NSF Grant #0085839, Collaborative Project: To Gather, Document, Filter and Assess the Broad and Deep Collection of the Digital Library for Earth System Education.
Final Report, 2000-2002
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1. Major research and educational activities

The purpose of this collection assessment project is to develop and provide information about the nature and use of the DLESE collections to library builders and collection developers. This work is intended to serve as a model for collections evaluation and assessment for NSDL as a whole, and for other NSDL collections. Collections assessment is a systematic comparison of the actual collection with the desired or needed collection, as expressed through collection scope statements, collection development projects, user feedback, and user needs as expressed through searches in the collection. The goal is to provide information needed to support development of a highly relevant and useful digital library collection as a teaching and learning resource for a diverse user population. A collection geared to user's needs is one of the many factors that contribute to a high quality, effective digital library,

I devoted the first year and a half of the project to developing the prerequisites for a collection assessment for DLESE, a brand new digital library with just an early development test collection and a small group of early adopters as users and contributors. Although this kind of systematic assessment has been done for print collections, there were no models for applying this to a digital education library.

I concentrated on educating the developing DLESE and NSDL communities about the concept and value of having an overview of the scope and balance of a community built collection of diverse objects. I introduced the idea of a collections assessment as a way to obtain this overview to better guide collection development at a time when calls for contributors to the collection were starting to be sent out. I discussed how this overview could be provided through a formal collections assessment procedure. I emphasized that it was necessary to have some way to describe the relative depth of the collection by different parameters to develop a collection that was not lacking in key subject areas, in material for all learning resource types, and in material that meets all grade level needs. It was also necessary to compare that collections depth to the desired collection as expressed by the collections scope statement, by searches and by input from users of DLESE and NSDL through meetings and forums.

At the same time, I worked with the technical, metadata and library experts who were developing DLESE to create the technical structure needed to do this assessment. I determined what kinds of data and metadata record structures were needed to support this work. The DLESE metadata framework and first version of the search engine was just being developed, so what was possible kept changing. A result of this work were recommendations to the DLESE Program Center (DPC) technical staff about which metadata fields needed to be indexed so the data would be available for use in collections assessment. The DPC technical staff did this where they agreed that the information is important, where there is already metadata, and of course where the data structure allows

for this. An outcome of this work is the list of 30 controlled vocabulary topic terms which are assigned to each cataloged resource, and provide a way to assess based on subject. I had many discussions with the other project participants, interested DLESE builders, and the DPC technical staff about the most important metrics needed to describe the collections and the searches.

After several iterations of the kinds and formats of data produced and further development of the search and reporting systems, I developed specifications and requirements for the basic collection and usage data needed. I was able to obtain usable data starting in March 2002. We continue to refine the specifications and to adjust search filters as the system changes over time. The data is reasonably consistent and accurate from March 2002 through the end of 2002. I developed an initial set of rubrics to measure relative collection depth, and these are being refined but need much more development and testing.

Much of this work was done through e-mail, conference calls, at meetings and through presentations on the topic at forums such as the DLESE Collections Committee meetings, a DLESE metadata workshop, the 2000 DLESE Summer Leadership meeting, DLESE annual meetings, and NSDL meetings.

After a great deal of initial development work, in parallel in many ways with the early development of the DLESE metadata and search/browse systems, I have now been able to document the scope and balance of the actual collection with respect to the three parameters that were identified as most critical: learning context (early elementary through graduate/professional, plus informal and general public), topic (from the list of 30 controlled vocabulary terms), and resource type (e.g. photograph, map, classroom activity). I have produced charts that show the distribution of requests to the Discovery System "Browse" facility according to these same three parameters. For requests to the Discovery System "Search" facility, I have quantified the distribution of requests according to learning context and resource type. It is much more difficult to quantify the number of searches on topic, and along the consultant on the project, Constance Rinaldo, I have spent a lot of time manually mapping subject searches to the topic terms so we can do that with some degree of confidence. We are beginning to be able to identify the most heavily requested subject terms. We have also recently begun to more deeply examine search terms that result in null-returns. Through null search analysis, we are able to isolate searches that are correct in terms of search syntax and in scope of the DLESE project, so therefore may reflect weaknesses in the collection by subject. The information from these analyses are shared with the co-PI on the project responsible for setting collection priorities.

In collaboration with the DPC technical staff, we have identified further work that is needed to pull together content data, browse data and search data. Browse and search data are obtained from different data streams but both are needed to understand what users are looking for in the collection.

In addition to my work on collections assessment, I have been active in the governance of DLESE as a member of the first Steering Committee for 3 years, I have contributed to DLESE and NSDL meetings and documents. For DLESE, I have worked

on the DLESE Collections Policy, the Scope Statement, the Collections Accession Policy, the Deaccessioning policy and I participated in the Workshop on the Quality of the DLESE collections. For NSDL, I have contributed to the NSDL Collections White Paper, and the NSDL Collection Development Policy.

2. Outreach activities

I have given formal and informal presentations on the theory and application of this project to DLESE Collection Committee members, the DLESE Project Center staff, DLESE Steering Committee members, DLESE collection developers, and the DLESE community at the DLESE annual meetings, and to the NSDL collections community at NSDL meetings.

3. Findings

This project has practical applications to the DLESE collections management operation, and it has an experimental component of developing and testing methods for collections assessment that are applicable and useful across all kinds of digital libraries. Therefore, the core findings of the project are contained in the quarterly collections and usage reports which are used to track relative growth of the DLESE collections and usage by three major parameters, Learning Context, Learning Resource Type, and Topic. This findings report includes examples of these reports. Additional findings pertain to the process of doing collections assessment for a new digital library collection in a rapidly changing environment, and how that might be applied to NSDL as a whole and to other NSDL component collections. This is an area which needs more development, which we have been furthering through a new NSDL grant.

Chart 1 shows the relative growth in collections by Learning Context from March 2002, the first month for which we had usable data, through the end of 2002. Chart 2 shows the relative growth in searches added to browses on Learning Context. In some areas, like General Public level materials, the collection has grown more than the numbers of searches and browses, and in others, like the Elementary and Middle School levels, the searches and browses grew more than the collections.

