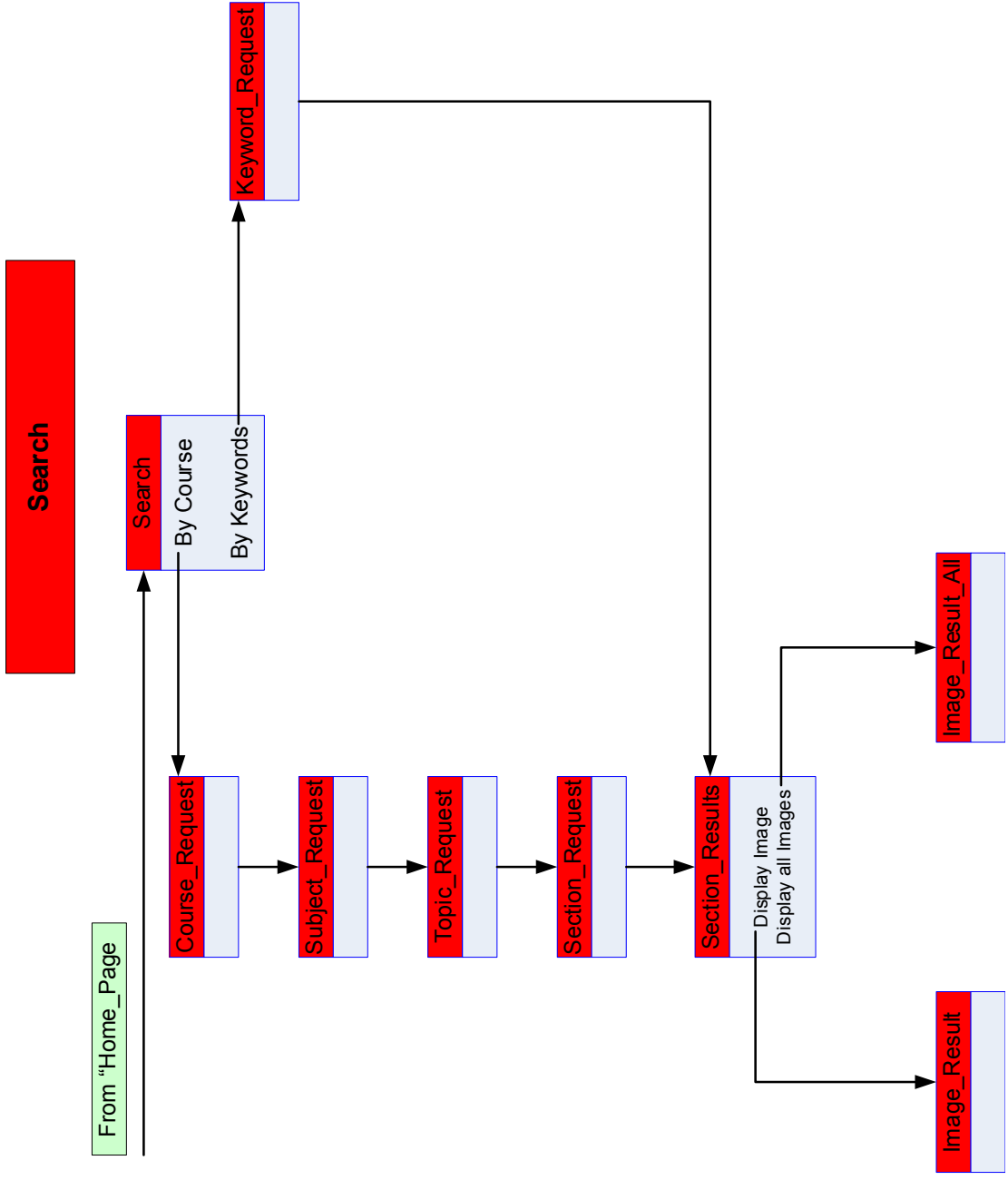


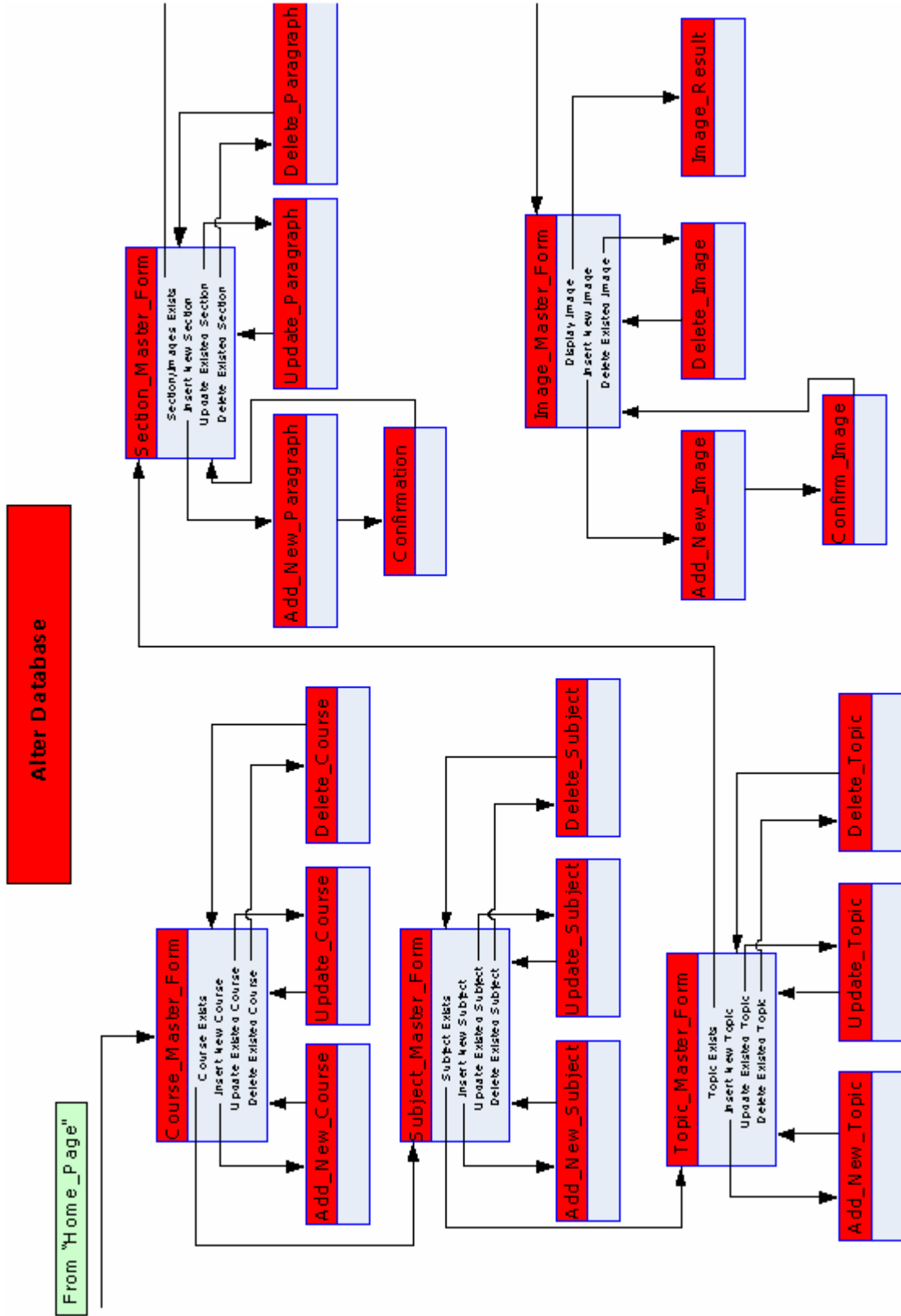
Figure 67. Inserting an Image Record

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VI. DISTANCE TRAINING SYSTEM DATA FLOW DIAGRAM







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VII. CONCLUSIONS

The purpose of this thesis had two main objectives. The first objective was the demonstration of the DTS application as a Content Management System. The second was the elaboration of Dreamweaver MX2004 as a web development tool.

A. DTS APPLICATION

1. Advantages

The DTS application was developed with the notion of the Content Management System (CMS) in mind and not the development of a Learning Management System (LMS). An LMS is appropriate for those students/users/visitors enrolled/registered/invited in the class. However, technical personnel of a military unit who must fix a piece of critical equipment before their campaign or individuals interested in accessing the information but are not registered, cannot have easy access to it, not to mention that they may not be aware of its existence. These military personnel or individuals are not interested in the services that an LMS provides such as grades or participation records. They simply want to access the information of interest in order to solve specific problems. This speculation in the military environment was the main reason leading to the development of the DTS application.

