U-M Library Discovery System: Search Query and Results Evaluation - Part 1: Descriptive Analysis

Created by: Suvi Hirawat, Ben Howell, Suzan Karabakal

Date started: Aug 20, 2024

DOI: 10.7302/25382

Abstract

This study aims to explore how users approach search query formulation to identify key factors affecting their ability to effectively retrieve relevant results through our Library Search interface, with the goal of improving search algorithms, metadata quality, and search guidance strategies. This study examines "long tail" or less frequently searched queries submitted through the main search box on the University of Michigan Library website homepage. From a random sample of 600 unique search queries from over 450,000 queries submitted between January and May 2024, researchers classified search intent, query characteristics, common search missteps, and result relevance in our U-M Library “Everything” or bento box results view.

The analysis revealed that approximately 75% of searches are for known items or sets, with 59.3% seeking specific known items and 14.8% seeking known sets. Only 25.8% of searches were exploratory. Advanced search features were rarely entered directly within queries, with fielded searches appearing in just 10.5% of queries, parentheses in 11.5%, quotation marks in 6.7%, and Boolean operators in only 2.7%. Despite these behaviors, Library Search demonstrated strong performance, with 82.5% of all searches yielding exact matches or highly relevant results.

The study identified several key opportunities for improvement, including enhancing search precision and fuzzy matching for misspelled queries, providing better guidance for exploratory searches, encouraging more effective use of or augmenting user’s queries with advanced search features, and improving the presentation and highlighting of known item

results especially exact matches. These findings provide a foundation for developing targeted enhancements to the library search experience that align with actual user behaviors and expectations.

Executive Summary

This study analyzes “long tail” search queries submitted on the homepage of the U-M Library Website. “Long tail” search queries refer to queries searched less frequently or only once by fewer users or often a single user. It also analyzes recreated search results and inferred relevance within the U-M Library Search "Everything" results page for searches. Using a sample of 600 unique search queries from over 450,000 queries submitted between January and May 2024, we classified search intent and nine other search query characteristics to understand query types, content, use of advanced search semantics like quotations, parentheses, Boolean operators and fielded searches and common search missteps. Understanding and describing the frequency of these characteristics is the first step to more deeply understanding the strength and direction of relationship between these characteristics that we investigate in our in-depth analysis[1]. Our goal is to deeply understand user behaviors and their impact on people’s ability to use our Search application to retrieve promising and expected results. We hope to use insights from this study to identify key problems we can build and refine solutions for enhancing our Search application’s search algorithms, metadata quality, and search guidance strategies to provide a more effective discovery experience.

[1] Suviksha Hirawat, Ben Howell, and Suzan Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," Technical Report, Section 1: Predictors of Search Relevance Across Search Intents, April 30, 2025, 9, https://doi.org/10.7302/25407.

Key Takeaways

1. Improving Search Precision for Long-Tail Queries Focused on Known Items[2] and Known Sets[3]

Problem and Insights

The majority of long-tail search queries in Library Search are for specific known items or known sets, which are groups of items that share characteristics, like title, author, publisher, or date of publication.

- 75% of long-tail searches fall into the Known Item or Known Set categories.
- Known Item searches make up 59.3% of all queries, with 90% using a title to search for the item.
- Known Set searches account for 14.8% of queries, with 70% including part or all of one or more author's names.

Although these types of searches are common, misspellings and typos negatively impact their search relevance, making it harder for users to retrieve exact matches.[4] As most users are looking for specific known items, improving search precision, result displays, and features that highlight known items and authors would help streamline discovery and reduce user frustration.

How might we...

- How might we improve search precision to better handle misspellings and typos in Known Item and Known Set searches?

---

[2] Known item: A search query for a specific, known item like a book, article, or database title (e.g., Moby Dick, JSTOR)

[3] Known set: Queries where users seek a collection of items sharing specific attributes or metadata (such as author, publisher, publication date, or format), rather than keyword-based content characteristics.

[4] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 19.

- How might we enhance result displays and search features to more prominently and effectively highlight known items and known author results?

2. High Relevance for Known Item and Known Set Searches, but Opportunities to Improve Precision

Problem and Insights

Library Search performs well for Known Item and Known Set searches, successfully returning exact matches in 70% of Known Item searches and 59% of Known Set searches. However, gaps remain in search precision:

- 6% of Known Item searches returned no results, and 10% yielded low relevance results
    - No results most often occurred because the query contained misspellings and typos, or we didn't own or license the known item, or there was insufficient data in the search query.
- 4.8% of Known Set searches had no results, and 7.2% returned low relevance results

While less than 20% of Known Item and Known Set searches result in low relevance or no results, these gaps represent an opportunity to improve search precision through better query parsing and metadata augmentation. Enhancing how search queries are processed and integrating richer metadata from sources beyond our current indexes could help users more easily locate desired items.

How might we

- How might we increase the number of exact matches and high-relevance results for Known Item and Known Set searches through improved query parsing and metadata augmentation?

3. Enhancing Exploratory Searches for More Effective Research

Problem and Insights

Exploratory searches, where users seek research materials on broad or unfamiliar topics, make up 25.8% of all searches in Library Search. These searches often include multiple keywords or phrases as users attempt to refine their research focus.

- 14% of exploratory searches yield low relevance or no results, suggesting opportunities to improve how these searches are supported.
- Even though many exploratory searches achieve high relevance rankings, users may still struggle to refine their queries effectively or to recognize and retrieve the best available resources.

Common challenges include:

- Ambiguous terms (e.g., "nature") that may refer to a topic, database, or journal title
- Translating research questions into effective search strategies, queries, and keywords
- Lack of guidance on refining broad searches into more structured research queries and subsequent refinements
- Limited awareness and visibility of relevant library resources, such as research guides, subject librarians, or authoritative definitions

Opportunity for Improvement

To enhance exploratory search experiences, we can explore ways to help users refine queries in real time, such as:

- In-context assistance to distinguish exploratory searches from known item searches (e.g., identifying when "Nature" refers to the journal vs. the scientific concept)
- Parsing search queries to surface key concepts, relevant keywords, definitions/summaries, or related subject headings

- Dynamic display of supporting resources, matching research guides, subject experts, and authoritative summaries or definitions to provide deeper context

How might we...

- How might we use keywords and terms in exploratory search queries to dynamically retrieve and display relevant information and library resources on a topic?
- How might we help search users quickly disambiguate the context of their searches between broad exploratory queries and known item searches for popular databases, online journals, or book titles (e.g., "Nature")?

4. Enhancing Search Precision for Title, Keyword, and Author Queries

Problem and Insights

Most users structure their searches around titles, authors, or multiple keywords, reflecting an expectation that Library Search will surface known items quickly and accurately:

- 59.3% of queries contain titles or parts of titles
- 22.3% of queries contain an author's first or last name
- 23.8% of queries contain multiple keywords

Users expect precise and relevant results when searching by title or author, with exact matches appearing at the top of search results. To support this, search algorithms and interface design should help users focus on top results by:

- Highlighting and prioritizing known item results with supporting metadata (title, author, year, summary, access links, etc.)
- Minimizing extraneous results that might dilute relevance
- Ensuring displayed information reassures users they are on the right path

How might we...

- How might we enable search to recognize and parse query content more effectively, applying relevant search technologies (algorithms, fields, suggested matches, etc.) to increase result precision and relevance?
- How might we refine result displays to ensure known titles and authors are clearly highlighted and easily recognizable to users?

5. Low Advanced Search Features Usage:

Problem and Insights

Users rarely take advantage of advanced search features, even though some significantly improve search precision:

- **Parentheses**: 11.5% of queries
- **Fielded searches**: 10.5% of queries
- **Quotations**: 6.7% of queries
- **Boolean operators**: 2.7% of queries

Among these, fielded searches have the greatest impact on search relevance:

- Searches with fielded searches are 24 times more likely to return highly relevant or exact matches.[5]
- Even without fielded searches, title or author searches are still 18 times more likely to yield relevant results.[6]

This suggests that users searching for known items (titles, authors) benefit from search intelligence, even without advanced features, but leveraging fielded searches would further improve precision. A cluster analysis found a high use of Boolean operators and quotations

[5] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 14.
[6] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 13.

and a moderate use of parentheses in the "Exploratory Searches with High Relevance" cluster.[7] The low adoption of Boolean operators and Quotations indicates that users may be unaware of them or find them difficult to use. Providing clearer, in-context suggestions could help users refine complex searches more effectively.

