

**Designing A Simple Resource Search UI for the  
Digital Library for Earth System Education (DLESE)**

**University of Colorado, Boulder  
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## Introduction

The focus of our project was to build functional prototype of the discovery system user interface (UI) for the Digital Library for Earth System Education (DLESE). The prototype had two goals: first to show a proof of concept for the DLESE project and second to provide an initial search and discovery implementation that can be extended to include multiple heterogeneous data collections in future iterations. Our design goal was to ensure that user's desired information be easy and convenient to discover via the UI. We focused on three components with this goal in mind: first a keyword search designed so that the most relevant information was returned at the top of the results list. Second a "browse" search that provided a summary of the resource topology in one simple view. Third a clear and concise presentation of search results that allow users to evaluate desired information quickly. Once the prototype was up and running we conducted user tests. The results of these tests and our recommendations for future iterations of the DLESE search engine are outlined at the end of this report.

## Background

The Digital Library for Earth System science is "an information system dedicated to the collection, enhancement, and distribution of materials that facilitate learning about the Earth system at all educational levels [1]". The main goal of DLESE is to provide a central place for Earth system educators at all levels and disciplines to obtain as well as submit educational resources of all varieties. Currently the DLESE staff is in the process of collecting and cataloging resources, most of which reside on the World Wide Web. At the time of our testing there were 42 resources cataloged and available in the DLESE database. Our goal for this project was to design a working UI that facilitates the discovery and retrieval of resources cataloged by DLESE. Jason Brant, Lynne Davis, Melissa Dawe, Lu Fan and Edgar Roman (2000) began this work and we used their research as a springboard for continued development.

DLESE has established a standard metadata set used to catalog resources. This metadata is recorded and stored in the DLESE database for each resource. The metadata provides a standard structure and outline for describing resources. We focused our UI development using the required metadata set only. From a users point of view the required metadata provides just the information needed to quickly determine the nature of a resource without being overwhelmed with details. The required metadata set includes key information such as the title of the resource, the resource URL, the resource type (book, web page, CD, etc.), the learning context (grade level), and the description of the resource. A complete listing of the required metadata set is provided in Appendix C.

The intended users of the DLESE search and discovery system are diverse. The core users are Earth system educators from k-12 all the way up to the graduate level. However, DLESEs' audience also includes students and the general public - anyone who may have an interest in Earth system science. Much of our design and development work was done with users' goals in mind. Brant et al (2000) looked at possible scenarios for users wishing to find resources through DLESE and identified critical user tasks that served as a guideline in our design. The full list of their user tasks is shown in Appendix D. Here is an example:

*You want to find material to teach your sixth grade students about tornadoes and hurricanes at a sixth grade level.*

From user tasks such as these we considered several different UI designs. An initial UI design was provided by Brant et al (2000) which was developed in Toolbook. We began

by adapting their design to an HTML based UI which could be accessible via a web browser. In considering various design layouts we used the cognitive walkthrough method for evaluation developed by Lewis and Reiman (1996). This method involves mentally “walking through” typical user tasks to make sure they can be completed using the UI, with consideration to ease of use. Heuristic evaluations were used when considering the flow of work and labels for buttons and headings.

## Design Rational and Technical Approach

Design of the prototype was divided into two subtasks. One that centered on the formulation of the HTML version of the discovery system, and one that supported the design of the API between the user interface and the underlying software components. The assumption going into the design of the interface was that the underlying architecture would support anything we could design using HTML. The following subsections will cover the design process and rational used in building the user interface for the prototype discovery system. This is followed by a discussion of the technical approach to the underlying software architecture.

### *Discovery System User Interface*

The design of the prototype discovery system for DLESE was based upon work previously completed during the spring of 2000 (Brant et al, 2000). This work included formulation of user tasks and the building and testing of a nonfunctional prototype. Table 1 shows the various inputs considered in our design and their corresponding features. The earlier prototype was not designed for use on the Web. In designing the user interface for the Web, we started with a collection of what were viewed as the most critical user tasks. These tasks would drive the form of our design. We then conducted a survey of the popular web search engines and metadata-based search sites (Social Science Information Gateway (SOIG), the Journal of Interactive Media in Education (JIME), the Waste Water Engineering Virtual Library (WWEVL)). We used concepts from these that would best support our user tasks and meet the prototype requirements set forth by the DLESE staff. Our design was primarily an adaptation of Google, an Internet search engine ([www.google.com](http://www.google.com)). Google’s design was simple, elegant, and presented the search results in an easily understood manner (figure 1).

Inputs	Design Requirements	Prototype Features
Scenarios, user tasks and previous user testing	<ol style="list-style-type: none"> <li>1. Support search by browsing as well as keyword search</li> <li>2. Provide quick access to resources by grade level</li> </ol>	<ol style="list-style-type: none"> <li>1. Keyword search (fig 2)</li> <li>2. Search by topic allows browsing (fig 7)</li> <li>3. Checkboxes for grade level (fig 2 and 3)</li> </ol>
Audience	<ol style="list-style-type: none"> <li>3. Provide earth science categories</li> </ol>	<ol style="list-style-type: none"> <li>4. Checkboxes for all categories in advanced search (fig 3)</li> <li>5. Search by topic (fig 7)</li> </ol>
DLESE required metadata set	<ol style="list-style-type: none"> <li>1. Present most information from this set</li> <li>2. Allow searching of the metadata set for retrieval of information</li> </ol>	<ol style="list-style-type: none"> <li>6. List view of results presents the highlights (fig 5)</li> <li>7. Full view provides most required metadata to the user (fig 6)</li> </ol>
Sparsely populated database	<ol style="list-style-type: none"> <li>3. Provide a topology of cataloged resources</li> </ol>	<ol style="list-style-type: none"> <li>8. Search by topic allows browsing (fig 7)</li> </ol>

Table 1 Inputs, Their Resulting Design Requirements and UI Features



Figure 1 Google Front Page

selections of grade level. It also did not have as clean an appearance as this design. The user on this page would begin a search by typing in a keyword and optionally selecting one or more grade levels via the check boxes. Then the user would either hit the enter key or click on the search button to begin the search.

At the top of the front page there is a link to the advanced search page. The advanced search page, shown in figure 3, allows the user to choose from all of the possible metadata categories. We considered several layouts including drop down menus for this page as well. Again, after initial usability inspections we decided to use the check box

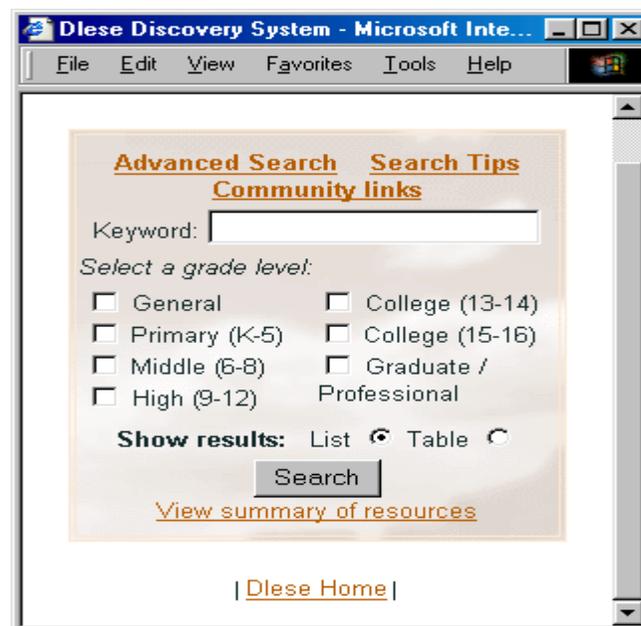


Figure 2 Prototype Front Page

Our first cut at a prototype page was very similar to Google. Later, it was modified to allow the user to limit their search by specifying a grade level. Figure 2 below shows the final version of the front page of the prototype. An earlier version included a drop down list for selection of the grade level. After some initial testing, including cognitive walkthroughs (Lewis and Reiman 1996), the drop down list was not used because it did not allow multiple

format shown here. The major advantage is that users can see all of the categories at once and can easily choose as many categories as they wish to refine their search. We also considered different labels for the checkboxes before settling on the ones shown here. These labels are short, allowing for a better page layout, and provide a concise user-friendly definition of the underlying metadata they refer to.

The screenshot shows a web browser window titled "Advanced Search" with the address bar displaying "http://oliver.page.ucar.edu:9089/dlese/jsp/prototypes/advanced\_search.html". The page features a search bar with a "Search" button and a "Qualify Your Search" section. Under "By Grade Level:", there is a "Select Grade Level" box with checkboxes for General, Primary (K-5), Middle (6-8), High (9-12), College (13-14), College (15-16), and Graduate / Professional. The "College (13-14)" checkbox is checked. Below this is the "By Resource Type:" section, which includes a "Select Resource Types" grid. The grid is organized into several categories: Audio, Dataset, Portal, Tools, Instructional Materials, Text, and Visual. In the "Instructional Materials" category, the "Lesson plan" checkbox is checked. The "Internet zone" logo is visible in the bottom left corner of the browser window.

**Keyword:**

**Qualify Your Search**

**By Grade Level:**

**Select Grade Level**

General  College (13-14)  
 Primary (K-5)  College (15-16)  
 Middle (6-8)  Graduate / Professional  
 High (9-12)

**By Resource Type:**

**Select Resource Types**

<p><b>Audio</b></p> <input type="checkbox"/> Book <input type="checkbox"/> Radio broadcast <input type="checkbox"/> Lecture <input type="checkbox"/> Sound <input type="checkbox"/> Music <input type="checkbox"/> Webcast <input type="checkbox"/> Oral history	<p><b>Instructional Materials</b></p> <input type="checkbox"/> Activity - classroom <input checked="" type="checkbox"/> Course <input type="checkbox"/> Presentation / demo <input type="checkbox"/> Activity - computer <input checked="" type="checkbox"/> Curriculum <input type="checkbox"/> Problem set <input type="checkbox"/> Activity - field <input type="checkbox"/> Field trip guide <input type="checkbox"/> Syllabus <input type="checkbox"/> Activity - lab <input type="checkbox"/> Instructors guide <input type="checkbox"/> Tutorial <input type="checkbox"/> Annotation <input checked="" type="checkbox"/> Lesson plan <input type="checkbox"/> Virtual field trip <input type="checkbox"/> Assessment <input type="checkbox"/> Module / unit <input type="checkbox"/> Case study <input type="checkbox"/> Project
<p><b>Dataset</b></p> <input type="checkbox"/> Dataset	<p><b>Text</b></p> <input type="checkbox"/> Abstract / summary <input type="checkbox"/> Periodical <input type="checkbox"/> Annotation <input type="checkbox"/> Policy / procedure <input type="checkbox"/> Book / monograph <input type="checkbox"/> Proceedings <input type="checkbox"/> Glossary <input type="checkbox"/> Proposal <input type="checkbox"/> Journal article <input type="checkbox"/> Report <input type="checkbox"/> Index / bibliography <input type="checkbox"/> Technical reference <input type="checkbox"/> Thesis
<p><b>Portal</b></p> <input type="checkbox"/> Educational.edu <input type="checkbox"/> Forum / discussion <input type="checkbox"/> For-profit.com <input type="checkbox"/> Listserv <input type="checkbox"/> Government.gov <input type="checkbox"/> Message board <input type="checkbox"/> Military.mil <input type="checkbox"/> Search Engine <input type="checkbox"/> Non-profit.org <input type="checkbox"/> Ask an expert <input type="checkbox"/> Clearinghouse	<p><b>Visual</b></p> <input type="checkbox"/> Artistic illustration <input type="checkbox"/> Scientific illustration <input type="checkbox"/> Imagery - remotely sensed <input type="checkbox"/> Scientific visualization <input type="checkbox"/> Map <input type="checkbox"/> Video <input type="checkbox"/> Photograph <input type="checkbox"/> Webcast
<p><b>Tools</b></p> <input type="checkbox"/> Calculation / conversion <input type="checkbox"/> Software	