The expert headquarters personnel, for example the signal corps experts on digital communications, are not content designers. They merely want to provide the signal corps units with all the necessary technical instructions about a specific system. Using the DTS application makes their job easier because they can manage their content through simple forms. Furthermore, the military personnel who request the information have the possibility to extract the material fast and correctly without the transformations from one form to another, to XML and so forth. The same idea applies to professors as well; they want to teach. They are educators, not instructional designers.

Another feature of the DTS application is its hierarchical structure. Whenever a hierarchical structure is used in a database design, a “clean”, reliable and robust data model results. This is very important because the DTS or any other application that manages content must be as “clean” as possible. Furthermore, the usage of a web

development tool, such as Dreamweaver, presupposes a reliable data model without design deficiencies and errors. In other words, Dreamweaver cannot mask database flaws. Therefore, it is imperative to be certain of the reliability of the data model design by checking the correctness and querying the database before beginning with the presentation part of a project. It is extremely difficult and time-consuming to go back and try to troubleshoot the database while in the phase of deciding and designing the functionality of the website's menu and the connection of the several screens.

As far as the organizational structure is concerned, the ideas are rather straightforward. First it must be emphasized that the database engine (MySQL) does not support roles, but that is necessary to create roles. Using Dreamweaver's behaviors provided users single user IDs and assigned those user IDs the permissions associated with all of their roles. In other words, when a person connects to the database, a single user ID and password is used, and additionally, a role is specified. As long as that user is connected under the specified role, it is possible to act on only the permissions assigned to that role. For instance, take the Administrator, who is authorized to add or remove professors/authors. He is also authorized for addition, update or deletion of user records, course categories and professors. As long as the professor is logged in as the user, one role is assigned, for example, the instructor's role and then is classified as professor. The Administrator can also associate current professors to courses to authorize modification of course content.

The "Search" operation is featured from manual and keyword lookup. As indicated earlier, this database is not as restrictive as a LMS such as Blackboard, that limits access to specific parties and content. It is an open information repository available to anyone with access to the Internet. The usage of the "Category" entity, which is used to group similar courses in categories for easier identification purposes, facilitates even more the access of an external user. Another advantage of the "Category" approach that makes the application more flexible is that it is specified by the professor because the latter is the only person responsible for the subsection content.

This project was developed as a standalone application. It is obvious that, if the DTS was a part of a publicly accessibly Network, many security issues would be

generated. As a general rule, no MySQL server should ever be accessible from the Internet. As a result, the disadvantage of the DTS is that it faces a serious architecture problem because it requires a MySQL server to be directly accessible from the Internet. The the installation of the MySQL server behind a firewall would remedy that problem, preferably on a network segment in which only the client applications, such as the Web server or application server, can route to it.

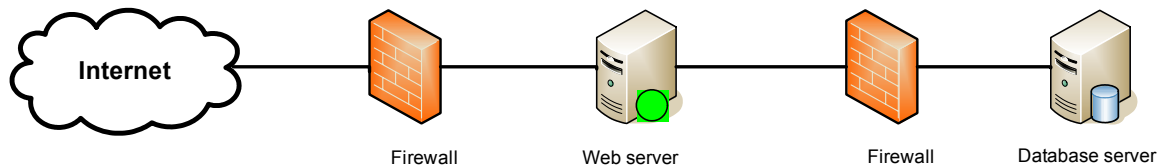


Figure 68. Securing the Database Server (After Ref. 4)

In conclusion, despite the security drawbacks of the DTS when using it in a deployment environment, it satisfies the main purpose of its existence: make content sharable.

2. Future Research

After deciding upon the application area and setting the business rules/requirements, the creation of the data model began from the smallest piece of information (paragraph) creating the “subsection” entity, and then, working incrementally, all the relations were created that constitute the DTS application. The DTS is a general Content Management System prototype, and as a result, it may be subject to modifications or extensions. Due to its flexibility and its expanding capability, it can be applied to military branches or college institutions that are interested in making their information sharable. For instance, it is possible to create the “track” entity for institutions that may need this extension in the data model. In this particular case, one track must consist of two or more courses and one course may or may not be included in many tracks. As a result, the creation of a join table between course and track for this occasion is mandatory. Therefore, a possible extension of the data model according to one’s requirements could be considered a field for future research.