How might we...

- How might we surface, encourage, or automate the use of advanced search features when they are most relevant to a user's query?
- How might we design more intuitive or automated ways to guide users toward fielded searches, especially when searching for known items or refining complex queries?

6. Understanding and Addressing Search Query Missteps

Problem and Insights

Users frequently make search query missteps that impact search relevance, though the effect varies by search intent. The most common misstep is not using fielded searches, followed by using ambiguous terms.

While the library's search system performs well for Known Item and Exploratory searches, opportunities exist to:

- Improve how the system suggests and highlights exact matches for books, articles, databases, online journals, and authors.
- Assist users in refining Exploratory searches with ambiguous terms for better results.

[7] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 21.

Key Search Missteps and Their Impact

1. **Not using fielded searches (374 queries, 62.3%):** Nearly two-thirds of searches lack fielded searches, yet fielded searches are 24 times more likely to return highly relevant or exact match results.[8]
2. **Ambiguous terms (119 queries, 19.8%):** Surprisingly, ambiguous terms double the odds of retrieving relevant results in Exploratory searches, suggesting the search engine successfully interprets these queries.[9]
3. **Incomplete title (77 queries, 12.8%) & Incomplete author (36 queries, 6.0%):** These missteps are common but do not significantly affect relevance, likely due to the robustness of the search algorithm.[10]
4. **Too few keywords (73 queries, 12.3%):** Exploratory searches with minimal keywords often return millions of results, making it harder to locate relevant materials.[11]
5. **Misspellings or typos (48 queries, 8.2%):** While more data is needed for statistical certainty, preliminary findings indicate that users who make typos are much less likely to retrieve their intended results.[12]

How might we...

- How might we help users refine their search queries by recognizing when a fielded search would improve results or when ambiguous terms could be clarified—suggesting or automatically adjusting searches to increase the likelihood of retrieving highly relevant or exact match results?

---

[8] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 14.

[9] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 12.

[10] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 17.

[11] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 12.

[12] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 10.

- How might we enhance the search interface to better support users making common search missteps, such as misspellings, incomplete titles, and minimal keywords, while still delivering accurate and relevant results?

These insights will help refine the search experience for both known-item and exploratory searchers, leading to more efficient, precise, and satisfying search outcomes across user groups.

Background

A descriptive analysis from our search query and relevance classification analyzing search queries from the “What can we help you find” search box on the lib.umich.edu homepage that leads users to the “Everything” results page. Suvi Hirawat, Ben Howell, and Suzan Karabakal conducted this research between May and August 2024. We randomly sampled 600 search queries from over 450k queries submitted via the search box on lib.umich.edu homepage leading to Library Search “Everything” results from January through May 2024. We purposefully chose a random sample of less frequently searched queries and not the top 600 out of 450,000 search queries. This is because the most frequently searched user queries are often for known databases and other popular known items (online journals, books, articles, etc.). We wanted to deeply understand the characteristics for the “long-tail” or more unique search queries.

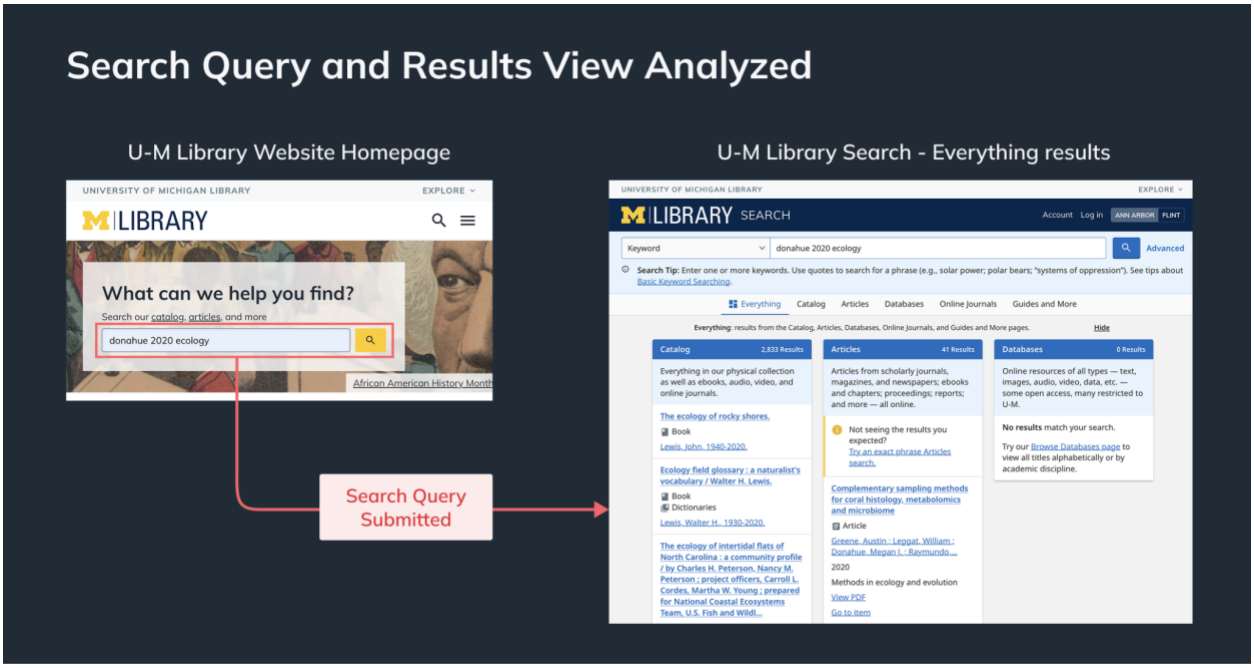


Fig 1. The context of the search queries and results we analyzed in this study started as users entered and submitted their queries in the search box on the Library Website Homepage at lib.umich.edu leading to the "Everything" results view in U-M Library Search.

We've developed a system of 12 categories for grouping and organizing search queries in our academic library platform. This system helps us better understand what users were looking for and how relevant their search results were. For example, we categorize searches based on what we inferred the user was trying to do (like looking for a specific book or exploring a topic), the type of resource they were searching for (like a book, article, or database), and any missteps they might have made (like misspellings or not using advanced search options). We also analyzed how relevant the search results were in our brief "Everything" results in our Library Search application. We inferred based on our recreated searches whether users would have encountered an exact match to their known item/set queries, highly relevant results for known set and exploratory searches, low relevance results or no results at all. These classifications and analysis will help us understand trends and clusters of user behaviors and how these behaviors affect search results within our Library Search application. We will use insights from this analysis to inform human-centered improvements to our Library Search application.

Our classification schema includes 12 categories: Search intent, Resource type, Fielded search used, Boolean used, Parentheses used, Quotation used, Academic disciplines, Language, Non-English query translation (our team translated non-English queries into English), Search query missteps, Best datastore match, and Match relevance.

As a first step in “sitting with” our data, we have completed this descriptive analysis. This milestone forced us to clean our data, make decisions about controlled vocabularies, and learn about and create a data dictionary to assign numerical values to our string values for multicategorical and categorical variables within each category. We used ChatGPT-4o all along the way to seek information and feedback about building classifications for search queries, to test ideas, ask dumb questions, to prompt for better research questions, to learn how to do our work more effectively, to preprocess and clean our data, and to learn and experiment with new analysis methods (cluster analysis, etc.) tools and programming languages (Python, SPSS, many Excel formulas).