Figure 3 Advanced Search Page

Our initial search interface (figure 2 and figure 4, top) also allowed the user to select whether they would like their results formatted in a table or list view. As you can see from the table results view below there are inherent problems with using it. The displayed returns cause scrolling and formatting problems. For these reasons the table view was not used in the final prototype nor was it integrated with the DLESE web site.

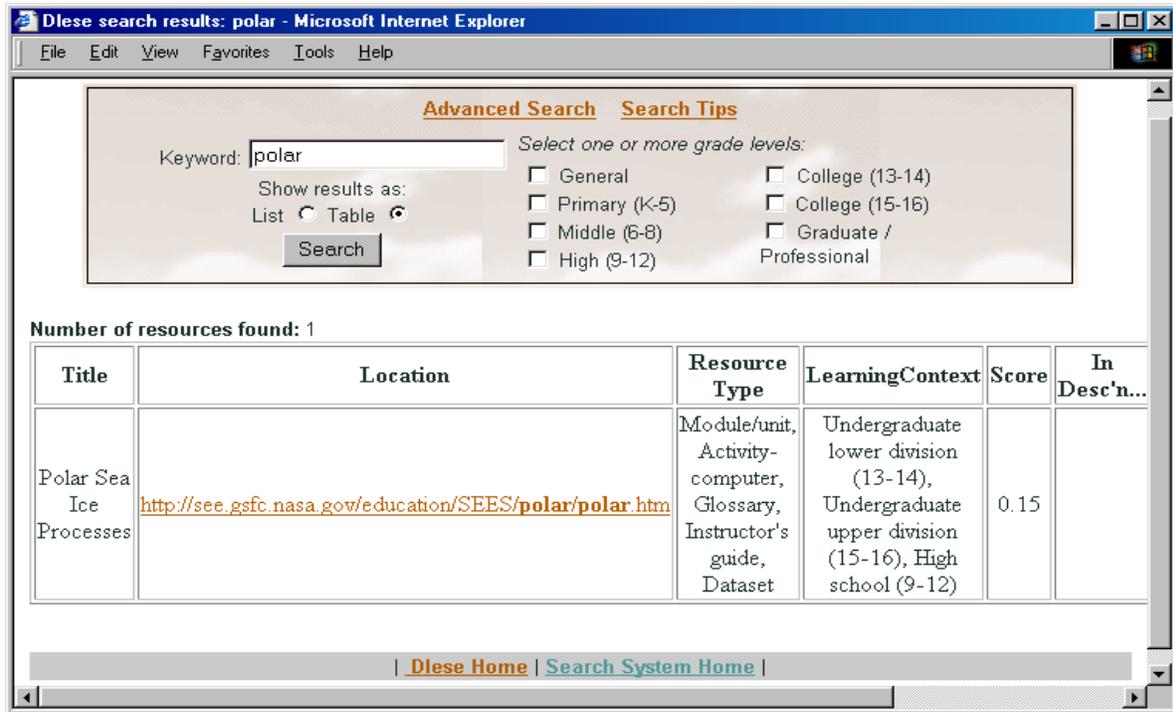


Figure 4 Table View Results Page

Rather than the table view we chose a list view (figure 5), again inspired by Google. In presenting the results we chose to use a subset of metadata that mapped best to what the users were looking for in the user tasks. Those metadata fields were the title of the resource, the URL, the grade level, and the type of resource. We also included a score that is calculated based upon where the keyword occurred in the metadata and how often it occurred. For example keywords occurring in the title would be weighted higher than those occurring elsewhere. Our intent was to give the user a quantitative means to distinguish among the results. The search results shown below are for a keyword query on *polar*. The user accesses the resource by clicking on the provided URL. We also included a horizontally laid out version of the initial search dialog along with the results. This allows the user to modify their search or start another without backing up.

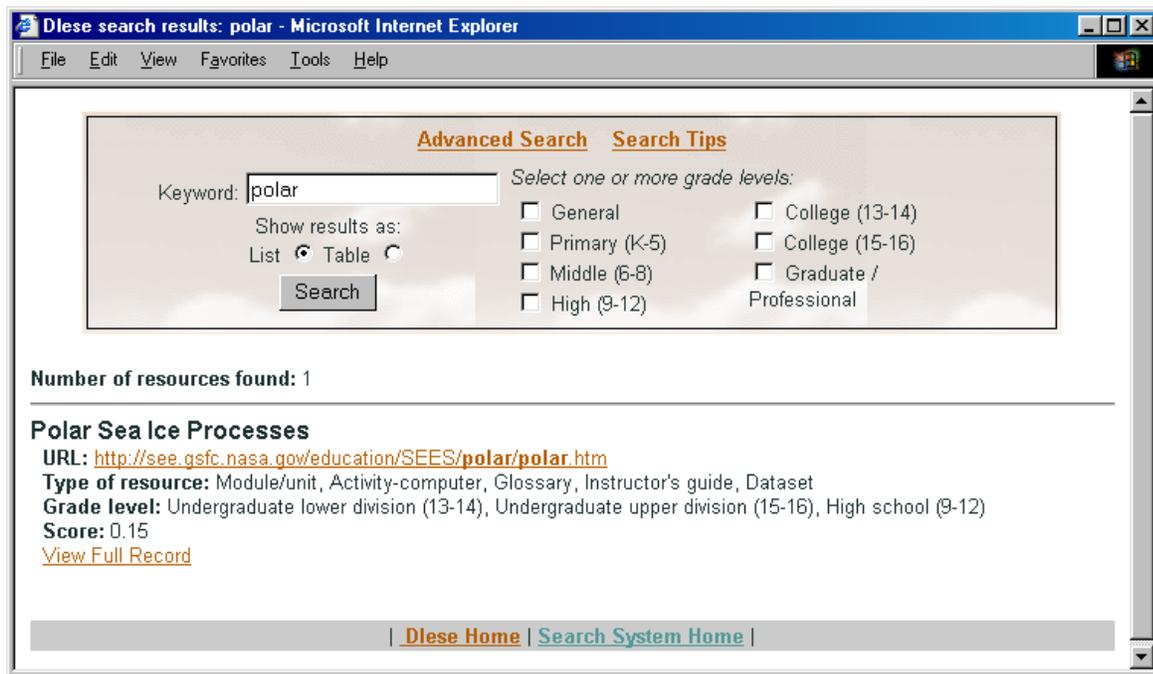


Figure 5 List View Results Page

The user tasks and requirements also lead to the development of a page that would allow the user to view a larger subset of the metadata record associated with the resource prior to looking at the resource. These include the title, URL, description, grade level, resource type, contributor, requirements, and cost/copyright metadata. Clicking on the View Full Record link accesses this page. Part of this page is shown below in figure 6.