The database product (MySQL) used for this application is an open source RDBMS with many other advantages as demonstrated previously. However, for the time being, it lacks a GUI, does not support views, cascading deletions, stored procedures nor triggers. Therefore, another field for future research would be the DTS testing using a larger and more complicated database product with XML capabilities such as Oracle or a SQL Server.

Finally, the keyword search function needs improvement. Instead of forcing the professor/author to specify keywords for a particular paragraph manually in a specific field of the “subsection” relation, a mechanism may be discovered that can generate keywords dynamically performing a kind of algorithm on the paragraph’s content. This algorithm may automatically capture title words, subsection headers and words in the first sentence of the paragraph.

Additionally, the manner in which images are inserted into the DTS is a bit cumbersome. First, the image is placed into the “images” directory of the application, and second, the path to the image is created in the source code of the file related to the image. Simple typographical errors may prevent the display of the imported image.

B. DREAMWEAVER MX2004

1. Advantages

There are many advantages to using Dreamweaver for designing and maintaining websites. First of all, building and editing websites is fast. A user may start with one of many basic templates and quickly modify it for specific purposes. The GUI interface allows simultaneous designing and coding. The user can see how html will appear immediately after writing the code. The split view interface allows the user to quickly build a page in the design view and then refine the html in the coding view. Also, code that needs modification may be located quickly by selecting the corresponding element in the design pane. The code pane automatically scrolls to the html for the selected element and highlights the code. The ability to work form one interface also accelerates web development. Dynamic features may be added to a site through the use of page behaviors, Dreamweaver's JavaScript interface, and server behaviors, and Dreamweaver's database connection interface. Also, basic image optimization may be accomplished within

Dreamweaver and more advanced image processing may be accomplished through close integration between Dreamweaver and Fireworks. Finally, Flash buttons and other basic Flash elements may be added within the Dreamweaver interface.

Another advantage to using Dreamweaver is that the program is extensible. Hundreds of third party extensions that add functionality may be downloaded for free or purchased. Extensions are usually written in html, JavaScript, or C. Most extensions do one or more of the following: automate changes to a document, interact with Dreamweaver to open or close windows or documents, connect to a data source, insert or manage a block of server code. Dreamweaver offers both a JavaScript API and an Utility API.

Finally, Dreamweaver is customizable. The user may set preferences controlling how and to what extent accessibility is coded. The user may adjust code coloring, what fonts are used for coding, and how code is highlighted. The user may also set which browsers to use for previewing a page. Besides setting preferences, the user may also directly edit the configuration files. In this way, menus may be rearranged to suite individual tastes. Tabs may be added or removed. The names of commands may be changed, added, or removed. Anything about the look and feel of Dreamweaver may be customized within the configuration files.

2. Disadvantages

Although Dreamweaver may be the best software of its type, it possesses several disadvantages. Dreamweaver's main disadvantage is that after creating an interacting web page, it is not possible to delete a functionality part of this specific page because the corresponding code(a part of it) sometimes remains hooked into the page, and in the worst case, it is scattered throughout the page. This drawback caused numerous problems during the DTS development. For instance, on many occasions, it was necessary to delete the page completely and rebuild it from scratch when an error occurred instead of fixing this particular error on the existing page.

The visual interface for building tables does not always work. The user must switch between code views and various design views in order to optimize table construction.

Although far from perfect, Dreamweaver MX 2004 is the best tool of its type and improves a bit with each release. Dreamweaver's flexibility facilitates its use by all members of a multidisciplinary web design team. Dreamweaver is arguably the best stand alone tool to use for developing today's complex websites that incorporate multiple server technologies (JSP, .NET, PHP etc.), integration with databases and content management systems. However, it is not possible to create a serious application relying exclusively on Dreamweaver or any other Web development tool. With the currently available development tools, hand coding is still required when developing serious Web applications.

APPENDIX A. DISTANCE TRAINING SYSTEM (DTS) SCHEMA

Please click on the following link to view Appendices A and B.

http://library.nps.navy.mil/uhtbin/hyperion/04Sep_Pogkas_Appendices.doc (Appendix)

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APPENDIX B. DISTANCE TRAINING SYSTEM (DTS) CODE

Please click on the following link to view Appendices A and B.

http://library.nps.navy.mil/uhtbin/hyperion/04Sep_Pogkas_Appendices.doc (Appendix)

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