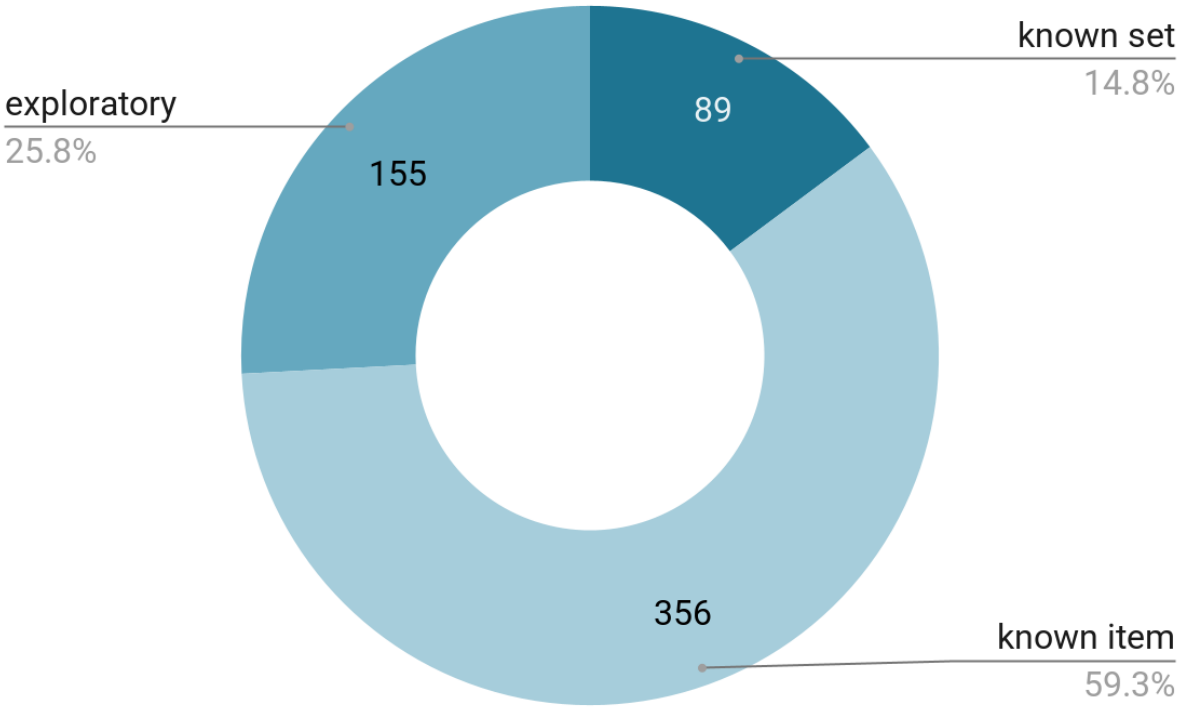
Search Intent

Definition: The overall intent and scope of the search query.
Data type: Nominal *(*Each search query is associated with a single search intent category.)*

Possible search intent types are:

- **Known Item:** A search query for a specific, known item like a book, article, or database title (e.g., Moby Dick, JSTOR)
- **Exploratory:** A search query was intended to reveal a broad range of information on a topic or subject across multiple information types, information sources, and formats
- **Known Set:** Queries where users seek a collection of items sharing specific attributes or metadata (such as author, publisher, publication date, or format), rather than keyword-based content characteristics. Unlike "Known Item" search, where users seek a specific, already-identified resource, Known Set searches aim to retrieve multiple related items matching particular bibliographic or categorical criteria. This differs from "Exploratory" search intent, where users have less defined parameters

and are using different keywords and phrases to discover information needs as they search.



Frequency distribution of Search Intent:

1. **Known Item:** 356 (59.3%)
2. **Exploratory:** 155 (25.8%)
3. **Known Set:** 89 (14.8%)

Summary

It's extraordinary that nearly 60% of all searches from the "long-tail" of sampled searches submitted from the search box on the lib.umich.edu homepage are for "known items". Half of those Known Item searches include titles in the query. An additional 15% of all searches are for a Known Set searches for materials by a specific author. In contrast, only a quarter (25.8%) of searches are "exploratory" in nature.

This suggests and aligns with over one hundred user interviews where we have observed search users exploring and finding promising research materials or other literature on topics outside of Library Search (using familiar Online Search engines) and then turning to Library Search when they need access to licensed materials.

Resource Type

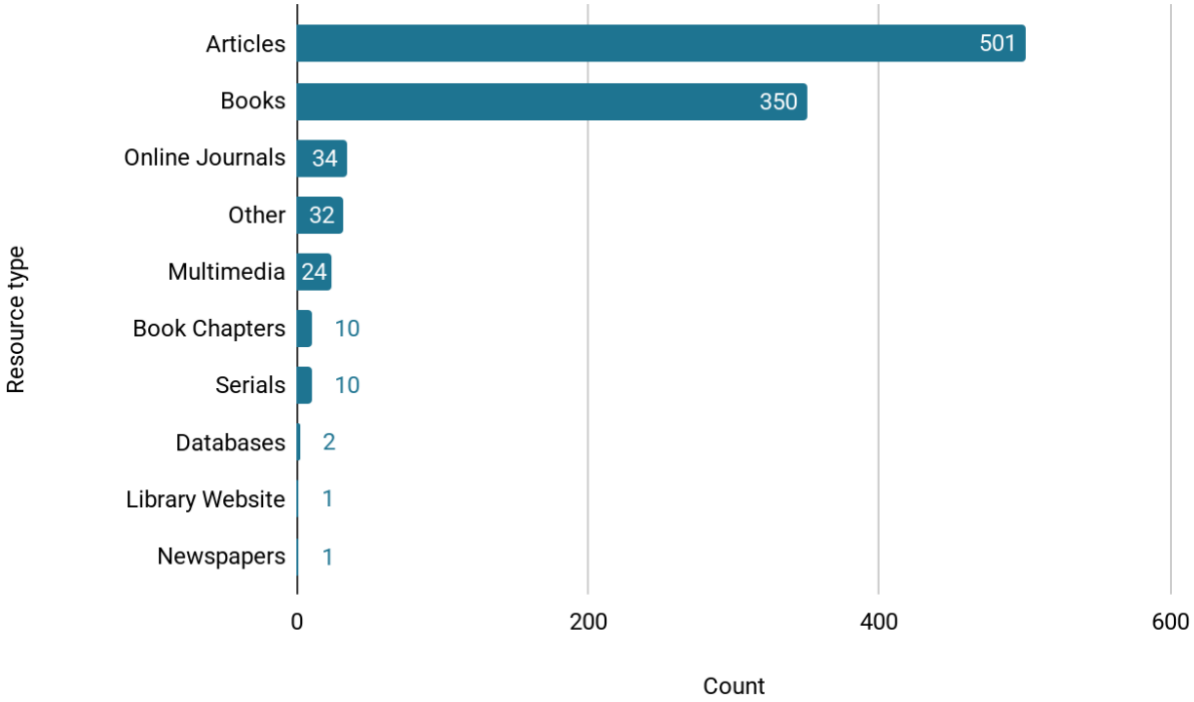
Definition: The nature or “What” of the item or the subject being searched.

Item types include articles, books, databases, multimedia, periodicals, newspapers, online journals, serials, and library website content (e.g., library blog posts, research guides, etc.).

Data type: Nominal *(*Each search query is associated with one or more resource type values.)*

Frequency distribution of Resource type:

*Represents proportions percentages (Fractional Percentages) or the number of times this value appeared divided by 600 search queries. They don’t add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple “Resource Type” values. Our Library Search application categorizes results into smaller buckets: “Catalog”, “Articles”, “Databases”, “Online Journals”, and “Guides and more”. These buckets also contain multitudes of results in overlapping formats. However, in our analysis, use Resource Type as a way to assign one or more values to search queries so we can infer if the search query was meant to find a book, an article, an online journal or all three.