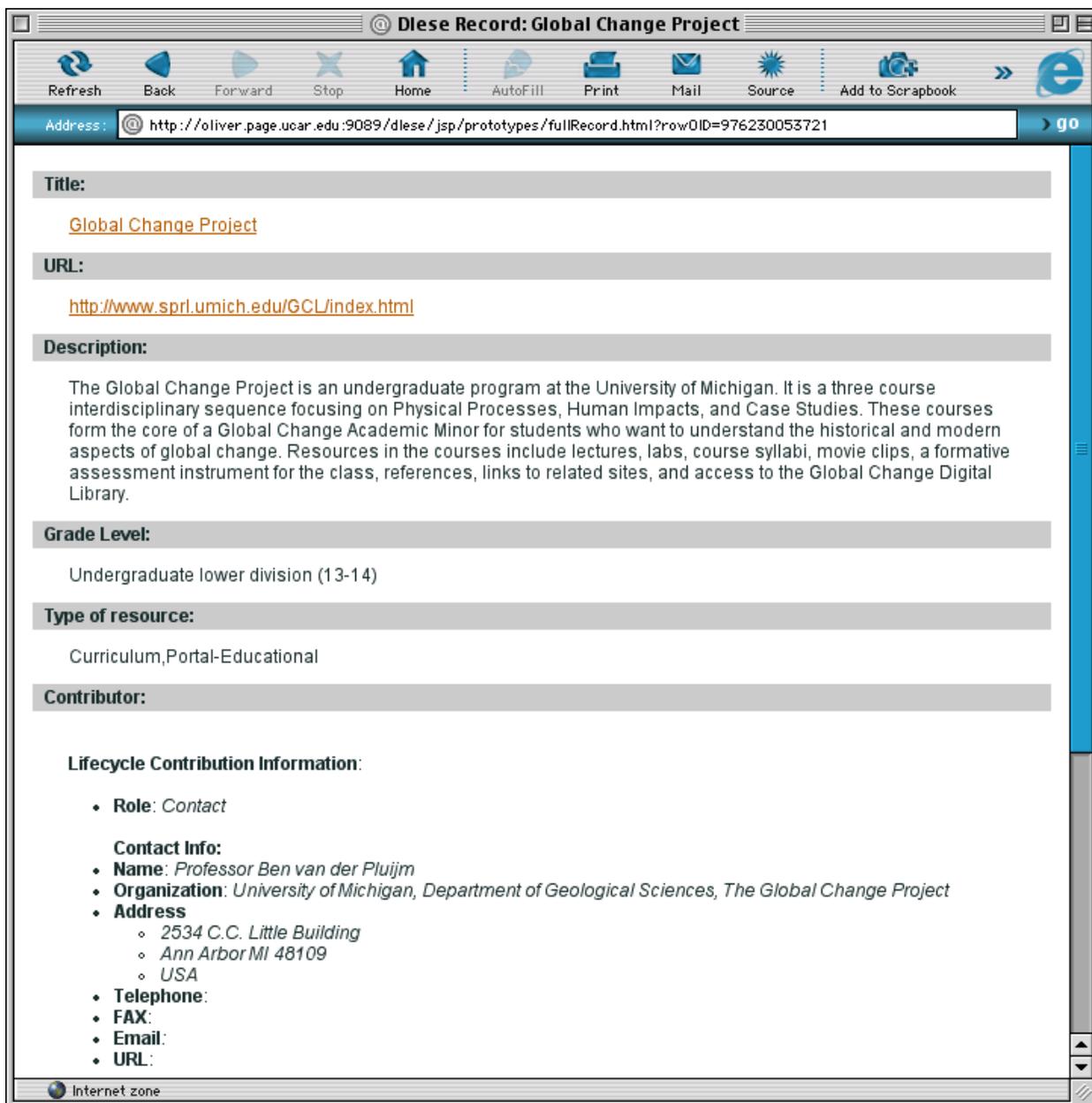


Figure 6 Full Record Page

From the initial formulation of the prototype we felt that it would be important, especially in a sparsely populated database, to allow the user to browse the database by topic. In a sparsely populated database, keyword searches will likely return zero results, unless the user is aware of what records are present. In addition, from the earlier testing done by Bryant et al (2000) it was clear that many people prefer to be presented with a topology of resources as a means of gathering ideas about possibilities. However, we failed to give this method of navigating the database enough prominence in the interface. Specifics on this problem will be covered in the recommendation section. Figure 7 below shows the "Browse current resources" interface to the data in the database that provided users the means to browse by category. This page was accessed from the front search page (figure 2) via a link at the bottom. Users can search the database by clicking on their topic of choice. Once a topic is chosen the user is presented with the results of their topic based query.

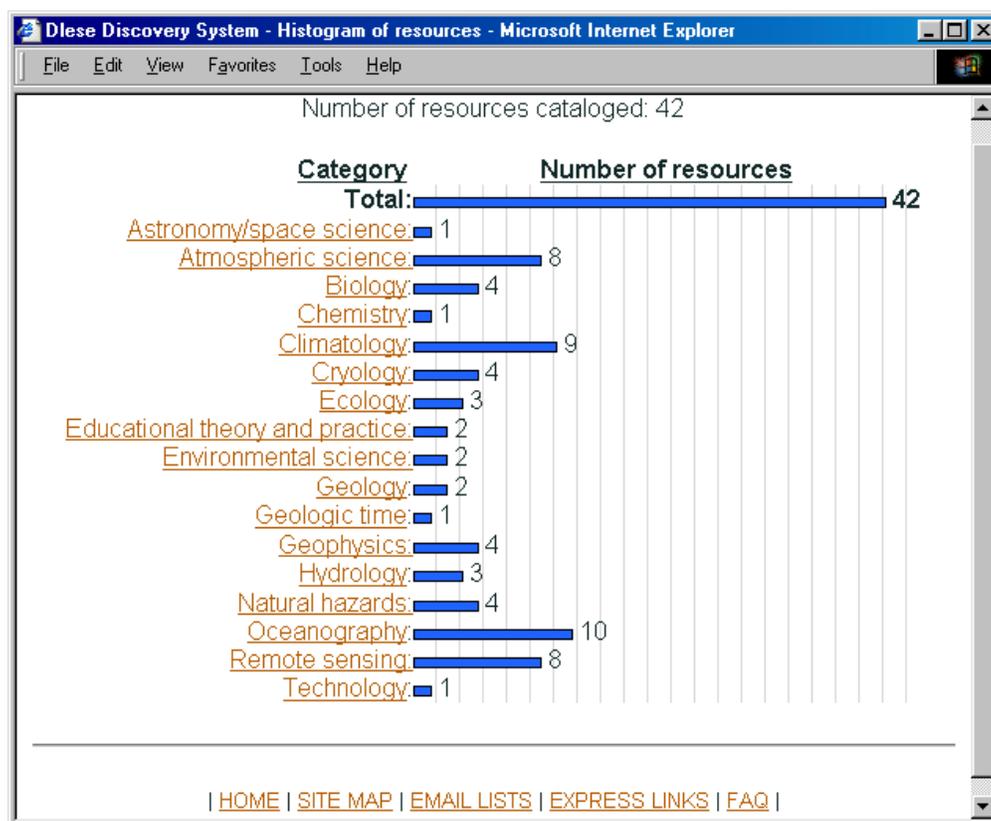


Figure 7 Browse by Topic Page

The discovery system was meant to be easily available to a wide audience from K-12 educators to college professors to students and the general public. Because of its accessibility, the web was a perfect place to put the system and it can be integrated into the existing DLESE community web site and other web sites or reside as a stand-alone site. For maximum compatibility we rendered the interface using simple HTML with javascript.

Another strength of this approach is the separation of the interface from the underlying search mechanism and data. The next section will discuss the software architecture of the discovery system and the reasoning behind the decisions that were made during the development of the prototype.

### ***Discovery System Software Architecture***

The major goal in designing an architecture for the prototype system was to separate the user interface elements from data retrieval processing. To this end, the architecture for the prototype system was broken up into four sub components. These components are the library user element, the user interface element, the middleware element, and the data element.

The library user element encompasses how the user accesses library data to accomplish their task. This environment was dominated by the requirement for the prototype to be accessed via a web browser. As you can see in the architecture diagram in figure 8 below this element consists of a web browser. Netscape and Internet Explorer versions 4.0 and above were targeted during our development and testing efforts as they are available on most computers today. The browser interacts with the user interface element via standard HTTP requests and the delivered HTML.

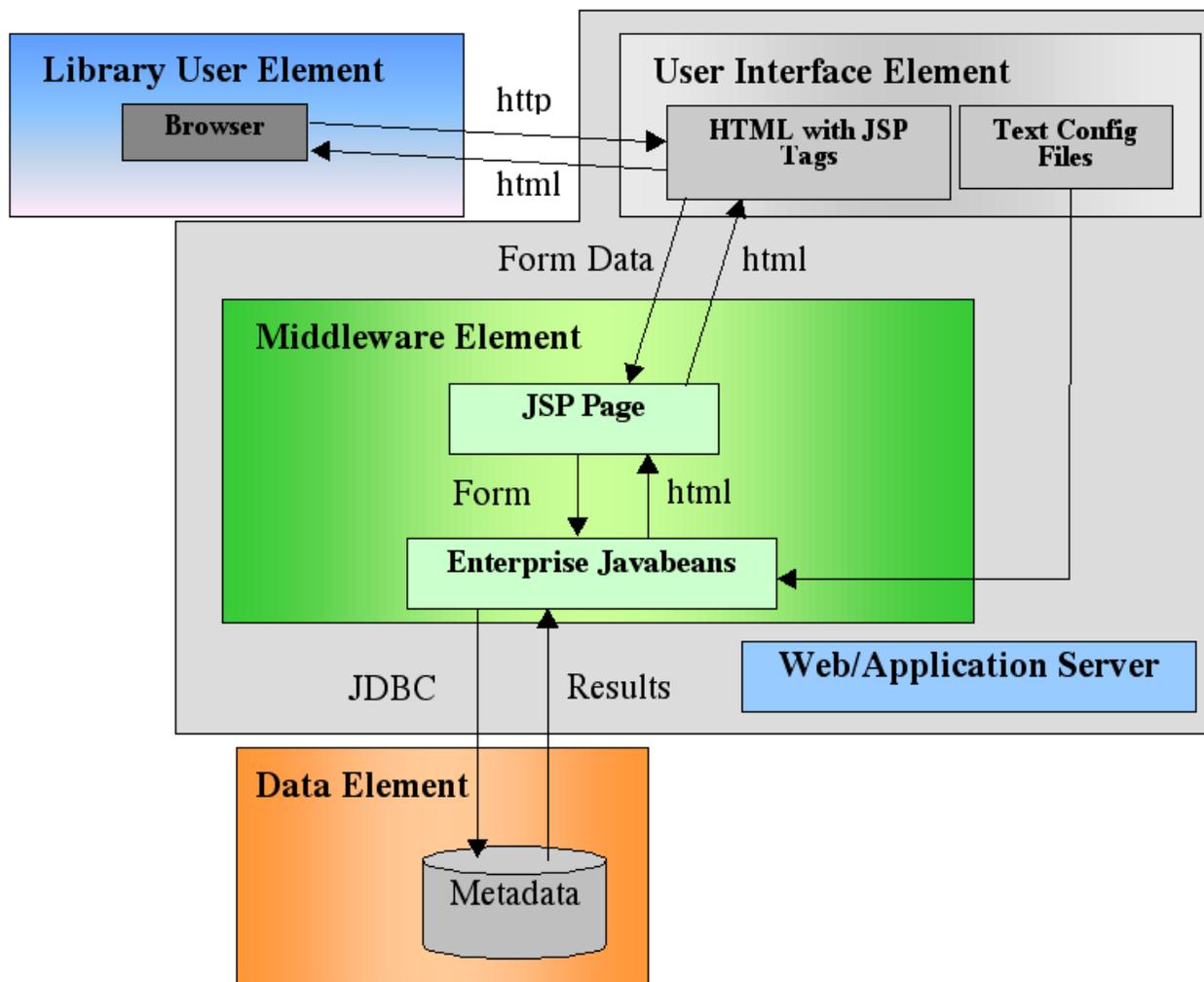


Figure 8 Prototype Architecture

The user interface element consists of two components. The first component being the text files which allow the user interface designer to independently configure the format of the results returned from the middleware. The other component is the HTML that defines the user interface and interacts with the middleware via Java server page (JSP) tags. Standard HTML code with JSP Tags was chosen for development of the user interface because this combination allows simple and straightforward user interface definition, eliminates compatibility problems, and simplifies the task of revising the prototype. The text based configuration files allow the user interface designer to tailor the format of the dynamic HTML results built by the middleware. Figure 9 shows a section of the configuration file that allows modification of the format of the results returned in the list format. The configuration entry "brief" refers to the list JSP output that appears in the results page. Other entries allow control over output format in other areas of the UI. The property is listed on the left side. The designer is free to change the look of the results by using standard HTML in the configuration. The VALUE reserved word is a placeholder for the data returned from the database. This setup gives the designer the freedom to change labels and other elements without changing the middleware or even restarting the web server. See Appendix E for the complete configuration manual provided by Gary Horton. The figure shows a sampling from the configuration file along with the corresponding output. Arrows point from the given configuration entry to the output it correlates to.