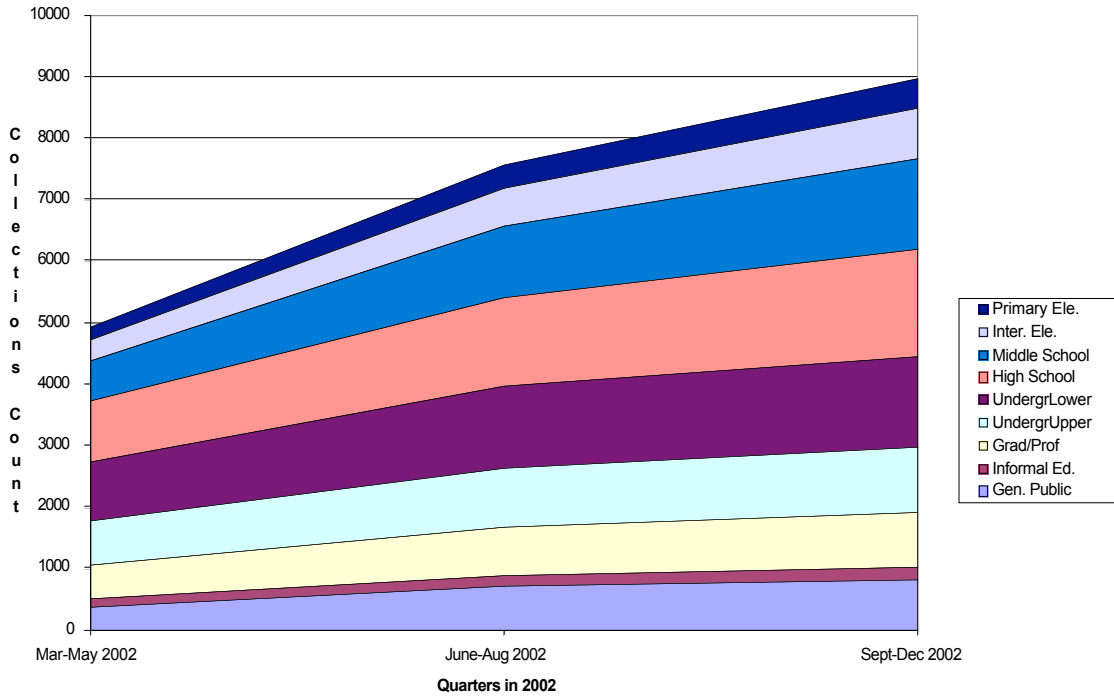**DLESE 2002 Collections by Learning Context**

Chart 1, DLESE 2002 Comparative Collections Growth by Learning Context
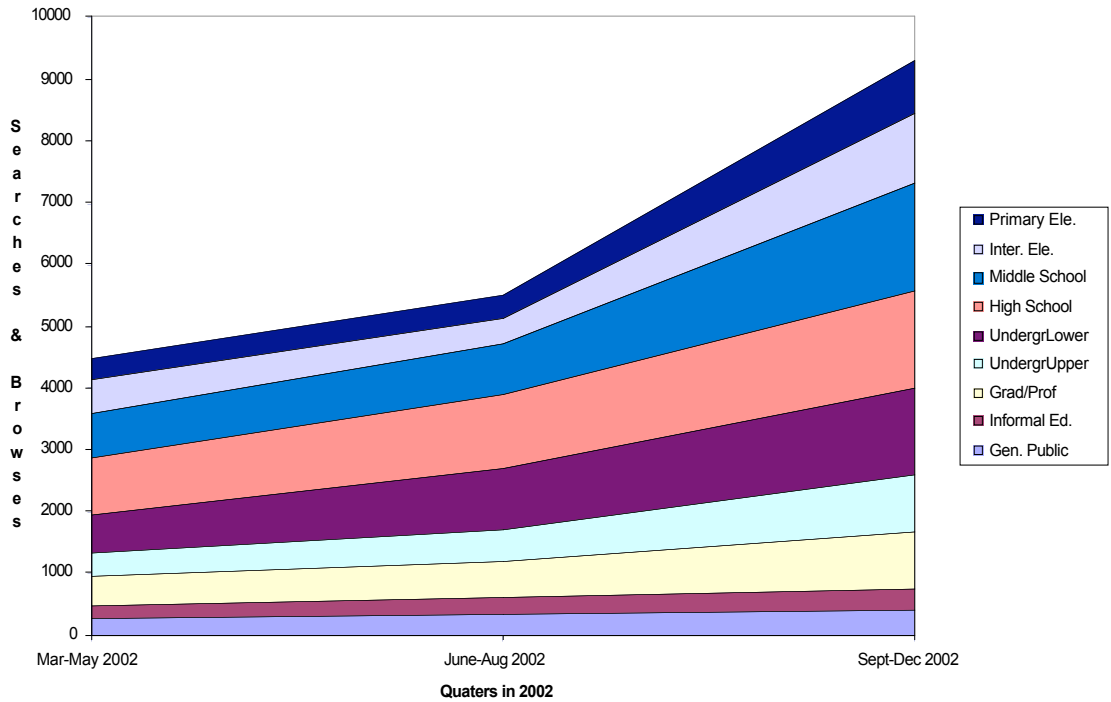
DLESE 2002 Searches & Browses on Learning Context