- **Articles**: 501 (83%)(5 of every 6 searches)
- **Books**: 350 (58%)(3 of every 5 searches)
- **Online Journals**: 34 (5.6%)(1 of every 18 searches)
- **Other**: 32 (5.3%)(1 of every 19 searches)
- **Multimedia**: 24 (4%)(1 of every 25 searches)
- **Book Chapters**: 10 (1.6%)(1 of every 60 searches)
- **Serials**: 10 (1.6%)(1 of every 60 searches)
- **Databases**: 2 (0.3%)(1 of every 300 searches)
- **Library Website Content**: 1 (0.2%)(1 of every 600 searches)
- **Newspapers**: 1 (0.2%)(1 of every 600 searches)

Summary

Percentages are cumulative and exceed 100% because multiple resource type values can be assigned a search query. Unsurprisingly, Articles (83%) and Books (58%) are the top resource types that people are searching for. However, there is a surprise about our sample of unique “long-tail” search queries. There were 965 total resource type classifications.

Looking at the percentage of the total resource type classifications assigned, 51% of all search queries were for articles and 36% were for books. This frequency distribution is very different for the top 600 most frequently submitted search queries where people search for Database and Online Journal titles most frequently.

Query Type

Definition: The words the library user used to get at the meaning of the subject, i.e., how did the search user decide to describe the subject of the search query. Researchers called this the “how” or the “Query Type”.

Query types include Single keyword, Multiple keyword, phrase, title, author name, DOI, ISBN, etc. (Other search query types may be generated by ChatGPT when it automatically classifies search queries)

Search queries may include multiple query types. For these types of queries, we would use query type 1, query type 2. For example, a search for “giver lowry” would be categorized as “Title, Author” since the item type was deemed a book and the query contained part of the book’s title and part of the author's name.

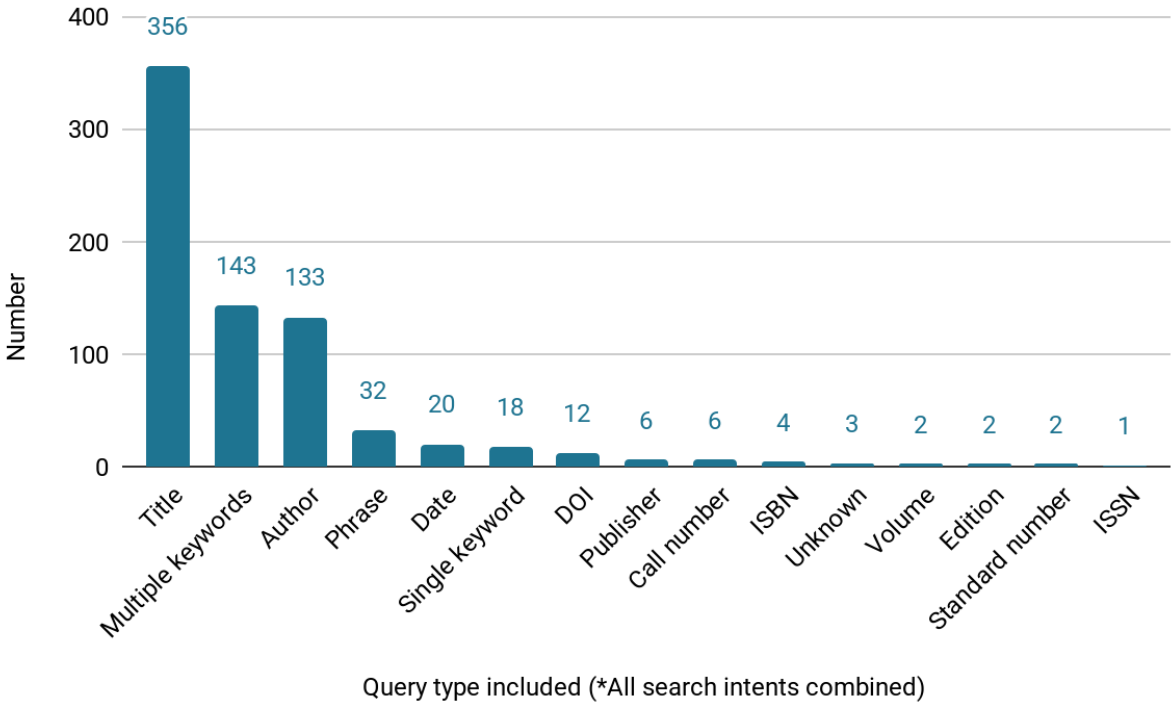
We have chosen to include additional values that UMGPT or ChatGPT-4o added to these fields if they are reasonably correct. Leaving these "extra" values outside our classification will help demonstrate where ChatGPT was able to discern what the resource was with reasonable measures of accuracy.

Data type: Nominal *(*Each search query is associated with one or more query type values in the order they are listed in the query.)*

Frequency distribution of Query Type:

*Represents proportions percentages (Fractional Percentages) or the number of times query type values appeared divided by 600 search queries. They don’t add up to 100% like

percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple “Query Type” values.

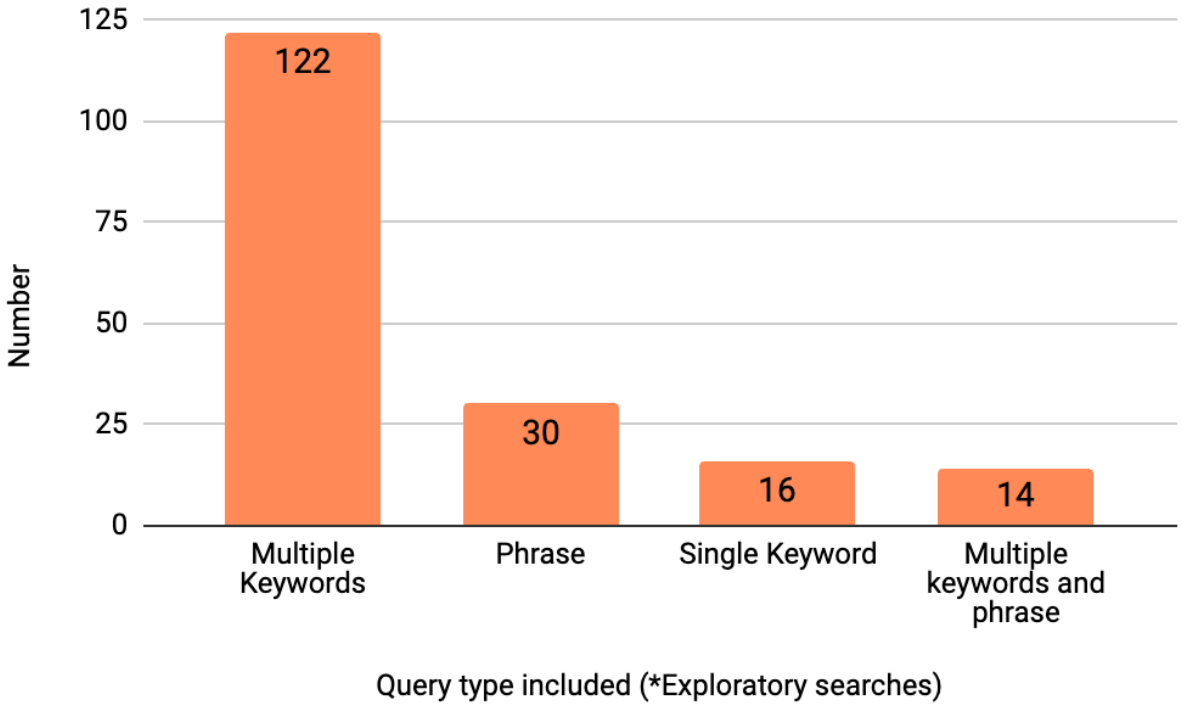


1. **Title:** 356 (59.3%)
2. **Multiple keywords:** 143 (23.8%)
3. **Author:** 134 (22.3%)
4. **Phrase:** 32 (5.3%)
5. **Date:** 20 (3.3%)
6. **Single keyword:** 18 (3%)
7. **DOI:** 12 (%)
8. **Publisher:** 6 (1%)
9. **Call number:** 6 (1%)
10. **ISBN:** 4 (.6%)
11. **Subject:** 3 (.5%)
12. **Unknown:** 2 (.3%)
13. **Volume:** 2 (.3%)
14. **Edition:** 2 (.3%)