## User Testing

For our user testing of the discovery system prototype we used a cross-section of users from the earth science and education fields. We adopted Lewis and Rieman's (1996) thinking aloud method for the testing itself and conducted informal interviews following the test with each user. Our goal in testing was to exercise as many aspects of the discovery system search UI as possible and to assess its overall usability in performing key tasks. We conducted our tests using the DLESE site configuration shown in figure 10. This DLESE site was designed to provide for two purposes: one to provide community resources to aid in the development stage of DLESE and the other to provide for searching and resource discovery functions. This site represents a sort of transitional phase for DLESE. In the future the DLESE site will provide it's major emphasis on the searching and discovery functions only. We were not directly focused on the DLESE web site as a whole, although user interactions with the larger site's UI did take place and are included in our discussion below. Our search UI pages and results appeared in the large lower right HTML frame shown in figure 10.

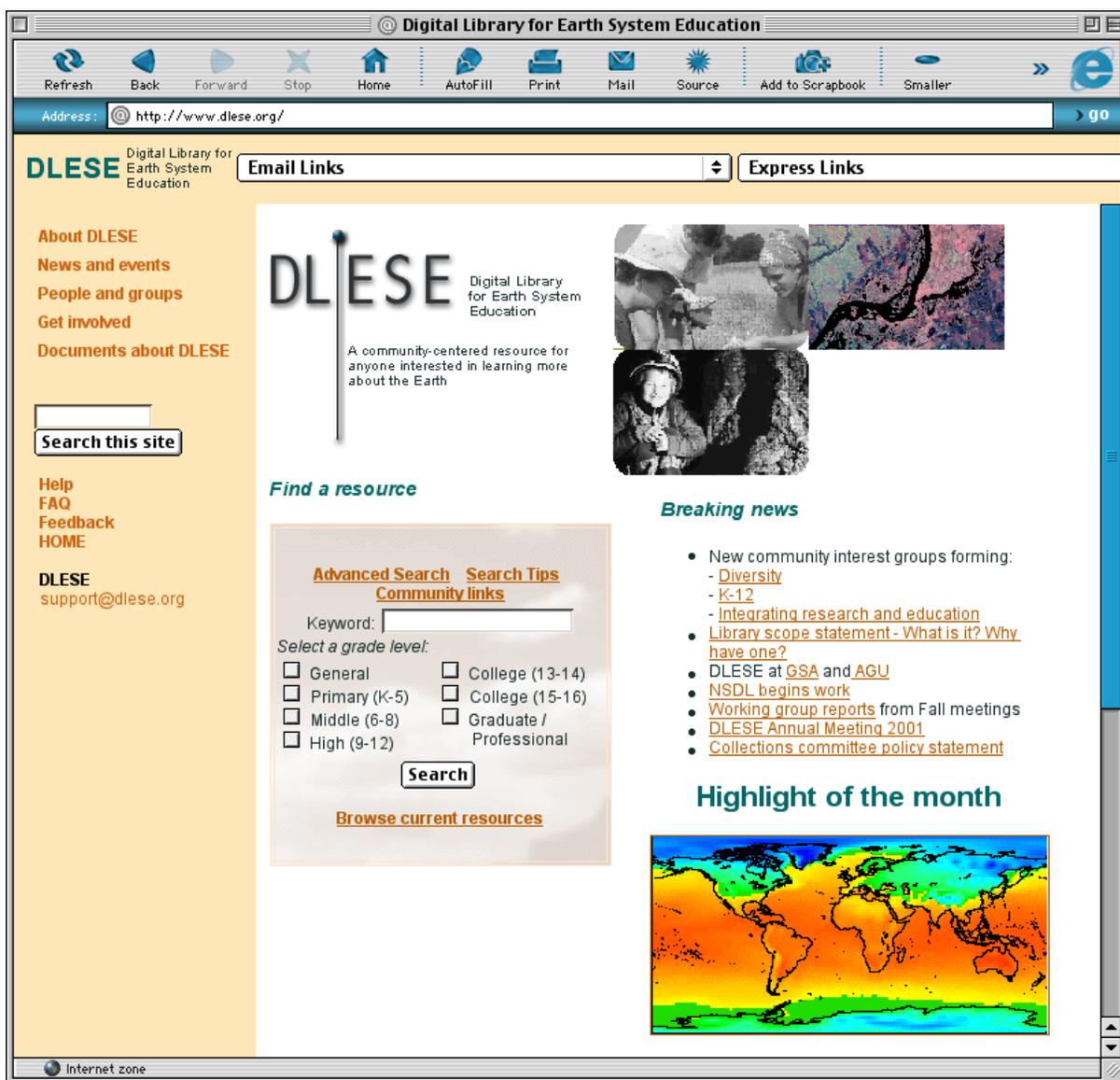


Figure 10 The DLESE Search Page Used During Testing

From the user tasks created by Brant et al we developed a specialized list of tasks to exercise our prototype's UI. Because the database was sparsely populated it was necessary to choose topics carefully so that our participants could perform a successful search. In addition we attempted to elicit both a browse style search as well as keyword searches from the participants. To do this we designed some user tasks toward general searching and others asked to perform specific searches. Here is one of the specific search tasks we asked our participants to perform (see Appendix A for a full list of tasks):

*You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.*

Here is a general search task we asked participants to perform with hopes of eliciting a browse style search:

*You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.*

We began each test by explaining the Lewis and Riemans (1996) thinking aloud method and then asked each user to perform several tasks. The method works by having participants verbalize their thoughts and observations as they navigate through the UI while performing the task. We took care not to bias participants toward certain behaviors by suggesting solutions or providing help unless absolutely necessary. If participants stopped verbalizing we asked them simply to "keep talking," following the guidelines developed by Ericsson and Simon (1993) (see Appendix B - Guidelines for Thinking Aloud user testing compiled by Melissa Dawe). Notes from each user test are provided in Appendix F.

The tasks were directed toward three different user groups: instructors, students, and the general public. We had them perform tasks according to their role in real life. In many cases we also asked them to simply imagine the role of the person in the task scenario and approach the test from that point of view. After beginning the test and allowing them to explore the UI and we interjected to cover limitations in the keyword search functionality when necessary and only after the participant attempted a keyword search that was not supported. Limitations included the need to enter single word searches only (most users initially choose multi-word phrases like "ocean habitat") and an exact match requirement (a search on "Ocean" or "ocean." with a period would not return a resource with "ocean" in it's body).

The seven participants were of the following backgrounds: a college instructor in earth science, a college professor in meteorology, a graduate student, a graduate professor, two grade school teachers and a high school teacher. In all cases except two, tests were conducted at their location on computers they would normally use for such tasks. The other two tests were conducted at UCAR on a local Windows machine. Full details of all participants including notes from the testing are provided in Appendix F.

Screen	Observations	Comments / Recommendations
<b>All Screens</b>	<ul style="list-style-type: none"> <li>Drop down menus were confusing. Most user's could not determine what they were meant for.</li> <li>Users could not easily bookmark resource URLs for later retrieval because they appeared in a frame.</li> <li>Small resolution screens blocked much of the UI from view.</li> </ul>	<ul style="list-style-type: none"> <li>The UI was changed after testing was completed so that resources now open in a separate browser window. This will make bookmarking easier and will make more screen space available to the resource.</li> </ul>
<b>Front search page</b> (figure 2)	<ul style="list-style-type: none"> <li>UI offered easy access to search by keyword functions.</li> <li>Most users did not see link to the category browse page or did not understand what the link meant.</li> <li>All users tried some sort of keyword search at some point.</li> <li>Most users checked grade boxes relevant to the task.</li> <li>Only one of six users found / used the "Advanced search" and "Browse by category" pages without prompting.</li> </ul>	<ul style="list-style-type: none"> <li>Users were forced to use a keyword search because the browse categories page wasn't noticed.</li> <li>Links to "Advanced search," "Browse current resources," and "Search tips" need to be re-worded and/or made more prominent.</li> <li>Consider putting the browse resources UI on the front search page, giving equal weight as the keyword search.</li> </ul>
<b>Results page</b> (figure 5)	<ul style="list-style-type: none"> <li>Users in liked the results layout.</li> <li>Four of six users clicked "View Full Record" to get additional info.</li> <li>Most users visited the URL of the resource to see what it contained.</li> </ul>	<ul style="list-style-type: none"> <li>Add the first sentence of the description field for results returned from a non-keyword search (currently not present for these types of searches).</li> </ul>
<b>Advanced search page</b> (figure 3)	<ul style="list-style-type: none"> <li>Users liked to be able to select exact resource categories and see what was available in the database.</li> <li>Most useful categories for grade and high school teachers were the instructional materials categories.</li> <li>Some confusion as to what the boxes meant.</li> </ul>	<ul style="list-style-type: none"> <li>Refine the labels for many of the categories.</li> <li>Try different layouts – make the list all vertical rather than in columns.</li> </ul>
<b>Full record page</b> (figure 6)	<ul style="list-style-type: none"> <li>The information was well laid out and easy to access.</li> <li>Description field was very useful.</li> <li>Learning context was good.</li> </ul>	
<b>Browse by category page</b> (figure 7)	<ul style="list-style-type: none"> <li>Liked by all.</li> <li>Provided a good overview of the resource topology.</li> <li>Some users wanted to use this instead of keyword for all searches.</li> <li>Many users still prefer keyword search.</li> </ul>	<ul style="list-style-type: none"> <li>Create a browse search UI that offers a topology of the three most requested sub-categories. The three sub-categories include topic (as is now shown), grade level, and instructional materials categories (lesson plan, activities, etc.) (see figure 12).</li> </ul>

Table 2 User Test Findings

## Recommendations and Findings

Recommendations of both grade school and high school teachers were to place the most wanted information foremost in the web site. Overall they identified these as grade levels, the instructional materials categories (such as lesson plans, activities, etc.), and topic (such as geology, chemistry, hydrology, etc) (table 2). Teachers expressed the need for efficiency in finding resources. "If I have to spend more than two minutes finding what I need I won't do it" was representative of this feeling. Of course, this is the central goal of any UI: making information quick and easy to find and retrieve.

Top three browsing interests:	
1.	Instructional materials categories (lesson plan, activity, handout, etc.)
2.	Grade Level (k-12, college, etc.)
3.	Topic (geology, chemistry, hydrology, etc.)

Table 3 Top Three Browsing Interests

The visual feedback given by the “Browse current resource” page was very appealing to most users. It allowed a quick visual inspection of the available resources and directed peoples attention toward relevant resources quickly (see figure 11). One user commented “I would put this on the front page of your site.” Unfortunately, most of the participants didn’t find this page without first being prompted. Most agreed that this presentation of the resource topology was extremely valuable and many said they preferred it to the keyword method to searching.

