# ENABLING DATA DISCOVERY AND DATA RE-USE BY IMPROVING SOFTWARE USABILITY

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## ABSTRACT

It is well understood that a good data scientist needs domain science, analysis, programming, and communication skills to create finished data products, visualizations, and reports. Articles and blogs tout the need for “expert” skill levels in domain knowledge, statistics, storytelling, graphic design, technology…and the list goes on. Since it seems impossible that one person would encompass all these skills, it is often suggested that data science be done by a team instead of an individual.

This research into, and experience with, data product design offers an augmented definition – one that elevates relationships and engagement with the final user of a product. Essentially, no matter how fantastic or technically advanced a product appears, the intended audience of that product must be able to understand, use, and find value in the product in order for it to be considered a success. Usability is often misunderstood and seen as common sense or common knowledge, but it is actually an important and challenging piece of product development.

This paper describes the National Snow and Ice Data Center’s process to usability test the Arctic Data Explorer (ADE). The ADE is a federated data search tool for interdisciplinary Arctic science data that has been improved in features, appearance, functionality, and quality through a series of strategic and targeted usability testing and assessments. Based on the results, it is recommended that usability testing be incorporated into the skill set of each data science team.

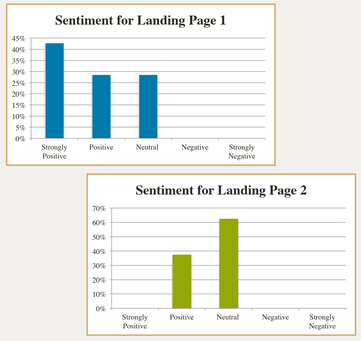
## Purpose of Usability Testing

The Arctic Data Explorer (nsidc.org/acadis/search) is a federated data search tool with over 20,000 dataset records from over 10 repositories. Usability testing throughout our software project ensures that the needs and wants of the intended audience are met. Subsequent resources and focus evolve based on feedback gleaned by talking directly with and observing actual users.

### Card Sorting

| Research Topic | Methods and tools | Audience | Results |
|---|---|---|---|
| Planning process<br><br>Next steps<br><br>New features | Card Sorting<br><br>Online survey using Qualtrics sorting and ranking features | Early project – ACADIS Advisory committee<br><br>Mid project – Early career scientists/ APECS | Affirmed Keyword, Spatial and Temporal as most important features.<br><br>People want to be able to scan the page with a map. |

### A/B Testing





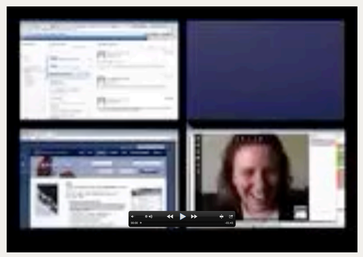


| Research Topic | Methods and tools | Audience | Results |
|---|---|---|---|
| Landing Page:<br><br>Do people understand what the tool is for?<br><br>Do they like the way it looks? | A/B testing<br><br>Online survey using Amazon’s Mechanical Turk<br><br>mturk.com | General audience of semi web-savvy people<br><br>$20 budget | Mixed preferences, but the insights informed decisions in our final design. |

### In-Person Interviews

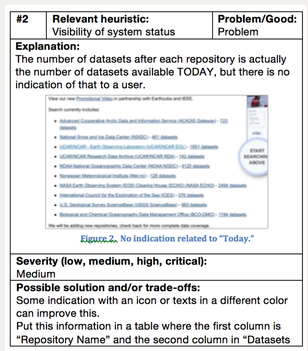
| Research Topic | Methods and tools | Audience | Results |
|---|---|---|---|
| Quality of search results<br><br>Tool functionality<br><br>Aesthetics<br><br>Confidence in the site/ Trust-worthiness<br><br>Error handling<br><br>Facet search functions | In-person interviews<br><br>Task-based and semi-structured interviews<br><br>“Think Aloud” method<br><br>Multiple note-takers<br><br>Some were like focus-groups | Scientists<br><br>Librarians<br><br>Software Engineers<br><br>Graduate Students<br><br>NSIDC User Support Experts and Technical Writers<br><br>ACADIS Advisory Committee | Improved:<br><br>Relevance ranking algorithm.<br><br>Facet binning.<br><br>Map interaction.<br><br>Map display<br><br>Temporal interaction.<br><br>Sorting.<br><br>Pagination.<br><br>Keyword search handling. |
| Aesthetics<br><br>General look and feel<br><br>Error handling<br><br>Tool functionality | In-person interviews<br><br>Task-based and open ended questions<br><br>“Think Aloud” method | Designers<br><br>Web-savvy general users<br><br>Software Engineers<br><br>Scientists<br><br>Librarians | Arranged/ spaced search results differently<br><br>Changed colors and data retrieval workflow |

### Online Interviews



| Research Topic | Methods and tools | Audience | Results |
|---|---|---|---|
| Aesthetics/ General look and feel<br><br>Quality of search results<br><br>Facet/Tool functionality | Online, one-on-one interviews<br><br>Task-based and semi-structured<br><br>“Think Aloud”<br><br>Video analysis | Early career and seasoned scientists<br><br>Librarians<br><br>Software Engineers<br><br>GIS experts | Discovered a number of bugs to fix.<br><br>Tool usefulness compared to traditional data discovery.<br><br>Scan-ability of results. |

### Heuristic Evaluation



| #2 | Relevant heuristic: Visibility of system status | Problem/Good: Problem |
|---|---|---|

**Explanation:**
The number of datasets after each repository is actually the number of datasets available TODAY, but there is no indication of that to a user.

Figure 2. No indication related to “Today.”

**Severity (low, medium, high, critical):**
Medium

**Possible solution and/or trade-offs:**
Some indication with an icon or texts in a different color can improve this.
Put this information in a table where the first column is “Repository Name” and the second column in “Datasets

| Research Topic | Methods and tools | Audience | Results |
|---|---|---|---|
| Tool Functionality<br><br>General audience communication | Heuristic Evaluation<br><br>Compare product to accepted, standard principles | Ph. D students in Computer Science from the University of Colorado Boulder | Improve error messages.<br><br>Documents like FAQs need to be easier to find. |
| Accessibility ADA compliance | Checklist and suggested actions | Data Curator | Add ‘alt’ info to images. Keyboard selection. |

## Recommendations

- A big budget is not necessary.
- PLAN! Research questions, methods, and audiences need to match and be focused.
- Testing should happen often and throughout the project.
- Prototype! Start testing even before coding.
- Communicate that you are testing the product, not the user.
- Have multiple people take notes. Each will contribute unique and informative observations.
- Be very careful how you ask questions and present tasks so that you don’t influence the results.

## Conclusions

- Tools that work get used again.
- To ensure products are useful and easily understood, testing is necessary.
- The intended audience MUST be solicited for feedback
- Testing can take many forms and many of them are free or cheap.
- User-Centered Design (UCD) is NOT “common sense”, but it is not difficult to incorporate into a project.

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