Chart 2, DLESE 2002 Comparative Searches & Browses by Learning Context over time

In addition to the overview fill charts, I produced quarterly bar charts that compare searches and browses to the collections. Chart 3 is a quarterly report comparing collections and searches and browses by Learning Context. Early in the development of the DLESE Collection, undergraduate level materials dominated the collection although there was a great deal of interest in materials at the middle school and elementary school levels. With input like this to the collection developers, the situation has changed and is more in balance. Chart 4 illustrates this shift.
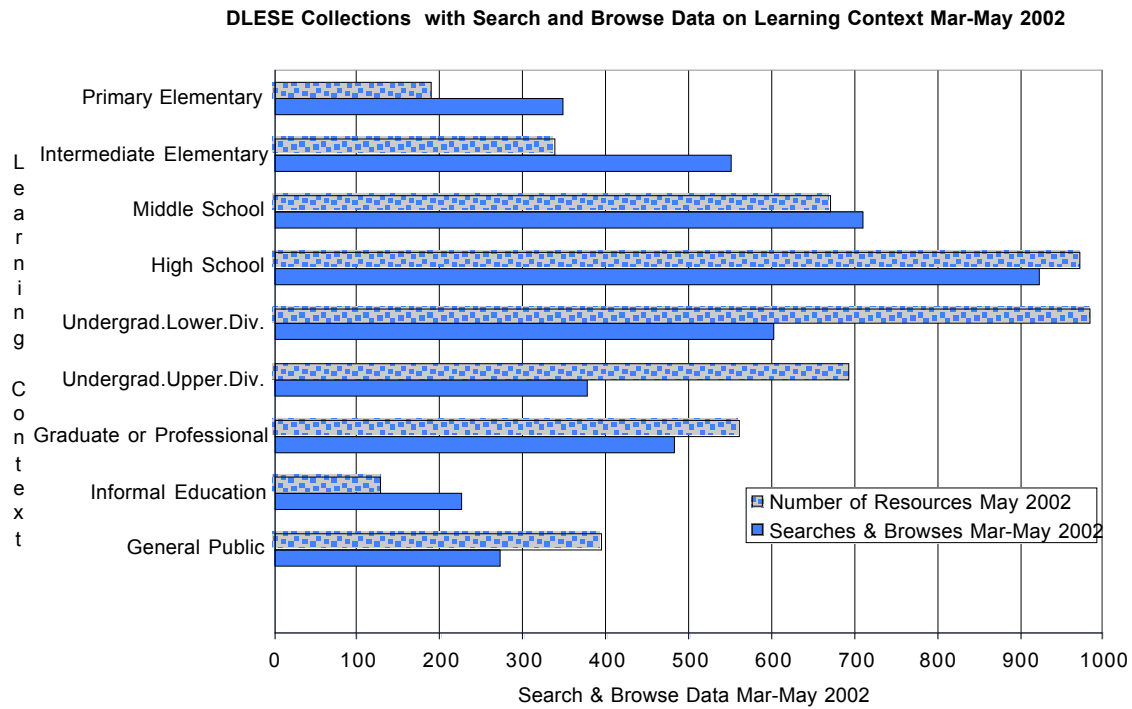
DLESE Collections with Search and Browse Data on Learning Context Mar-May 2002

Chart 3, DLESE Collections with Search and Browse Data on Learning Context Mar-May 2002.

DLESE Collections with Search & Browse Data on Learning Context Sept-Dec 2002
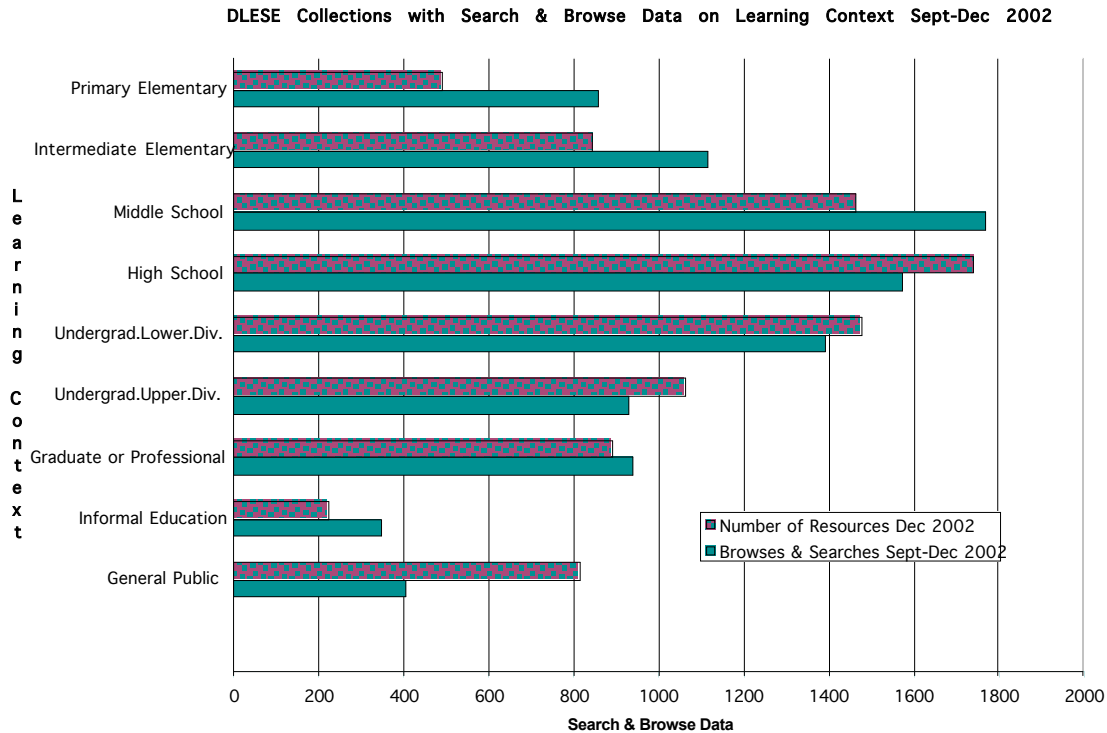

Chart 4, DLESE Collections with Search and Browse Data on Learning Context Sept-Dec 2002.