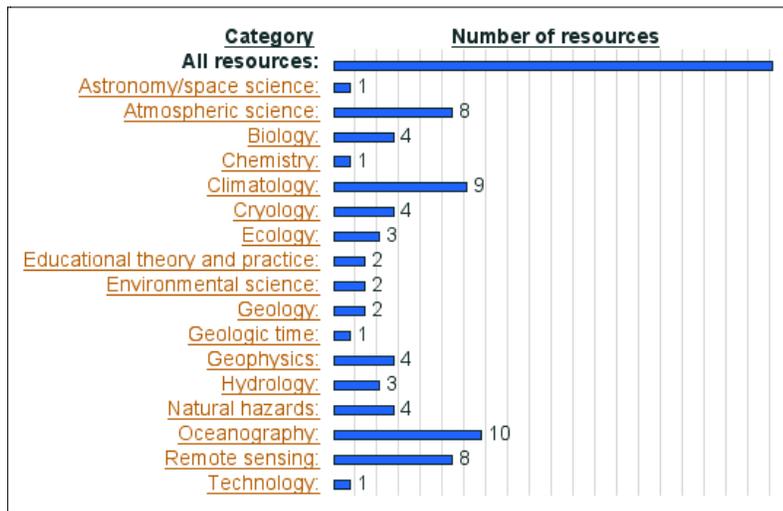


Figure 11 Resource Topology Graph Search

There were two types of search behaviors expressed by participants: one was to search by browsing categories and the other by keyword. Those who preferred browsing by category often became frustrated because the browse page was not immediately obvious, even though a link to it was visible on all search pages. To remedy this one solution would be to bring a browseable topology of the resources to the front search page giving it the same prominence as the keyword search.

The graphic nature of the current browse page (figure 11) was visually appealing to most, however it may take up too much space to fit on the front search page. One approach would be to provide the same information but eliminate the bar graph, leaving only the category title and number of resources – see figure 2. This would be very similar to layouts used by Yahoo, Google and others. A next generation DLESE search page might look similar to what is shown below in figure 12.



Figure 12 Keyword and Browse Search on a Single Page

### *Considerations for future search and discovery design*

User feedback indicated that a simple UI is more desirable than having lots of information available at all times. The testing we did was purely centered on resource search and discovery tasks and was not concerned with DLESE community tasks. As DLESE moves past the development stage and a final version of the UI is launched the site will be dedicated almost exclusively toward search and discovery. At that time it will be appropriate to devote a larger slice of the screen to search and discovery UI elements. Prior to final deployment it may be beneficial to devote a pilot page of DLESE that provides a dedicated search and discovery UI, similar to its final conception, to allow for testing and comments.

The final conception of the DLESE search and discovery UI might look something like what is shown in figure 12. From the current site UI a simplification can be made to include only the top search interests on the front search page. The front search and discovery page could be simplified to include only the DLESE navigation menu (shown on the left of figure 10) and search related UI components and links (figure 12). This will free up space on the screen for the browse categories and focus users attention to the search related features of DLESE. Equal prominence should be given to keyword search elements as well as browse elements to support both kinds of search behavior. There are advantages to designing the site without frames so that users can bookmark individual pages within DLESE easily. Consideration should be made to designing JSP and servlet pages so that they too can be

bookmarked as well, including search result pages if possible. The resource URLs should open in a separate window (this has already been implemented as of this writing) so that users can retain their search results and refer back to them easily by bookmarking. This may not be as important if frames are eliminated.

### *Searching functionality*

The current prototype does not currently support some important search features that will be available in the final DLESE search engine once deployed using Lucene. These include the ability to search partial strings, or non-exact match searching. Currently a search for "tectonics" returns one result even though there are two in the database (one is "tectonics" and the other is "tectonics," with a comma at the end). Stemming will be supported in the final search engine as well as multiple word and phrase searches.

## Summary

Overall this project was very challenging and rewarding. It was a great avenue to apply UI design development techniques in a "real-world" setting. This report represents the body of our work this semester. The appendices include our user tasks and think aloud guidelines, the required metadata set, the original usability tasks developed by Brant et al and Gary Horton's JSP user manual. The prototype code resides on UCAR's web server space. Our recommended fixes to the prototype are detailed above. However, the most interesting phase of the project remains to unfold. It will be very interesting and exciting to see the evolution of this first-generation prototype toward future DLESE designs.

## References

*Designing a User Interface for a Geoscience Digital Library* (2000). Jason Brant, Lynne Davis, Melissa Dawe, Lu Fan, Edgar Roman, May 12, 2000.

*Core Servlets and JavaServer Pages (JSP)* (2000). Marty Hall.

*Task-Centered User Interface Design -- A Practical Introduction* (1996). Clayton Lewis, John Rieman.

*HTML & XHTML : The Definitive Guide* (2000). Chuck Musciano, Bill Kennedy.

*Generic Query Metadata for Geospatial Digital Libraries* (Buckets article), James Frew et al, Alexandria Digital Library, Department of Computer Science, University of California Santa Barbara.

Ericsson, K. Anders and Herbert A. Simon (1993). *Protocol Analysis*. The MIT Press, Cambridge, Massachusetts.

[1] DLESE web site. <http://www.dlese.org>

## Appendix A – Tasks Used During User Testing

### Instructor tasks:

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.
2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You've heard DLESE is a good resource for science material, so you go there for teaching ideas.
3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic *at their level* to get them excited and engaged.
4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.
5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.
6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

### Student tasks:

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

### General tasks:

- You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

## Appendix B – Guidelines for Thinking Aloud User Testing

The following guidelines were compiled by Melissa Dawe and were used during the think aloud user testing to be consistent with the testing done by the other DLESE project team.

The goal of think-aloud user testing in our research is to better understand what the user is *thinking* as they are trying to solve a particular task that they have been given. This can be a tricky thing -- merely the act of verbalizing cognitive processes that may not have been encoded orally can significantly change the way a user approaches and executes a task. In order to minimize the effect of thinking-aloud on the user's processing, Ericsson and Simon have developed some guidelines in their work *Protocol Analysis* (1993). They distinguish between different types of think-aloud activities, which have different degrees of intrusion on the user's thought process.

A common prompt from the researcher in a think-aloud test is to ask the user to "tell me what you are thinking," or "tell me why you just chose that." Ericsson and Simon argue that these types of questions cause the user to break out of the task and self-reflect, articulating an answer that is "other-oriented." These types of questions are better left for a discussion after the user has completed the task.

A better approach in think-aloud experiments is to ask the user to verbalize the 'raw' thought processes that pass through his/her mind, without concern to their completeness or rational. The following quotes, taken from think-aloud researchers, capture this approach:

"Don't plan what to say or speak after the thought, but rather let your thoughts speak, as though you were really thinking out loud" (Silveira, 1972)

"The chief thing is to talk aloud constantly from the minute I present the picture, for I want to get everything you happen to think of, no matter how irrelevant it may seem." (Patrick, 1935).

Research in think-aloud experiments has shown that "inducing the subject to explain his solution very likely changes the structure of his thought processes." As researchers, we may even want to warn our subjects against trying to explain their solution during the think-aloud. Here is an example of such a warning:

"Do not try to explain anything to anyone else. Pretend there is no one here but yourself. Do not tell about the solution but solve it" (Krutetskii, 1976)

During the think-aloud, if the user stops talking, prompt him with requests like "keep talking," rather than asking "what are you doing?" or "what are you thinking?"

It may also be useful to precede the experiment with a short practice task, to help the subject get used to verbalizing his/her thoughts. One such task would be to ask the subject to add or subtract two three-digit numbers.

### References

Ericsson, K. Anders and Herbert A. Simon (1993). *Protocol Analysis*. The MIT Press, Cambridge, Massachusetts.

## Appendix C – The DLESE Required Metadata Tag Set and Vocabularies

The DLESE Metadata Working Group has identified a minimal set of metadata tags that are necessary to identify a resource, as well as allow discovery by a user of the library.

<b>Content</b>	<b>DLESE tag set</b>
TITLE	General.Title
DESCRIPTION	General.Description
LEARNING RESOURCE TYPE	Education.LearningResourceType (type of resource; controlled, restricted vocabulary )
LEARNING CONTEXT	Education.LearningContext (grouped grade levels; controlled, restricted vocabulary )
URL	Technical.Location
TECHNICAL REQUIREMENTS	Technical.Requirements.Type and Technical.Requirements.Name (in addition to a browser, which is assumed; controlled, but expandable vocabulary)
COPYRIGHT/COST	Rights.Cost (yes/no ) Rights.CopyrightAndOtherRestrictions (yes/no) Rights.Description.Langstring
CONTRIBUTOR (the person creating the metadata record)	Metametadata.Contribute.Centity.Extension.FirstName Metametadata.Contribute.Centity.Extension.LastName Metametadata.Contribute.Centity.Extension.email

### Optional:

#### RESOURCE ORIGIN

(the author or publisher of the site being cataloged)

Lifecycle.Contribute.Role (controlled, restricted vocabulary)  
 Lifecycle.Contribute.FirstName  
 Lifecycle.Contribute.LastName  
 Lifecycle.Contribute.Organization  
 Lifecycle.Contribute.email

### Vocabularies associated with the Required Tag set 10/4/00

LEARNING RESOURCE TYPE – restricted, must choose from this list  
 – precise definitions pending

Digital reproduction  
 Photoprint  
 Slide

Photonegative  
 Glass negative  
 Graphic (figure, table, illustration, graph, diagram)  
 Map  
 Image  
 Simulation (data-generated)  
 Animation (videoclip)  
 Instructional Video  
 Audio (clips, books, presentations)  
 Webcast  
 Software – tools  
 Narrative Text  
 Case study  
 Index (bibliography, abstracts)  
 Data set  
 Calculators  
 Syllabus  
 Course  
 Curriculum  
 Module/Unit  
 Lesson Plan  
 Activity- Lab  
 Activity-Field  
 Activity-Computer  
 Activity-Classroom  
 Tutorial  
 Problem Set  
 Assessment  
 Answer Key  
 Instructors Guide  
 Services (ask-an-expert, threaded discussions, message boards)  
 Virtual field trip

LEARNING CONTEXT - restricted, must choose from this list

Primary School ( K-5)  
 Middle School (6-8)  
 High School (9-12)  
 Undergraduate Lower Division (13-14)  
 Undergraduate Upper Division (15-16)  
 Graduate - Professional  
 Informal education  
 Any level

TECHNICAL REQUIREMENTS – expandable, choose from this list or enter free text

TYPE

Operating System  
 Browser  
     Plug-in (application enhancement)  
     Subscription  
     Membership  
 Software (stand alone application )

NAME

PC-DOS  
 MS-Windows  
 MacOS  
 Unix  
 Multi-OS  
 Other

None  
Any  
Netscape  
Microsoft Internet Explorer  
Shockwave Flash Player  
Real Player  
QuickTime  
Adobe Acrobat  
Platform emulation  
Unknown

RESOURCE ORIGIN - restricted, must choose from this list

ROLE

Author  
Publisher  
Contact  
Editor  
Contributor  
Principal Investigator

## Appendix D – Usability Tasks Developed by Brant et al (2000)

### Initial Task Suite

#### Usability Task 1

You would like to find a few photographs taken by the Sojourner of the surface of Mars for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later. You would like to preview them online, and download them.