15. **Standard number:** 1 (.1%)
16. **ISSN:** 1 (.1%)

Frequency distribution of Top Query Types (For 155 Exploratory Searches)

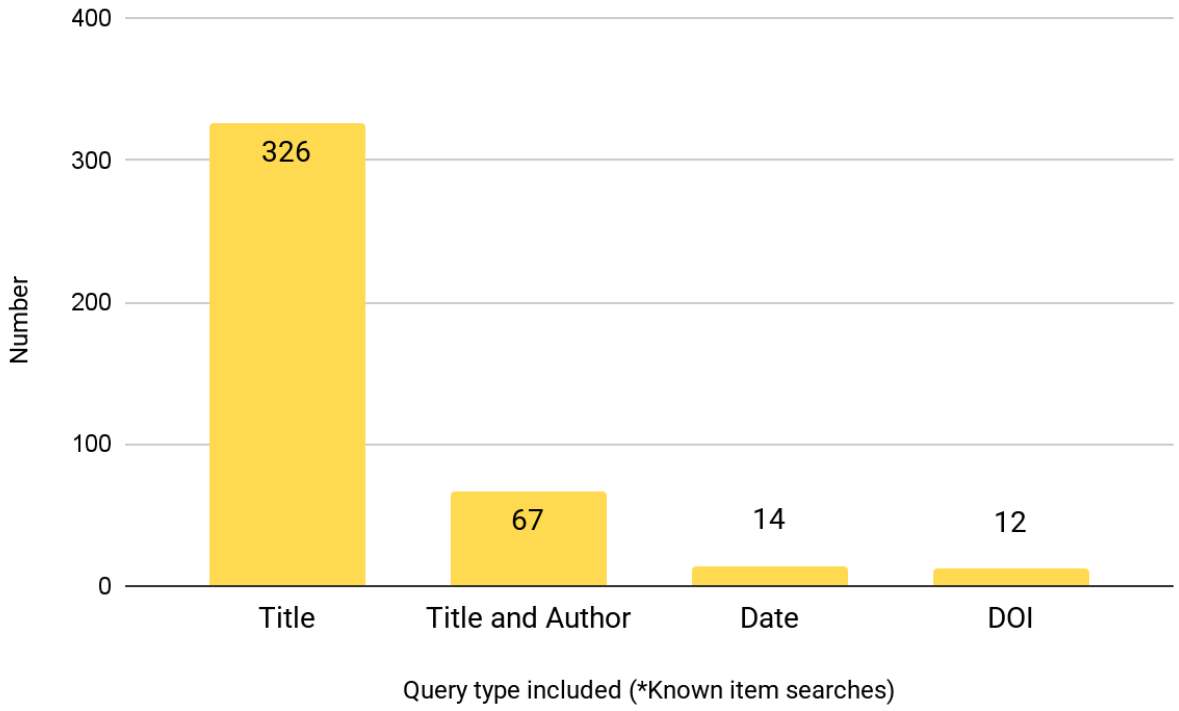
*Represents proportions percentages (Fractional Percentages) or the number of times query type values appeared divided by 155 Exploratory search queries. They don't add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple "Query Type" values.



- **Multiple Keywords:** 122 (78.7%)
- **Phrase:** 30 (19.4%)
- **Single Keyword:** 16 (10.3%)
- **Multiple keywords and phrase:** 14 (9%)

Frequency distribution of Top Query Types (For 361 Known Item Searches)

*Represents proportions percentages (Fractional Percentages) or the number of times query type values appeared divided by 361 Known Item search queries. They don't add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple "Query Type" values.

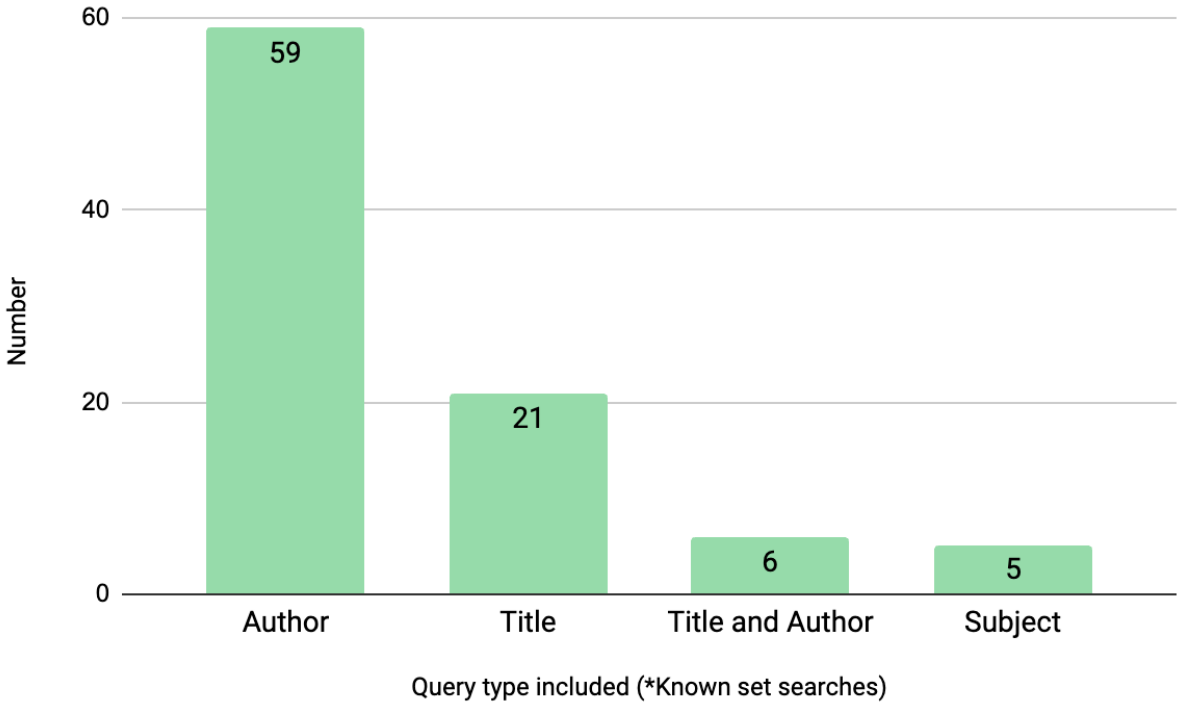


- **Title:** 326 (90.3%)
- **Title and Author:** 67 (18.6%)
- **Date:** 14 (3.9%)
- **DOI:** 12 (3.3%)

Frequency distribution of Top Query Types (For 83 Known Set Searches)

*Represents proportions percentages (Fractional Percentages) or the number of times query type values appeared divided by 83 Known Set search queries. They don't add up to 100%

like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple “Query Type” values.



- **Author:** 59 (71.1%)
- **Title:** 21 (25.3%)
- **Title and Author:** 6 (7.2%)
- **Subject:** 5 (6%)

Summary

90% of all Known Item search queries include titles, 18.6% include title and author. Other search query content like dates or DOIs are rarely included (under 3% of the time).

Almost 80% of all Exploratory search queries contain multiple keywords, 20% include phrases, and 10% contain a single keyword.

We can continue to weight our search algorithms to prioritize indexing, search formulation features, and results to match titles, authors, and keywords.

Ordinal Data Categories (Fielded search, Boolean, Parentheses, Quotations)

All search queries we analyzed were entered from the “What can we help you find” search box on the homepage of lib.umich.edu. All fielded searches, booleans, parentheses, or quotations (ordinal data categories) would have to be entered manually in this search box.