Charts 5 and 6 show the collection depth and usage by Learning Resource Type for the quarter June-August 2002 as an example. The Learning Resource Types were established by the DLESE community through a variety of meetings, and provide an example of community input into the "ideal" library. However, the collections clearly do not supply sufficient items of many of these learning resource types, and usage confirms that these are of interest to the users. Examples of the types of learning materials in demand but for which there were few resources are Audio Webcasts, Field Trip Guide, Radio Broadcasts, and Visual Webcasts. There were no materials at all for some kinds of learning resource types for which there were search requests, such as Audio Book, Lecture, Proposal and Thesis. This information identifies the kinds of materials that need to be added to the collection if available, or which should be developed if not available.
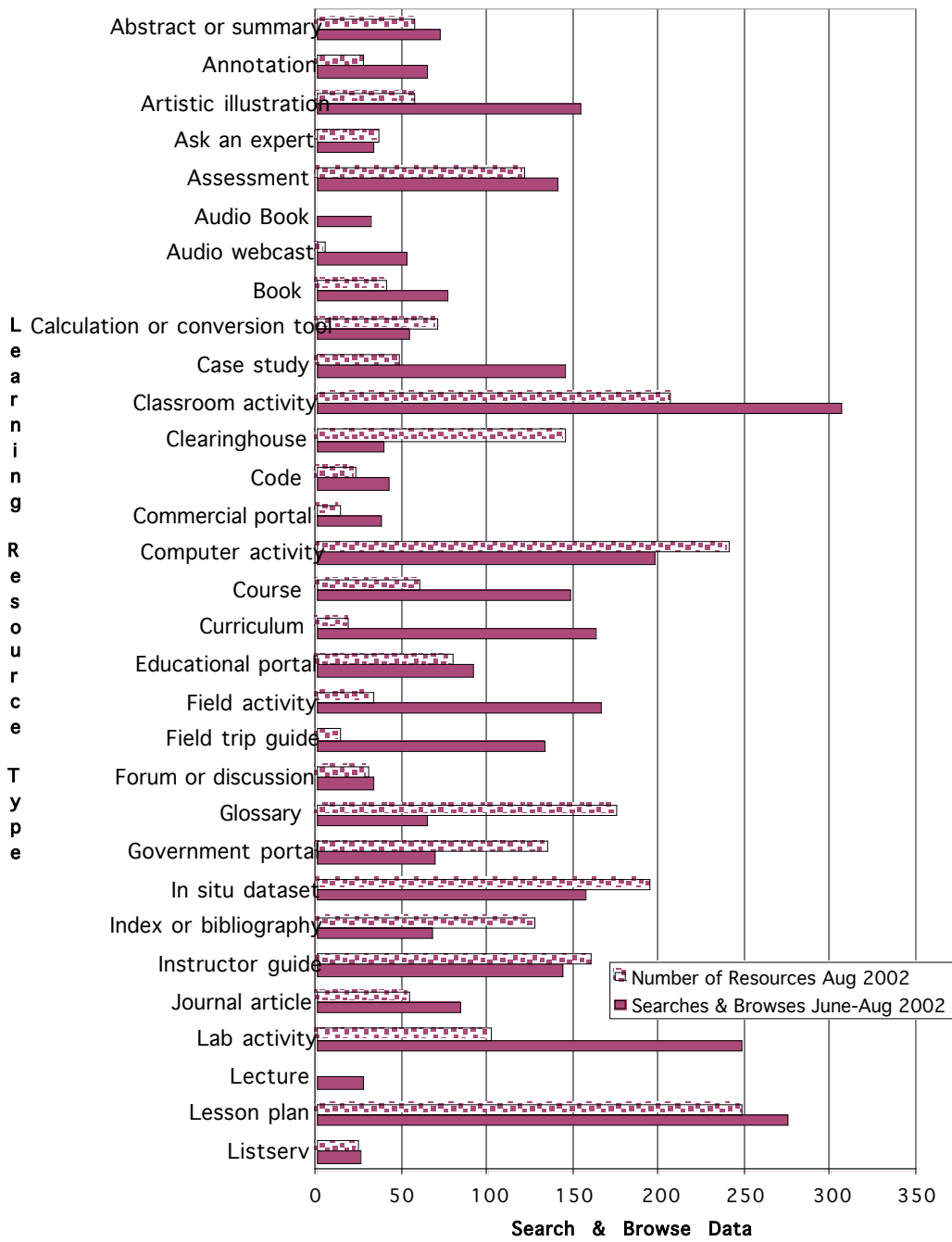
Chart 5, DLESE Collections with Search and Browse Data on Learning Resource Type Part 1, June-Aug 2002.

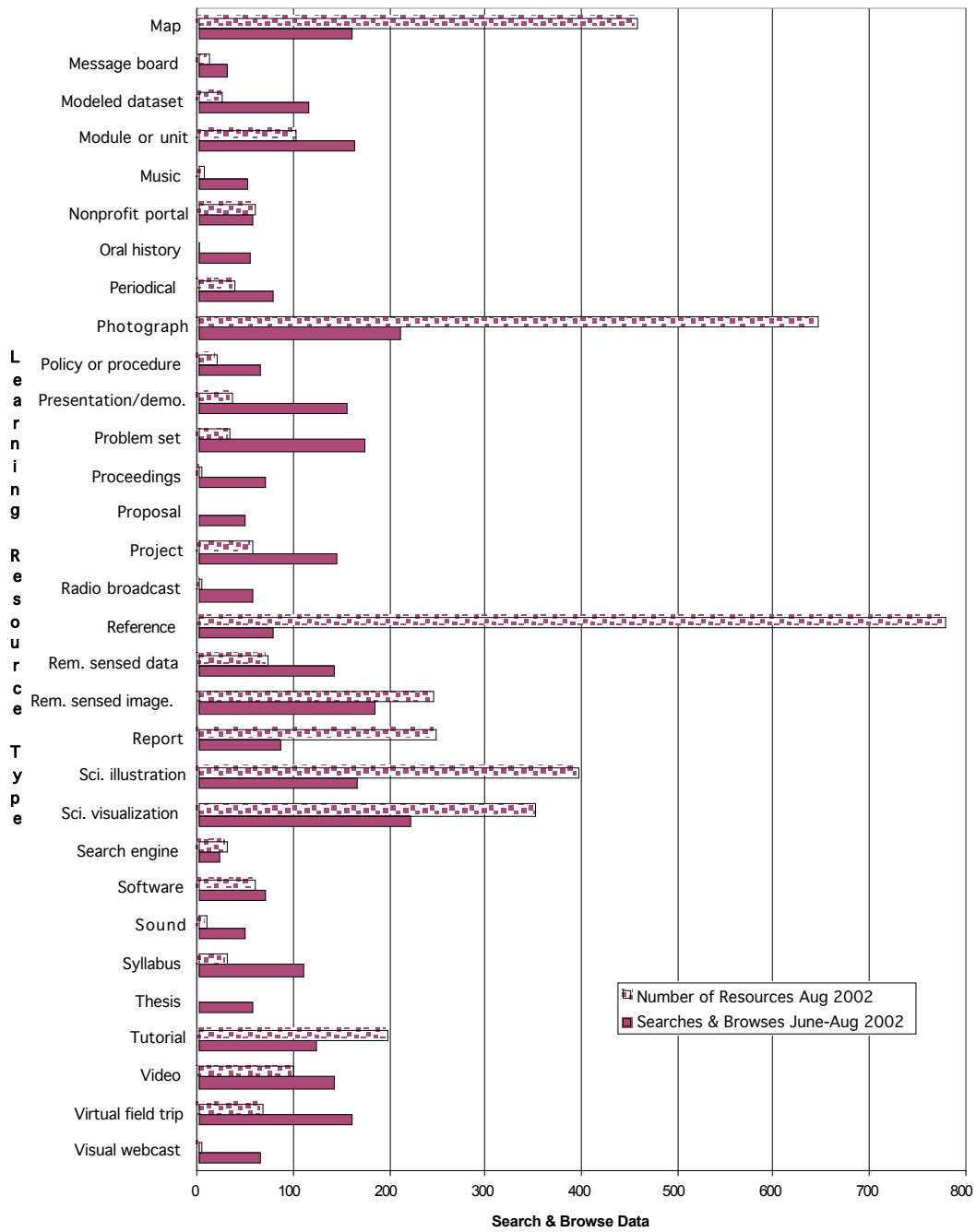**DLESE Collections with Search & Browse Data on Learning Resource Type June-Aug 2002 Pt.2**