#### Usability Task 2

You are teaching an 11<sup>th</sup> grade biology class. You are teaching a unit on DNA and how it works. You want some animations demonstrating how DNA replicates.

#### Usability Task 3

You are interested in finding out about the affect of sound traveling through ocean water has on gray whales.

#### Usability Task 4

You want to find material to teach your sixth grade students about tornadoes and hurricanes at a sixth grade level.

### Future Task Suite

These tasks were reserved for testing at a future date.

#### Contributing to the library:

Jack has developed a Java applet that facilitates his first year geology students' ability to dynamically visualize geological relationships. It runs on a web browser. He wants to submit his applet to the library for other professors to use and he seeks academic recognition from a review panel and would like feedback from other professors who use the applet so he can improve it.

#### Professional Development Task:

Joanna is an earth science teacher who is holding a workshop in Denver for meteorology teachers on how to use UNIDATA tools. Workshops are a common way for professors to get together and spread the word about new teaching resources, so she would like to get as many colleagues to participate as she can. She would also like to get information about meteorological education societies, at the state and national levels, to give them information about the workshop.

#### Textbook abstracts for students:

Aaron is a non-science major taking a freshman survey course in Geology and wants to know which geology books to start with for a research project. Aaron is overwhelmed by the number of geology books in the geoscience library and wants to know why each of them would be good. He wants to know which books cover which topics and to what detail - all in a simple description. In particular, he is interested in metamorphic rocks, and he wants to know which books would be best for him to read more about them at an introductory level.

#### Augment a Class:

Tom is teaching an undergraduate geology class. He needs to find arguments against a "Young Earth Theory" to stimulate discussion in class.

#### Locating materials:

Faye is an undergraduate Earth Sciences professor. She needs to find a map from the Middle Ages to incorporate into a colloquium that she is giving.

## Appendix E - DLESE-JSP User's Manual

*Author: Gary Horton  
Last Modified: 10/20/00*

### Audience

This document is intended primarily for web authors who wish to use DLESE's JSP tags to add dynamic data from the DLESE database to their web application. Programming expertise is not needed to harness this information. This document is also useful as a reference for maintenance needs surrounding the development and operation of websites using the underlying JSP engine and Java middleware/database.

### Environment variables and other symbols

There are two *prototyping environments*: development and release. For development context, I use the symbol DEV, and for release I use DLESE in the discussions to follow.

You *should* set up, in your .cshrc or .profile, environment variables as follows for the DEV and DLESE environments, respectively (adjust syntax for /bin/sh shells):

```
setenv DEV_HOME /mnt/page/org/dpc/dlese
setenv DLESE_HOME /mnt/page/release/org/dpc/dlese
```

***NOTE:** These locations, and all other "hardwires" discussed here are subject to change over the course of the DLESE development. Use these environment variables to minimize the impact on your configurations when this happens. **These locations are in fact likely going to change in the near term!!!***

There are two web-server "contexts" named "dev" and "dlese", that map to the physical locations as indicated by the environment variables for DEV and DLESE (\$DEV\_HOME and \$DLESE\_HOME) respectively.

Locations of interest under these top-level directories include jsp, classes, propertyFiles, scripts, webserver, and src. Though there is a jsp subdirectory, you are not restricted to placing JSP and HTML files there; these may go anywhere that the webserver can "see", i.e. anywhere under its context starting point. New or modified class files *must* go in the proper package location under the classes subdirectory, likewise for java source in src. Property files *must* go in the propertyFiles subdirectory. There are currently some utility scripts that you'll likely use already present in the scripts subdirectory. Finally, the webserver directory has startup scripts and configuration files for the LWS webserver, which is what is currently in use, but note that we soon will add Tomcat.

### Example file set

*Previous situation about Tomcat not supporting JSP tags in HTML files has been addressed, and I've renamed the example files back to the original names using .html extnesions.* Under the prototype environment of choice, these are

```
./jsp/searchMgr/dlese.html
./jsp/searchMgr/prototypeSearch.jsp
./jsp/searchMgr/results.html
./jsp/searchMgr/fullRecord.html
```

*This last name (fullRecord.html)is now under the control of the web author, and can be configured at runtime by changing the "template" used for this part of the output. This is part of a larger new feature set that provides the web author complete control over the output formatting in a dynamic manner. An interface has been developed to provide this control; two example implementations of the interface are provided, which can be used either as examples or used as templates to create your own custom formatting stuff. These examples output HTML "table" format and the Google-style format that I refer to as "brief".*

***It is strongly recommended that any changes you make to any files be done in the development area (\$DEV\_HOME, servlet context of "dev"), since when I do a release I'll be overwriting the previous versions. We should set up a second webserver over the development area to support independent development, which port number will be 9089 (for LWS). I should show you how to do this so you can control things as needed.***

*As well, we'll soon have Tomcat instances available. I'll make releases to the release area (\$DLESE\_HOME, servlet context of "dlese") probably once a week or as needed.*

Please read the JSP comments (surrounded by <%-- and -->) in these files for pointers to details on this output formatting control, and for other details on usage.

## LWS web server

For the LWS web servers, one is available for each prototyping environment. For DEV, use <http://oliver.page.ucar.edu:9090/dev>, (as mentioned above, a separate instance at 9089 is soon to come, as are instances of Tomcat) and for DLESE use <http://oliver.page.ucar.edu:9091/dlese>. The former is subject to frequent recycling, while the latter will not be mucked with by except as necessary to support new releases, clear up confusion, etc. To start either webserver, scripts under the scripts subdirectory are available, namely startdevlws and startlws for DEV and DLESE, respectively. You can use the "admin" servlet (append /admin to above URLs) to access an interactive administrative interface, and you *should* use this to shutdown the server.

Modifying a JSP page does not require restart of the webserver, but changes to class files do. *If for some reason, the initialization stage of a JSP page proceeds but then some exception prohibits further progress, most often you'll need to restart the webserver here also.*

Once the webserver is running, access the above example file set for DLESE with:

<http://oliver.page.ucar.edu:9091/dlese/jsp/searchMgr/dlese.jsp>

or for DEV with

<http://oliver.page.ucar.edu:9090/dev/jsp/searchMgr/dlese.jsp>

## Configuration files

You shouldn't need to change configurations for the LWS server unless you're adding new classpaths, using a different JDK, changing the physical location for the context, etc. There is one very important **environment configuration** file for DEV and DLESE, respectively `./propertyFiles/DEV.properties` and `./propertyFiles/DLESE.properties`. Read the commentary in the version appropriate to your prototyping environment for the first step in familiarization. Of importance to DLESE environment is the *Name Mapping, Search Buckets and Result Fields, Keyword Searches, and Output Formatting* sections. Of importance to DEV environment are all sections, but that discussion is beyond the scope of this document.

*It is strongly recommended that you make a copy of the DEV.properties file in the development area, renaming it to e.g. DLESE (or whatever argument you send to the init property in the JSP initialization sequence). Then, as new functionality is embedded in new releases of DEV.properties, you should either again make a copy -- modifying as appropriate, e.g. turning debugging off, etc. -- or cut and paste the new sections from DEV.properties to your existing DLESE.properties (or whatever name). I'll make efforts to make any such new functionality obvious as to its whereabouts. The current version of DLESE.properties can either be removed or edited to meet new functionality.*

We currently (in *Name Mappings*) have a mapping from a "HTML" level name to the database name, but remaining to be added is a mapping from a "friendly" user-level name to the database (or HTML) name. It appears, at the moment, that we need both because user-level names will desire embedded spaces, but the JSP processing done is keyed off the HTML element names, and this will break with embedded spaces (for that matter, I'm not sure you can embed spaces in HTML element names anyway...). (NB: it turns out that you can, and I'll eventually support this in the name mapping mechanisms).

*Search Buckets and Result Fields* allow you to specify defaults for these, which can be overridden by the HTML (JSP) pages.

*Keyword Searches* allows customization of various keyword searching behaviors.

*Output Formatting* provides dynamic control on the HTML (or other) formatting syntax surrounding the dynamic data generated by the JSP tags.

Take a first stab at understanding these from reading the documentation and ask your local DLESE-JSP expert for

clarification.

### Re-creating and re-populating the database

Scripts are available for re-creating and re-populating the database, respectively `createdb` and `populatedb`, in the `scripts` subdirectory. DEV and DLESE each have separate databases (and for that matter separate scripts), so each environment can go about this independent from the other. The `create` script is useful if the metadata schema has changed and the database needs to change to match it; it not only creates the new schema, but re-populates the database with record files as indicated in the environment configuration file. The `populate` script assumes the database schema is ready, deletes any existing records, and re-populate again with record files as indicated in the environment configuration file. Additional behavior can easily be added to `populate` without first deleting, so that e.g. one could populate with many records to benchmark performance, etc. *Though I provide this information for documentation purposes, these types of operations should probably be done only in consultation with your local DBMS expert.*

### Javadoc

For a reference to the available java methods that do the work here, see

<http://oliver.page.ucar.edu:9091/dlese/doc/index.html>

### What's New

10/20/00

Still missing from the new output format examples is support for contexts in the "brief" style, and support for more than one value that gets wrapped with HTML that differs for each value, e.g. a resource that has more than one URL will currently (I think) only be wrapped with one actual `<a>` tag. What you want is a separate `<a>` tag for each URL. For now, let's just avoid resources with more than one URL, which I think is currently the case with currently records catalogued.

JSP tags `getBriefResults` and `getTableResults` have been removed, in coordination with the new output formatting scheme. Now use `getFormattedResults` instead. Which style of output is used defaults to "brief", and you can change this either at initialization time (with a JSP set on the `outputFormat` property) or using a checkbox at runtime. See new javadoc on `setOutputFormatting` and the JSP file `discovery.html` for details and examples.