Definitions

- **Fielded Search:** Queries that include fielded search type, a colon, and then the corresponding search term. An example would be: "author: Whitman, Walt" or "title: Field of Dreams"
- **Boolean:** Queries that contain one or more Boolean terms in all caps or those that separate terms with Boolean terms, but they are not capitalized when our team infers that the user intended to show a meaningful query relationship between search terms to yield desired results
- **Parentheses:** Queries that use parentheses to intentionally search grouped words
- **Quotations:** Queries that use quotations to intentionally search grouped words

Possible values include:

0-No: No [ordinal value] was used; **1-Yes:** One instance of [ordinal value] was used; **2-Multiple:** Multiple [ordinal categories] were used

Data type: Ordinal *(*Each search query is associated with a single value per category.)*

Frequency distribution of Ordinal Data:

	Fielded search	Boolean	Parentheses	Quotations
0-None	**535** (89.2%)	**579** (96.5%)	**526** (87.7%)	**549** (91.5%)
1-One	**63** (10.5%)	**16** (2.7%)	**69** (11.5%)	**40** (6.7%)
2-Multiple	**2** (.3%)	**5** (.8%)	**5** (.8%)	**11** (1.8%)

Summary

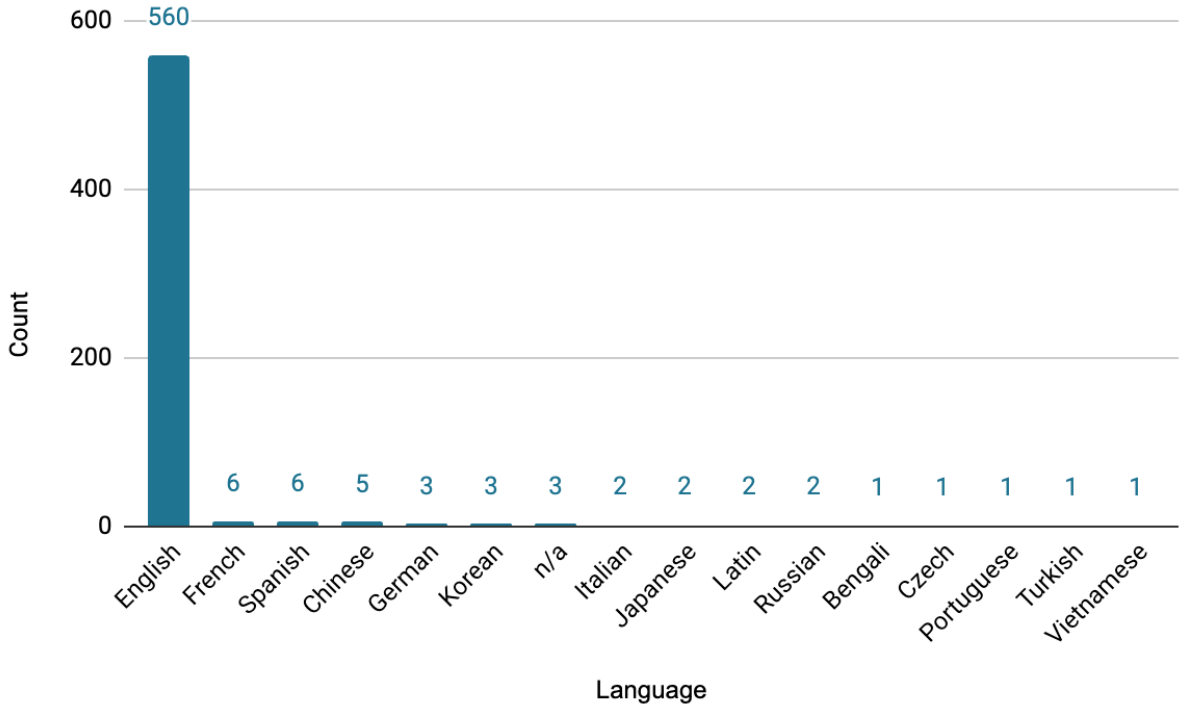
Parentheses and fielded searches were the most common ways people added advanced characters to their search queries with around 10% of searches using these characteristics. Only 40 (6.7%) of all search queries even used quotation marks and only 16 (2.7%) used Boolean terms. Since users entered these search characteristics manually from the simple search on the Library Website homepage, we want to know how fielded searches, parentheses, quotation marks, and Booleans are added to subsequent search queries once researchers are within the Library Search application. We would assume that the use of fielded search queries would be much higher when it is offered as a set of drop-down options in Library Search and where people have access to more advanced search features.

It's recommended that we investigate search queries submitted within the context of our Library Search application to better understand the characteristics of initial and subsequent search queries. We also recommend investigating secondary research and conducting follow-up qualitative research to better understand how people understand and use these search query characters in their search queries and why.

Language

Definition: The language of the search query.

Data type: Nominal *(*Each search query is associated with a single language value. If multiple languages are used in the query we use the non-English language.)*



Frequency distribution of Language:

17. **English:** 560 (93.8%)
18. **French:** 6 (1%)
19. **Spanish:** 6 (1%)
20. **Chinese:** 5 (.8%)
21. **German:** 3 (.5%)
22. **Korean:** 3 (.5%)
23. **n/a:** 3 (.5%)
24. **Italian:** 2 (.3%)
25. **Japanese:** 2 (.3%)
26. **Latin:** 2 (.3%)
27. **Russian:** 2 (.3%)
28. **Bengali:** 1 (.2%)
29. **Czech:** 1 (.2%)
30. **Portuguese:** 1 (.2%)

31. **Turkish:** 1 (.2%)
32. **Vietnamese:** 1 (.2%)

Commentary

An overwhelming majority of search queries are in English (93.8%). The next most common non-English languages used in search queries are French, Spanish, and Chinese with each at 1% of all search queries. Out of all 40 non-English search queries in our sample, 29 (72.5%) were for Known Items, 9 (22.5%) were Exploratory searches, and 2 (5%) were Known Set searches.

We have opportunities to remind people through broader and regular communications and search examples that they can search and find results with non-English terms and using non-Roman characters.

Academic Discipline

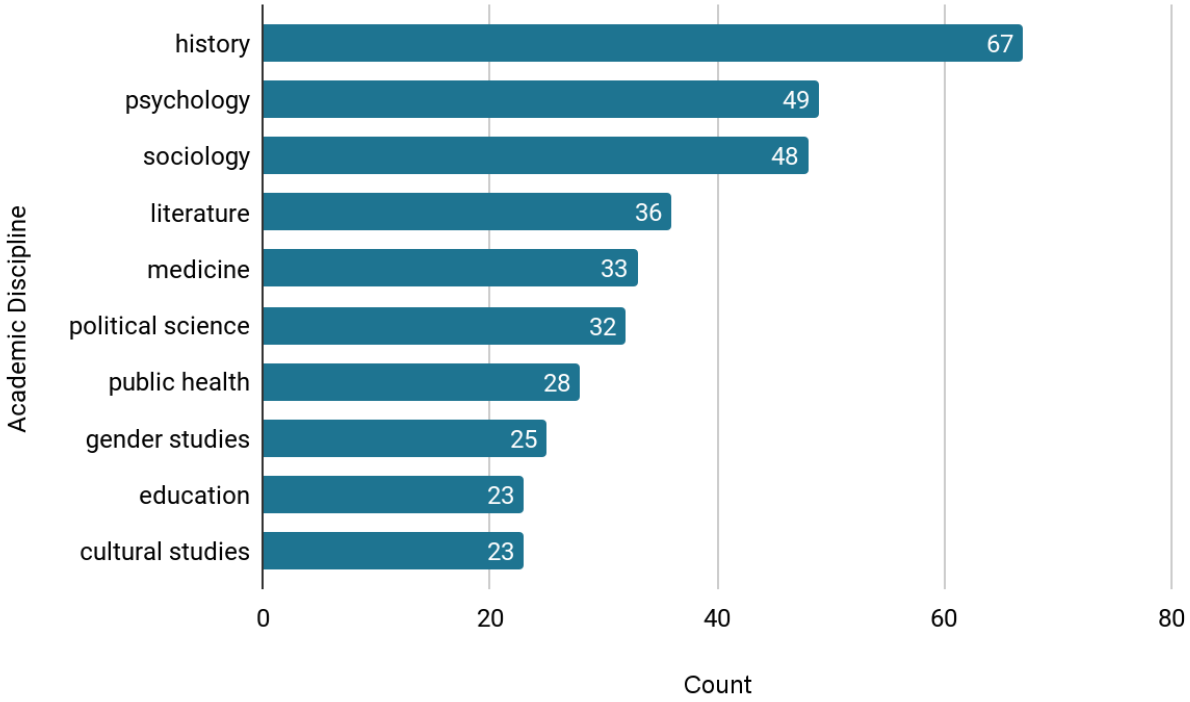
Definition: One or more academic disciplines associated with a search query generated by ChatGPT, then reduced manually to a smaller set of values.