Chart 6, DLESE Collections with Search and Browse Data on Learning Resource Type, Part 2, June-Aug 2002.

The numbers used in these charts are based on the available metadata and controlled vocabulary for Learning Context and Learning Resource Type. Although there are 30 controlled vocabulary terms for Topic, one of which at least must be assigned to each metadata record, the search system allows the user to do free text keyword searches, so the collection analysis by Topic is done on the controlled vocabulary Topic terms but the usage analysis needs to be done on both the controlled vocabulary topic browses and the free text searches. The consultant on the project and I manually mapped every search to one of the 30 controlled topic terms for the Mar-May and June-September 2002 quarters. We found that many searches cannot be mapped because they are strictly for a geographic region, the search is for a learning resource type (the user did not know how to limit their search to these), the search was out of scope or for a personal or corporate name. This took a lot of time, so we wanted to determine if browses sufficiently represented searches so that we could just do usage analysis on browses. We found that searches and browses correlate poorly, and that unfortunately we had to do this subject to topic mapping to get the best idea of what topics users were searching. Chart 7 illustrates that leaving out free text search data can lead to an over representing or under representing of a topic in the usage data.

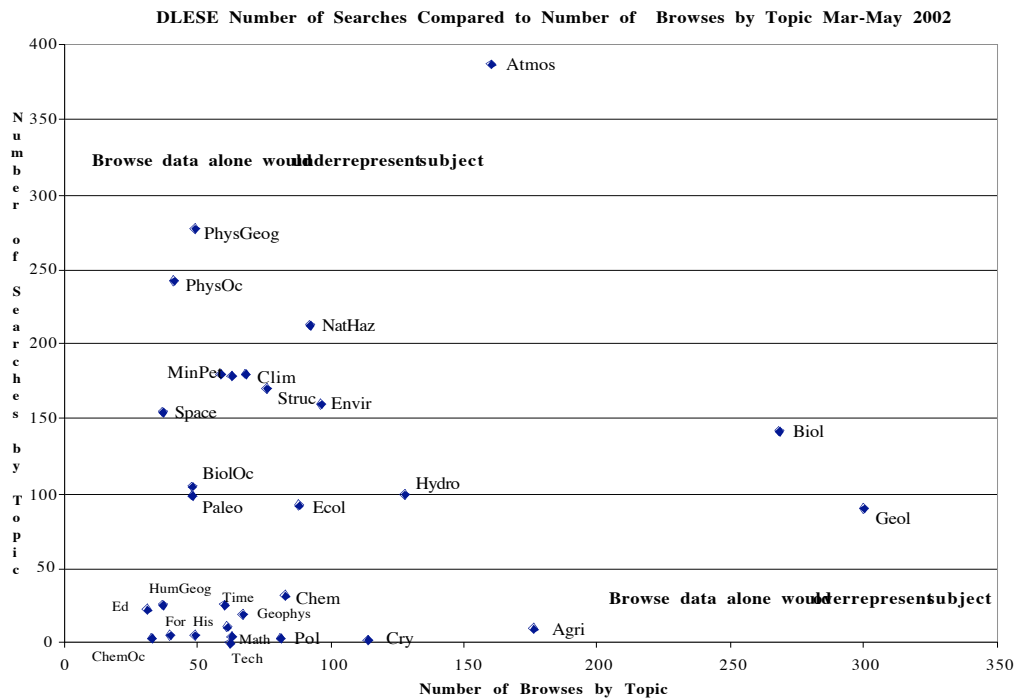Chart 7, Scatter plot showing correlation of number of free text keyword searches to number of browses in order to determine need for subject mapping.

We have completed subject mapping for two quarters for 2002, and are considering whether we can afford the resources to continue doing this for DLESE. Trends in topic and subject searching, when combined with collection depth, are useful but perhaps not

possible to continue to obtain. I have discussed the idea of using our subject mapping worksheets as learning tools for possible automation of this aspect of the project.

Charts 8 and 9 show the collection and usage data by topic, which includes all searches that could be mapped to one of the controlled vocabulary topic terms.