## Appendix F – User Test Transcripts and Notes

Note: We performed six user tests. Melissa Dawe and Lynne Davis performed an additional user test to make a total of seven.

### Usability Test of DLESE discovery and search engine prototype:

**Test method:** Think-aloud

**Location:** DPC

**Test subject:** College earth science instructor

**Gender:** Male

**Test moderator:** John Weatherley and Troy Weingart

**Browser:** Netscape 4.7 for Windows

**Screen Resolution:** Approximately 1280 X1024

#### General user comments / observations:

- “Browse current resources [link] doesn’t make me think of what is here.”
- Would have used the browse by category page a lot more if he had seen it.

#### Instructor tasks:

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You’ve heard DLESE is a good resource for science material, so you go there for teaching ideas.

#### Observation:

- Typed a keyword search on “climate.” From list of results, clicked on the resource URL. Explored the resource. Liked the map diagram – “could use in a presentation.” Looked for the URL but saw www.dlese.org in Netscape’s URL bar. Explored the resource’s web site thoroughly. Tried a calculator on the site.
- Tried the “Email Links” drop down menu. Didn’t know what many of the items were. Many links didn’t work. “Join a Group label is somewhat cryptic.”
- Browser window got out of site and he couldn’t get back to DLESE without re-typing the URL.
- “Strange that Global Climate Change was not returned at the top of the list even though ‘climate’ is in the title.”

**Results:** Participant completed task successfully.

**Recommendation:** Fix the results scoring. Consider no frames.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

#### Observation:

- Typed “ocean” and checked grade 6-8.
- Looked at full record. Saw and liked the listing of classroom activity.
- “Good that the title is right at the top.”
- Looked at several full records at random to see what “Learning Resource Type” was about.

**Results:** Participant completed task successfully.

**Recommendation:** Consider changing the labels on the “View Full Record” page to match the ones in list view, making them user defined instead of metadata defined.

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

**Observation:**

- Typed “clouds” but zero returned. Tried “water” and found a resource with “cloud formation” in the description.
- Tried keyword search in the “Search This Site” box.
- Tried drop down menus, found them “confusing.”
- Got away from the search page and couldn’t find way back to it. Didn’t see the “Home Page” button or didn’t know what it was for. Tried using the back button to get back.

**Results:** Participant unable to find an interactive resource he felt met the task.

**Recommendation:** Make the home page button more clear.

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don’t have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it’s content in the future.

**Observation:**

- Found the resource immediately after typing “climate” for keyword search.
- Looked through resource pages. “Great resource.”
- Physically wrote down the URL.

**Results:** Participant completed task successfully.

**Recommendation:**

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

**Observation:**

- Typed “tectonics”.
- Looked through full record. Was interested in the authors. Noted them from the record.
- Looked through site itself.

**Results:** Participant completed task successfully.

**Recommendation:** View Full Record is a good page.

**Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

**Observation:**

- Typed “overview”.
- Tried searches on “earth” “geology” as well.
- Looked at several site’s View Full Record page.

**Results:** Participant completed task successfully.

**Recommendation:**

**General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

**Observation:**

- Typed “oceanography”.
- Second resource was good: “I could spend hours here.”

**Results:** Participant completed task successfully.

**Recommendation:**

## Usability Test of DLESE discovery and search engine prototype:

**Test method:** Think-aloud

**Location:** CU Engineering Center – Whitewater lab

**Test subject:** Graduate student

**Gender:** Male

**Test moderator:** John Weatherley

**Browser:** Netscape 4.7 for Linux

**Screen Resolution:** Approximately 1024 X 728

**General user comments / observations:**

- “Email Links and Express Links don’t mean much to us.”
- Suggested putting a link to the search page and having the front page be separate.

**Instructor tasks:**

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You’ve heard DLESE is a good resource for science material, so you go there for teaching ideas.

**Observation:**

- Went to the DLESE menu and went to “overview” page to read what DLESE is all about. Spent quite a bit of time looking through menu items for a description or instructions page.
- After some time he found the search box. He said “Find A Resource should be bigger. It’s not obvious.”
- Typed “Global Climate Change.”
- Tried “Advanced Search” link to see if there was a list of rules for keyword search.
- After I informed him of single word search restriction, he search on “climate” and found a resource.
- Looked at Full View. Liked it.
- Looked at the resource itself. Found a CD.

**Results:** Participant completed task successfully.

**Recommendation:** Implement / provide instructions page.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

**Observation:**

- Typed “ocean” and checked boxes.
- Wasn’t sure what we meant by habitat but he found a resource he liked. Looked at full record again as well.

**Results:** Participant completed task successfully.

**Recommendation:**

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

*Task not performed by this participant*

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.

**Observation:**

- Typed "climate". Found link to climate system resource.
- Loved the resource itself.
- Couldn't bookmark the page. After trying several times finally was able to do it by right-clicking on the frame.

**Results:** Participant completed task successfully.

**Recommendation:** Remove frames.

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

*Task not performed by this participant*

**Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

**Observation:**

- Typed "earth".
- Clicked Browse Current Resource link.
- "I really like this page. You can look at each of the categories and find information on each."
- He felt the Browse by category page was excellent for browsing lots of resources.

**Results:** Participant completed task successfully.

**Recommendation:** Create other browse pages for more of the metadata.

**General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

**Observation:**

- Typed "ocean."
- Clicked the "General" checkbox. He noted that it was strange that the general box was more restrictive than having no boxes. He thought it would provide a wider range of results.

**Results:** Participant completed task successfully.

**Recommendation:**

## Usability Test of DLESE discovery and search engine prototype:

**Test method:** Think-aloud

**Location:** DPC

**Test subject:** Graduate professor

**Gender:** Female

**Test moderator:** John Weatherley and Troy Weingart

**Browser:** Netscape 4.7 for Windows

**Screen Resolution:** Approximately 1280 X1024

### General user comments / observations:

See below descriptions

### Instructor tasks:

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You've heard DLESE is a good resource for science material, so you go there for teaching ideas.

#### Observation:

- Keyword "Earth science."
- Went to browse resource (had been prompted from seeing earlier test with another user).
- Choose "Geology" topic category from the list.
- Viewed some resources by opening them up in a new window using right mouse button.
- Noticed the "Highlight of the Month" that featured the Global Warming Project after she was done.

**Results:** Participant completed task successfully.

**Recommendation:** Implement / provide instructions page.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

#### Observation:

- Typed "ocean" and checked boxes.
- "Visited links color is hard to see."
- Participant said she would like to be able to sort results by grade level.
- Had difficulty getting back to the home page to start another search.

**Results:** Participant completed task successfully.

#### Recommendation:

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

#### Observation:

- Typed "cloud" for keyword search.
- Wanted to be able to have a checkbox for resource type on the front search page. Went to advanced search.
- Participant felt it wasn't clear at first that "Instructional Materials" was the category for resource type.
- Comments on advanced search category heading labels: "Visual" doesn't help as a category. "Portal" is vague. "Text" is too broad a category.
- Didn't expect to have the keyword carry through to the advanced search page.
- Felt the advanced search page was a strange blend of media types vs. resource type.
- "Define your search" or "Specify your search" or "Refine your search" might be more clear than the current "Qualify your search" label at the top of the advanced search page.

**Results:** Participant completed task successfully.

**Recommendation:** See above for user comments.

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.

**Observation:**

- Typed "climate" with grade level checked.
- Felt that the resource titled "The Climate System" should have been returned higher in the list.
- Thought the label "View Full Description" might be better than "View Full Record."

**Results:** Participant completed task successfully.

**Recommendation:** See above user comments.

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

*Task not performed by this participant*

**Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

*Task not performed by this participant*

**General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

*Task not performed by this participant*

## Usability Test of DLESE discovery and search engine prototype:

**Test method:** Think-aloud

**Location:** Bear Creek Elementary School computer lab

**Test subject:** Grade school teacher

**Gender:** Female

**Test moderator:** John Weatherley

**Browser:** Netscape 4 for Macintosh

**Screen Resolution:** Approximately 800 X 600

**General user comments / observations:**

After showing her the Browse by Category bar graph page she commented that she liked the format and would have gone to it if she had seen it.

**Instructor tasks:**

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You've heard DLESE is a good resource for science material, so you go there for teaching ideas.

**Observation:**

- Keyword "Global climate change" and checked the 9-12 grade level box.
- After searching a second time, she wished that the check box remained checked for subsequent searches.
- Looked though some of the menus on the left for instructions. Frustrated.
- "I haven't found what I can do with kids."
- Tried a search using the "search this site" search box.
- Found information on the DLESE site. Made comment that "I would like to see information about the source of the information" so that she can judge how legitimate it is (did not yet see the full record screen).
- Expressed that "the site needs to be simpler" and that it's "difficult to use."
- "I want to see a list of all the topics covered in earth science. Like k-12 Biology, History, etc."
- Saw the "Global Warming Project" highlight of the month and clicked on it.
- Resource had frames inside of frames and was extremely difficult in the small monitor.
- Tried some links in the resource that required PDF but not PDF viewer on the machine.
- Difficulty getting back to the start.

**Results:** Participant completed task successfully.

**Recommendation:** Eliminate frames.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

*Task not performed by this participant*

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

*Task not performed by this participant*

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.

**Observation:**

- Typed "climate" with grade level checked.
- Went to the full record of a resource. Saw that it was from Columbia University so it has legitimacy.
- Could not bookmark it. Noticed that the frame would not allow bookmarking.

**Results:** Participant felt she did not find a resource that was "off the shelf" but did like resource she found.

**Recommendation:**

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

*Task not performed by this participant*

**Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

*Task not performed by this participant*

**General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

*Task not performed by this participant*

**Usability Test of DLESE discovery and search engine prototype:**

**Test method:** Think-aloud

**Location:** Bear Creek Elementary School computer lab

**Test subject:** Grade school teacher

**Gender:** Female

**Test moderator:** John Weatherley

**Browser:** Netscape 4 for Macintosh

**Screen Resolution:** Approximately 800 X 600

**General user comments / observations:**

- Really preferred the advanced search page method as her primary mode of searching. The learning resource type “Instructional Materials” categories were the most important to her.
- Would like to be able to sort results.
- After showing her the browse by category page she commented that she liked it, but still preferred the advanced search type of search.
- She felt the label “Browse Current Resources” on the front page implied a “huge summary of resources” and not what it actually was. Suggested the label “Categories of Resources.”

**Instructor tasks:**

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You’ve heard DLESE is a good resource for science material, so you go there for teaching ideas.