Example:
For the search query "Under Pressure, Chinese Newspaper Pulls Exposé on a Charity" the related academic disciplines would be "Journalism, Media Studies".

Data type: Nominal *(*Each search query is associated with one or more academic disciplines.)*

Frequency distribution of Academic discipline data:

*Represents proportions percentages (Fractional Percentages) or the number of times academic discipline values appeared divided by 600 search queries. They don't add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple "Academic Discipline" values.



25 Most Common Academic Disciplines:

1. History (67 occurrences)
2. Psychology (49 occurrences)
3. Sociology (48 occurrences)
4. Literature (36 occurrences)
5. Medicine (33 occurrences)
6. Political Science (32 occurrences)
7. Public Health (28 occurrences)
8. Gender Studies (25 occurrences)
9. Education (23 occurrences)
10. Cultural Studies (22 occurrences)
11. Economics (21 occurrences)
12. Philosophy (21 occurrences)
13. Media Studies (18 occurrences)
14. Art History (17 occurrences)
15. Religious Studies (17 occurrences)

16. African American Studies (15 occurrences)
17. Linguistics (14 occurrences)
18. Environmental Science (14 occurrences)
19. Anthropology (11 occurrences)
20. Urban Planning (10 occurrences)
21. Asian Studies (10 occurrences)
22. Business (10 occurrences)
23. African studies (9 occurrences)
24. Environmental studies (9 occurrences)
25. Film Studies (8 occurrences)

View list of frequency counts of all academic disciplines across search queries.

10 Most Common Co-occurring Academic Disciplines:

1. ‘Gender Studies’ and ‘Sociology’ (6 co-occurrences)
2. ‘Public Health and Sociology (5 co-occurrences)
3. ‘Gender Studies’ and ‘History’ (5 co-occurrences)
4. ‘Economics’ and ‘Sociology’ (5 co-occurrences)
5. ‘Sociology’ and ‘Urban studies’ (5 co-occurrences)
6. ‘Medicine’ and ‘Pharmacology’ (5 co-occurrences)
7. ‘African American Studies’ and ‘History’ (5 co-occurrences)
8. ‘Epidemiology’ and ‘Public Health’ (5 co-occurrences)
9. ‘Psychology’ and ‘Sociology’ (5 co-occurrences)
10. ‘Psychology’ and ‘Public Health’ (4 co-occurrences)

View list of all co-occurring academic disciplines

Commentary

(*These values for academic disciplines were generated via ChatGPT-4o’s interpretation of search query relationship to common academic disciplines.)

History, Psychology, Sociology, Literature and Medicine are the most common academic disciplines representing search queries submitted from the “What can we help you find” search box on the homepage of lib.umich.edu. The distribution of frequency of these academic disciplines suggests a broad range of topics. History is the academic discipline with the highest number of searches associated with it (67 occurrences). All but the five top academic disciplines have below 33 occurrences. This suggests a very “long tail” of many different academic disciplines related to search queries.

Search Query Missteps

Librarians spend time teaching researchers how to approach keyword searching within Library discovery interfaces. However, researchers often use search query techniques they use in other online searches and expect similar results. They can also misspell or have typos in words, titles, or authors. Our team created a list of missteps that represented the most frequent “errors” we could infer from the search queries, which we frequently based on keyword search best practices that librarians recommend. Analyzing these missteps, both independently and against our relevance scores, reveals how they impact the discovery system's ability to deliver accurate results for both exploratory and known item searches. Our team analyzed Search Query Missteps in relation to other Search factors and Search Relevance in our In-Depth Analysis[13].

The most common search misstep—'Does not use fielded search'—has a variable impact on search relevance. While failing to use a fielded search does not always prevent users from finding relevant results, the advantage of using one is significant. Searches that used a fielded search (most often for titles and authors) were over 24 times more likely to yield high or exact relevance compared to general searches. Paradoxically, even searches (most often for titles and authors) that did not use a fielded search were still almost 18 times more likely to produce high or exact relevance results. This suggests that while fielded searches

[13] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 1.

significantly improve search precision, some searches that include titles, authors or other identifiers like ISBNs can still achieve strong relevance—though with less certainty[14].

One of the top insights from our statistical analysis is that Misspellings and typos are the single most detrimental search query misstep, reducing relevance by up to 90% in precision-critical searches like known item and known set searches[15].

Search Misstep Definition: Common 'errors' users make when entering search queries, often leading to less effective search results. These missteps are categorized based on inferred user intent and represent what would typically be considered missed opportunities to improve search effectiveness based on librarian-recommended strategies.

Here are some of the most frequent errors:

- **No apparent missteps:** When a search query doesn't have any apparent missteps.
- **Does not use fielded search:** Not specifying fields like title, author, or subject may result in irrelevant results by searching broadly across all fields instead of targeting specific ones.
- **Too few keywords:** Using just one or two broad terms often yields irrelevant results.
- **Ambiguous terms:** Words with multiple meanings or that are too generic can produce a wide range of results that are not specific to the user's intent.
- **Misspelling or typos**: Misspellings and typos can lead to irrelevant search results or even no results at all.
- **Uses natural language:** Entering full sentences or questions instead of concise keywords may only sometimes yield the best results, although commercial search engines have improved in understanding natural language queries.
- **Incomplete title:** When a user has entered just part of a title.

[14] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 14.
[15] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 1.

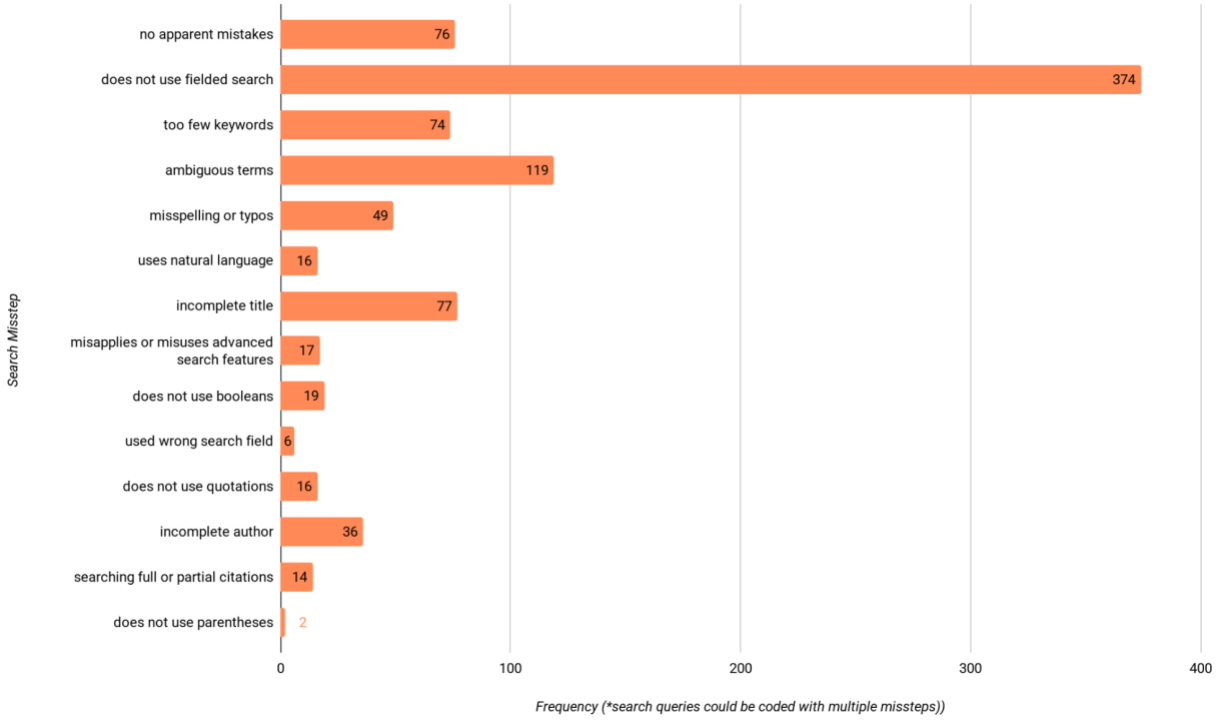
- **Misapplies or misuses advanced search features:** When a user misapplies an advanced search feature that our system would not recognize, such as "&" in the place of "AND".
- **Does not use Booleans:** Failing to use Boolean operators (AND, OR, NOT) can limit the ability to refine searches by combining terms, excluding unwanted results, or broadening the scope as needed.
- **Used wrong search field:** When user searches with the wrong advanced search field like searching a title and using the author field by mistake.
- **Does not use quotations:** Not enclosing exact phrases in quotation marks may lead to results that include individual words rather than the desired phrase.
- **Incomplete author**: When a user has entered part of an author name.
- **Searching full or partial citations:** Copying and pasting in full or partial citations does not currently return expected exact match results in U-M Library Search.
- **Does not use parentheses:** Omitting parentheses in complex queries can lead to incorrect grouping of search terms, resulting in irrelevant or incomplete search results.