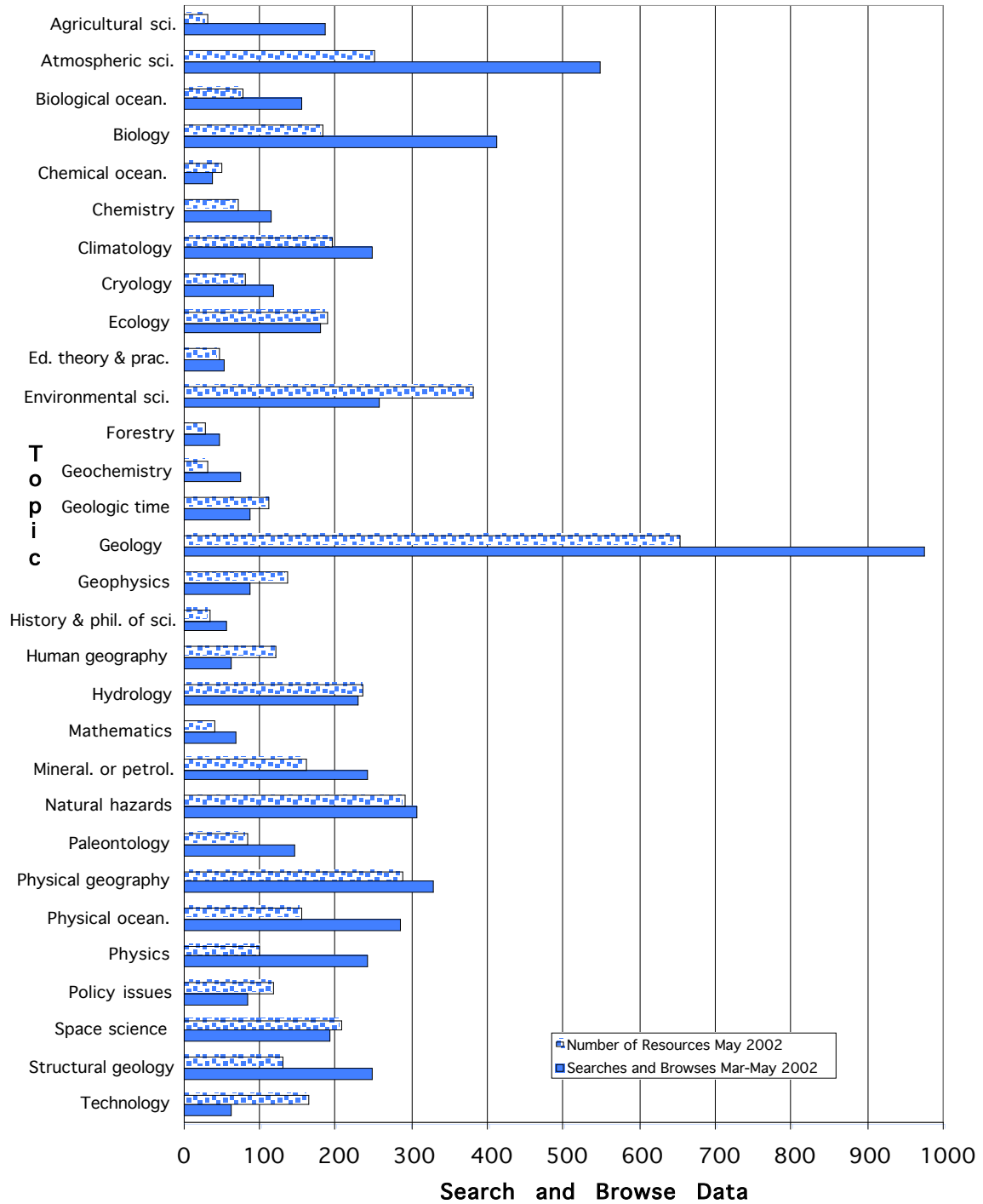DLESE Collections with Search & Browse Data on Topic Mar-May 200

Topic (vertical axis), Search and Browse Data (horizontal axis)

Topics (top to bottom): Agricultural sci., Atmospheric sci., Biological ocean., Biology, Chemical ocean., Chemistry, Climatology, Cryology, Ecology, Ed. theory & prac., Environmental sci., Forestry, Geochemistry, Geologic time, Geology, Geophysics, History & phil. of sci., Human geography, Hydrology, Mathematics, Mineral. or petrol., Natural hazards, Paleontology, Physical geography, Physical ocean., Physics, Policy issues, Space science, Structural geology, Technology

Legend:
☐ Number of Resources May 2002
■ Searches and Browses Mar-May 2002

Chart 8, DLESE Collections with Search and Browse Data on Topic, Mar-May 2002.