**Observation:**

- “I’m looking for a place that has categories.”
- Did keyword search on “climate change” then tried “climate” after I explained limitation.
- “I wonder what the scores mean?” (not clear).
- Not sure what “Portal” meant on advanced search page.
- Commented that she had to scroll a lot on the advanced page both horizontally and vertically.
- Tried the full record of a resource. Found a resource she liked.
- Noticed the “Global Climate Change” highlight of the month on the front page.

**Results:** Participant completed task successfully.

**Recommendation:** Make advanced search smaller or rearrange order. Try different labels on advanced search boxes.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

**Observation:**

- Typed “oceans” returned one resource.
- Found resource immediately and liked it.

**Results:** Participant completed task successfully.

**Recommendation:**

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

*Task not performed by this participant*

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don’t have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it’s content in the future.

**Observation:**

- “I haven’t found anything that says ‘Lesson plans’” (didn’t see it in the advance search area).
- Suggested not to have a search on the front page but to have a link to the search page.
- Did a keyword search on “climate” and found the resource she liked right away.

**Results:** Participant completed task successfully.

**Recommendation:**

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

**Observation:**

- Used advanced search and typed “tectonics.” Checked several boxes, especially in the Instructional Materials area.

**Results:** Participant completed task successfully.

**Recommendation:**

**Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

*Task not performed by this participant*

**General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

*Task not performed by this participant*

## Usability Test of DLESE discovery and search engine prototype:

**Test method:** Think-aloud

**Location:** Participant’s home

**Test subject:** High school geography teacher

**Gender:** Male

**Test moderator:** John Weatherley

**Browser:** Explorer 5 for Macintosh

**Screen Resolution:** Approximately 1280 X 960

**General user comments / observations:**

- Felt the Instructional Materials categories were very important. Lesson plans, activities, assessments, etc.
- Felt that many of the resources would be appropriate for geography teachers as well. "Anything that has a map is great and I can use it a lot."
- Wanted to be able to click on the DLESE logo to get back to the home page. Liked that the "Home" button was clear on the left menu.
- Suggested site for reference: bigchalk.com.
- Suggested a button that says "list all resource"
- Liked the fields in Full View.
- "Teachers are always in a big rush so they need to be able to find resources immediately."

**Instructor tasks:**

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

*Task not performed by this participant*

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You've heard DLESE is a good resource for science material, so you go there for teaching ideas.

**Observation:**

- Clicked on the Highlight of the month "Global Warming Project."
- Likes lesson plans and materials that can be used in class.
- Liked the resource

**Results:** Participant completed task successfully.

**Recommendation:**

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic at their level to get them excited and engaged.

**Observation:**

- Clicked middle school check box and searched on "ocean habitats."
- Then clicked on "Browse current resources" link. Clicked on oceanography link.
- Tried several resources. Saw one resource was a CD but looking for a lesson plan.
- Was frustrated, did not find a lesson plan.

**Results:** Participant felt could not find a good resource.

**Recommendation:**

4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

*Task not performed by this participant*

5. You are a college professor and have just learned you will be teaching a course on the climate system beginning in one week. You don't have lesson plans for the class and you would like to find an off-the-shelf course you can reference right away. You want to save the resource or bookmark it so you can access it's content in the future.

**Observation:**

- Typed "climate."
- Read the description clipping returned by the search on the results page.
- Went to the Climate System resource. Loved the lecture notes and the course schedule. Would use it.
- Could not bookmark the resource. (I showed him how to command click to open it in a separate page and bookmark it).

**Results:** Participant completed task successfully.

**Recommendation:**

6. You are a geology professor teaching an introductory course. You are preparing a section on plate tectonics and need extra material to supplement what is covered in the text.

**Observation:**

- Typed "tectonics."
- One resource returned. At first didn't think it was what he wanted but looked more closely and found it to be perfect. Would even use it in his own class.

**Results:** Participant completed task successfully.

**Recommendation:****Student tasks:**

1. You are an undergraduate student working on a class presentation summarizing the field of earth science. You want to provide a brief overview of several fields within earth science. As an extra bonus you would like to print some written material to hand out to the class.

**Observation:**

- Typed "earth" in the keyword search. Too few results.
- Then went to the Browse page. Found lots of resources "Most of these are related to earth science. I could just start making slides for a presentation."
- To do an overview of earth science he felt might be frustrating because he would have to pick out several things himself.

**Results:** Participant completed task successfully.

**Recommendation:****General tasks:**

1. You overheard a relative of yours talking about a web site for earth science educators. Because of your interest in the oceans and oceanography you decide to take a look at the site to see what kinds of resources are listed in that area.

*Task not performed by this participant*

**Usability testing of DLESE prototype:**

*Test method:* Think-aloud of the DLESE site.

Note: While users did access such sites in the course of this testing, we did not intend to evaluate the Metadata, Software Architecture, or any external sites (including subcommittee). These will be considered during separate user tests at a later date.

*Location:* Tester's Computer (laptop) in his office at Metro State College, Denver

*Test subject:* Professor of Meteorology, MSCD. Took on roles of Instructor and Library User (Discovery Tasks).

*Test moderator:* Melissa Dawe and Lynne Davis

*Browser:* Netscape, Version unknown

Date: November 28, 2000

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Discovery Tasks (user performed discovery tasks 1-4):

1. You teach an introductory geology class for undergraduates. You would like to find a few cool photographs of different volcanoes for your class. You know that you need images that are of high quality and high resolution, so that you can turn them into slides later.

**Task execution:**

- From home screen: focuses on 'search resources' box
- Types 'volcanoes' in the search text box
- Selects instructional level: 'College (13-14)'
- Clicks 'search', result page appears.
- Briefly examines search results, clicks on 'View Full Record' of first result. Scrolls to the end of the record. Examines the two hyperlinks on the top of the page, to see if they point to the same place (by holding the mouse over each one and looking at the URL appear in the bottom of the browser window).
- Clicks on URL, takes him to the external site. Searches there, examines images.

**Conclusion:** Feels satisfied with completion of task

**Recommendation:** Confusion caused by having both the title and URL hyperlinked in the 'View Full Results' window. Consider hyperlinking only one or the other.

2. You are teaching an 11<sup>th</sup> grade earth science class. You are teaching a unit on global climate change for the first time. You've heard DLESE is a good resource for science material, so you go there for teaching ideas.

**Task execution:**

- User starts by exploring the site, apparently after observing labels in previous tasks and feeling curious. Clicks on 'express links', 'email lists'.
- Clicks on 'Resources' in top right corner of site
- Types in 'global climate change' in 'search resources' text box
- \*moderator explains that due to current limitations in the prototype, the search must be limited to a single word. Refines his search to 'climate'.
- Selects instructional level: 'high school'
- Clicks 'search', result page appears.
- Scrolls through results, scanning quickly. Stops at result called 'Global Climate Change'
- Clicks on 'View Full Record' for this resource
- Scans description, sees instructor's guides, comments that he 'wants to get to that.'
- Clicks on URL link for this resource
- Scans content at that site for ~1 minute, comments that he needs help with pedagogy, clicks to different pages but is dissatisfied.
- Returns to results page (using browser back button)
- Clicks on URL for 'Global Warming' resource
- Scans content here, clicks on 'Teacher resources'.
- Comments, 'I need to know about what global climate change *is* before I can start talking about global warming.'
- Returns to results page (using browser back button)
- Clicks on 'Advanced Search'. Shows enthusiasm, and is pleased at all the options here. Comments 'I wonder if I have to select all these things, or just one?'
- In 'Resource Type,' puts check next to Curriculum, Lesson Plan, Syllabus, Course
- Clicks on 'Search,' results return 'Global Lab Curriculum.'
- Clicks on this URL, scans contents, comments "It's not actually taking me to what it says."

**Conclusion:** User not satisfied with completion of task

**Recommendation:** Provide help in advanced search area. Also see observations.

3. You want to find material to teach your sixth grade students about different ocean habitats. You are looking for interesting resources that discuss the topic *at their level* to get them excited and engaged.

**Task execution:**

- From 'search for resources' screen, types 'biology' in the text box.
- Selects instructional level: 'middle'
- Clicks 'search,' results page appears with 0 results.
- Comments, did I spell it right?'
- Goes back to search page, changes his search to 'marine'
- Clicks 'search,' results page appears with one result.
- Clicks on 'View Full Record' for result
- Scans it quickly, goes back to search page
- Clicks on 'Advanced Search'
- Notices that the word he entered, 'marine,' is no longer in the search box. Comments, 'I wonder if I can type 'biology' here and it will search on 'marine biology.'
- Clicks search,' results page appears with 0 results.
- Types in 'oceanography' in the text box.
- Clicks 'search,' results page appears with 2 results.
- Clicks on 'View Full Record' for first result
- Scrolls through the page, comments that the description is too long. Would prefer an outline or summary.
- Clicks on hyperlinked URL for this resource, scrolls quickly through the entire page.
- Comments 'Wow, there's a lot of stuff I'd have to digest here. What I would like to do is go back to the advanced search, see if I can just find lesson plans!'"

**Conclusion:** User seemed somewhat satisfied with results.

**Recommendations:**

- Confusion over new/refined searches. Consider using explicit buttons, 'new search' and 'refine search' to clarify this.
  - Consider having a 'summary' version of the description when it is more than 1-2 short paragraphs.
4. You are looking for a good activity, preferably interactive, to teach your undergraduate students about cloud formation.

**Task execution:**

- From search resources page:
- Types in 'clouds' in text search box, comments that he would enter 'cloud formations'
- Selects instructional level: 'College (13-14)'
- Clicks 'search,' results page appears with 0 results.
- Shows surprise at getting no results. Types 'clouds' into 'search this site' text box.
- Clicks 'search,' results page appears with 2 results.
- User appears very confused at this point, task stops.

**Conclusion:** Unsuccessful

**Recommendation:**

- Make sure that search engine is capable to do some word stemming, to return resources on 'cloud' when 'clouds' is search term!
- Problem with multiple search boxes surfaced: user entered resource search term into 'search this site' box. How can we fix this?

**Observations:**

User always selected grade level on front page – is that because he felt it was required?

User interpreted resource type list as hierarchical, from left to right. Thus, for example he selected Course->Syllabus, selecting 'Course' as qualifier for 'Syllabus'

User repeatedly feels dissatisfied with the search results, in that they do not match what he specified. Commented things like:

"It's not actually taking me to what it says"

"Wow, there's a lot of stuff I'd have to digest here. What I would like to do is go back to the advanced search, see if I can just find lesson plans!"

It appears that when, in the results description a discrete resource type like 'lesson plan' is listed, he expects to be taken directly to a lesson plan. Instead he is taken to the front page of a comprehensive web site, at which point he is required to search further. This uncovers a granularity mismatch at the metadata level: user is getting resources with different 'resource types' embedded in them, requiring him to search once again.