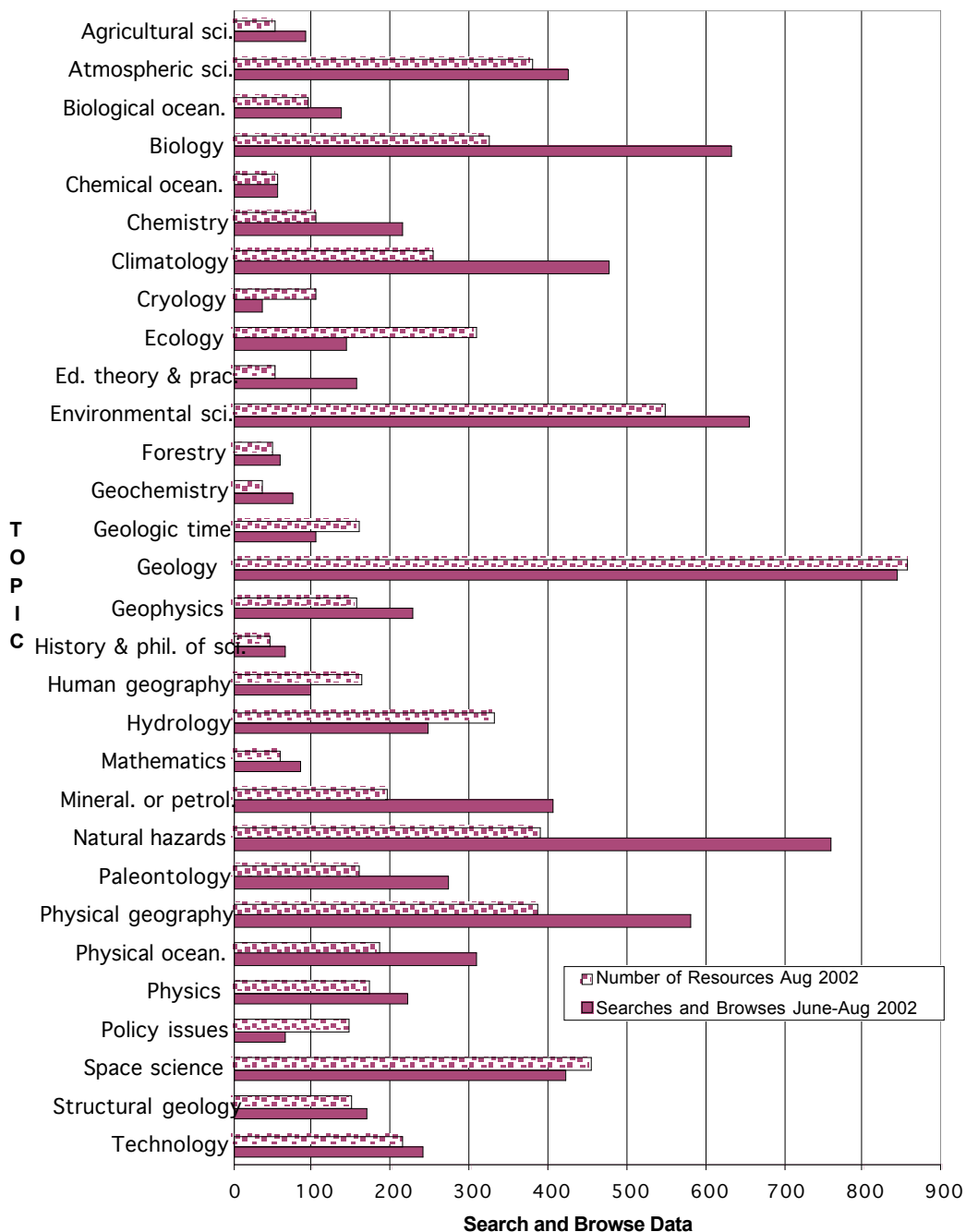**DLESE Collections with Search & Browse Data on Topic June-Aug 2002**

Chart 9, DLESE Collections with Search and Browse Data on Topic, June-Aug 2002.

Trends in needs for material on various topics change over time; we noticed that some months, certain topics would be in remarkably greater demand than others. Another way to view the relative proportions of resources and searches plus browses is to look at ratios of these. Chart 10 shows in ascending order the ratio of the number of searches plus

browses to the number of resources. A large number indicates that there were more searches plus browses than resources for the topic; a small number indicates that there were more resources than searches plus browses.

DLESE Ratios of Number of Searches & Browses to Number of Resources by
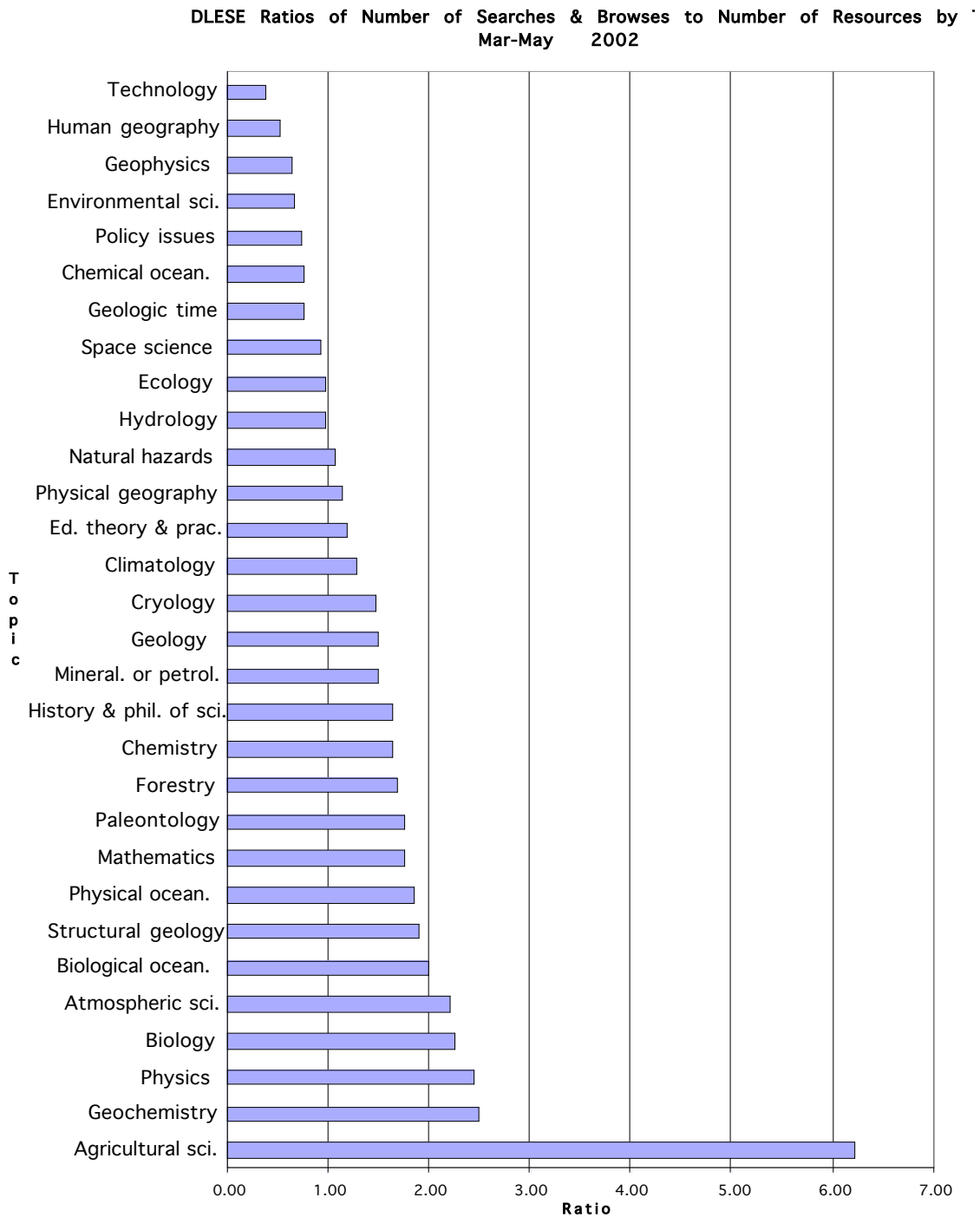**Mar-May 2002**

Chart 10, Ratios of DLESE Collections and Searches plus Browses on Topic, Mar-May 2002.

It is much more difficult to make collection priorities decisions based on topic collection and search data due to the fact that the controlled vocabulary terms do not reflect a lot of the earth system and geographic searches performed. However, we noted the dominance of traditional geology resources and the growing user interest in areas like Biology and Agricultural Science, and collection efforts were shifted in those directions.

Gaps in the collection were also identified from the Null Search Analysis, which we started doing in the fall of 2002 after discussions at NSDL and DLESE meetings about the need for a null result baseline for DLESE and other NSDL library collections. Table 1 shows the distribution by type of null searches from June-December 2002.

DLESE Zero Result Search Data	6/02	7/02	8/02	9/02	10/02	11/02	12/02
Percent of all searches with zero results	19	19	22	25	22	24	21
Percent of zero result searches that are out of scope	5	8	9	5	10	9	7
Percent of zero result searches with syntax errors	19	25	30	27	20	29	30
Percent of zero result searches with no errors and in scope	77	67	63	66	70	63	64
Percent of zero result searches with no errors, in scope and not qualified	48	49	36	38	34	36	45
Percent of zero result searches with no errors, in scope but qualified	52	51	64	62	66	64	55

Table 1, Analysis by type of null result searches by Topic, June-December 2002.

A major factor in a null result of a topic search for this time period is the user adding search limits by learning resource types and/or learning context when doing a power search. We labeled these limits as qualifiers and separated the set of null searches by whether they had a qualifier. Collection gaps by topic are likely to be found in the set of null searches with no qualifiers. We are starting to look closely at those for patterns that show areas where the collection needs building.

A table listing all null searches, both those qualified by learning resource type and/or by learning context, was sent to the project collaborator in charge of setting collection priorities for the broad collection. The following examples of subject areas that need more materials in the DLESE collection were gleaned from both qualified and unqualified searches:

1. Material on specific geographic areas and geologic sites
Examples:Baja, Badlands, Santa Monica Mountains, Amazon, Finger Lakes, Santa Cruz Island, Newberry Crater, West Virginia, Afghanistan, Pinatubo
2. Pollution oriented searches
Examples: acid mine drainage, Alaska oil drilling, oil spill data, surface ozone
3. Earth System searches on oceans, atmospheres, climate events and for concepts
Examples: geochemical cycles, atmosphere circulation, ecological footprint
4. Geotechnical topics
Examples: rock strength, rock mechanics
5. Specific geological and natural hazard topics:
Examples: mineral and fossil names; complex or specific volcanoes and earthquake searches

The next steps in this project are being carried out under a new grant, and include continuing to analyze the 2003 data to get an overview of collection and search/browse activity. The data for 2003 is collected and reported differently than 2002 data so more work on that is required first. I will continue to focus on unqualified null result searches to look for specific collection gaps by topic, and use that information to guide the collection developers. In order to help identify what kinds of resources need to be developed, I will analyze qualified searches more deeply to identify types of resources by topic that are being sought on a very detailed level. I am working with the DLESE Project Center staff in charge of generating the statistics to become aware of and to apply newly developed industry standards for reporting usage statistics. I hope to also work with the DPC on a project to automate the subject mapping work. I am also starting to work more closely with the NSDL Evaluation group to bring this work into that core effort to develop high quality digital libraries.

4. Participants:

Constance Rinaldo of Harvard University has worked closely with me as a consultant, analysizing the collections and use data, mapping free-form subject searches to the controlled vocabulary, identifying resources in the ecosystem science subject areas, and advising on vocabulary to help with cataloging and discovery for the ecosystem science materials in DLESE.

The other PI's on the grant are close collaborators:
Kim Kastens of the Lamont-Doherty Earth Observatory of Columbia University is the Lead Institution PI and overall project coordinator, Christopher DiLeonardo of the Foothill-DeAnza Community College District, and Sharon Tahirkheli of the American Geological Institute.

Other people involved are:
John Weatherly, Software Engineer at the DLESE Program Center (DPC) regularly assists with providing collections and use data in the needed formats and with interpretations of this raw data. Mike Wright, Technology Development and Operations Director at the DLESE Program Center (DPC), worked with me on refining what data needed to be included in these data reports. Tamara Sumner of the Computer Science Department at the University of Colorado and co-chair of the NSDL Evaluation and Educational Impact Standing Committee, has been involved in several discussions of what could and could not be done regarding collections assessment in a digital library, and in discussions of the value of developing a baseline for null search results.

5. Publications, Presentations and Products:

a. DeFelice, Barbara J., 2000, Building a Community Centered Digital Library for Earth System Education, Proceedings of the Geoscience Information Society, vol. 31, p. 91-95, 2000. (Paper presented at the Geological Society of America Annual Conference, November 2000).

b. DeFelice, Barbara J., 2001, "Another Node on the interNet", Computers and Geosciences, vol. 27, no. 5, p.611-613, June 2001.

c. "Collection Assessment Overview and Techniques" document prepared by Barbara DeFelice for the DLESE Annual Meeting workshop, June 2002; presented workshop.

d. Collections Assessment in DLESE/NSDL: Issues and Methods, talk prepared and presented by Barbara DeFelice at the NSDL PI's meeting December 2002.

e. "Comparing the Scope and Balance of DLESE Collections with the Community's Ideal Collection: Collection Assessment in DLESE", presentation written and prepared by Barbara DeFelice and delivered by Kim Kastens at the DLESE Annual Meeting, August 2003.