Data type: Nominal *(*Each search query is associated with one or more search query missteps)*

Frequency distribution of Search Query Missteps data:

*Represents proportions percentages (Fractional Percentages) or the number of times this value appeared divided by 600 search queries. They don't add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with

multiple “Best Datastore Match” values.



1. **Does not use fielded search:** 374 (62.3% of all searches)
2. **Ambiguous terms:** 119 (19.8%)
3. **Incomplete title:** 77 (12.8%)
4. **No apparent missteps:** 76 (12.7%)
5. **Too few keywords:** 73 (12.3%)
6. **Misspelling or typos:** 48 (8.2%)
7. **Incomplete author:** 36 (6.0%)
8. **Does not use booleans:** 19 (3.2%)
9. **Misapplies or misuses advanced search features**: 17 (2.8%)
10. **Does not use quotations:** 16 (2.7%)
11. **Uses natural language:** 16 (2.7%)
12. **Searching full or partial citations:** 14 (2.3%)
13. **Used wrong search field:** 6 (1.0%)
14. **Does not use parentheses:** 2 (0.3%)

Summary

The most common “Search Query Missteps” were “Does not use fielded search” (62.3%) of all searches and “Ambiguous terms” (19.8%). Most missteps are relatively infrequent, with 9 of 14 occurring in less than 10% of searches, and 6 occurring in under 3% of searches.

Overall, Library Search is quite robust with over 80% of all search queries across search intents yielding “Exact” or “High relevance” everything results despite the presence of various “Search Query Missteps”. In our in-depth analysis report[16] we analyze the relationship between the top missteps and their impact on relevance in everything results.

The most frequent search query missteps have varying impact on search relevance. Here are a few examples:

1. **Misspellings and typos** have the strongest negative impact on search relevance across all search intents and datastores.[17]
2. **Fielded searching** significantly enhances results for known items. The probability that any Known Item search results in a High Relevance or Exact Match is 79.78%. Searches using fielded search are 24 times more likely to yield high or exact relevance compared to general searches. Even non-fielded searches containing titles, authors, or identifiers like ISBNs can still achieve strong relevance, though with less certainty.[18]
3. **Absence of Boolean operators** (AND, OR, NOT) moderately impacts relevance, with the strongest effects in exploratory and article searches. While Boolean omission is

[16] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 10.
[17] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 2.
[18] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 16.

less critical for known-item queries, it becomes essential for refining broad results in exploratory searches and for complex article searches.[19]

Best Datastore (Search Category) Match

Definition: One or more of the The U-M Library Search datastore(s) (Search categories) that have an exact or high match relevance for the search query. Ex: (catalog, articles, databases, online journal, and guides and more).

Use **datastore x, datastore y** if there are multiple matches that are promising in different datastores
Use **No Results** if the match relevance is low or if there are no results.

Data type: Nominal *(*Each search query is associated with one or more Best Datastore Match values.)*

Co-occurrence Matrix of Best Datastore Match Values:

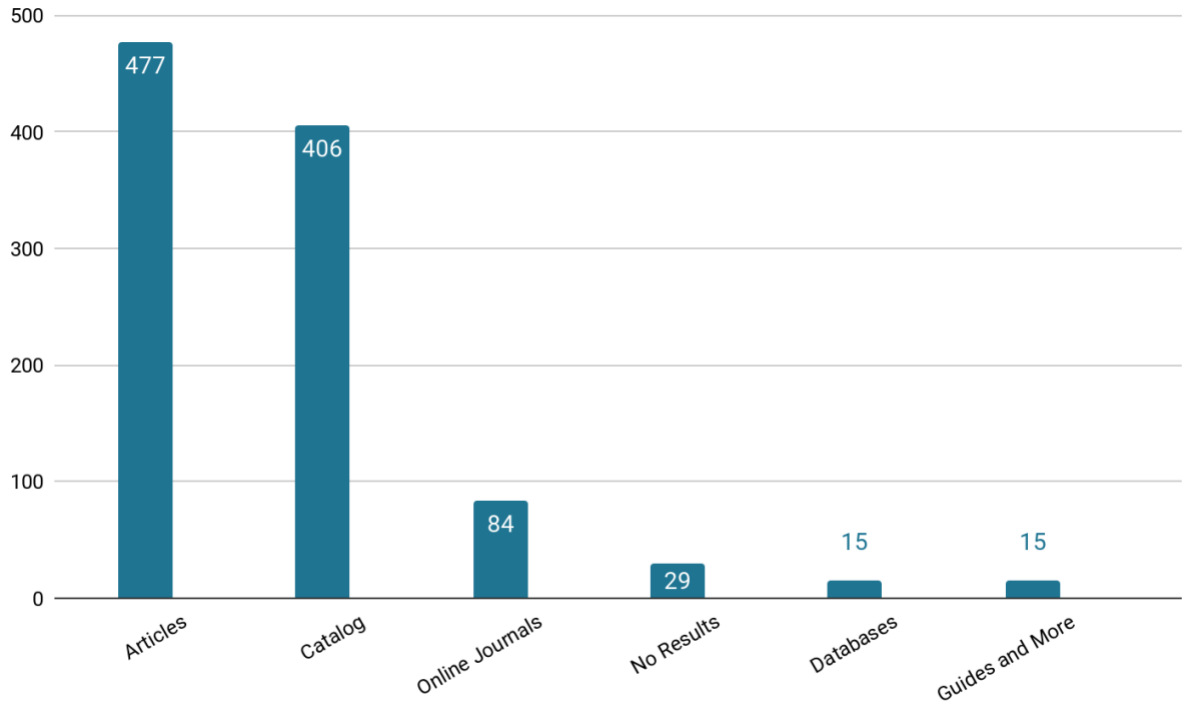
The table below shows the frequency that we marked search queries with the values of one or more search categories referred to as “best datastores”, or if there were no results.

Values	Catalog	Article	Online Journals	Databases	Guides and More
Catalog	406	316	76	14	14
Article	316	477	71	13	15
Online Journals	76	71	84	11	10
Databases	14	13	11	15	6
Guides and More	14	15	10	6	15

[19] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 21-23.

Frequency distribution of Best Datastore Match Values:

*Represents proportions percentages (Fractional Percentages) or the number of times this value appeared divided by 600 search queries. They don't add up to 100% like percentages of a whole (Relational Percentages). We do this because a query could be classified with multiple "Best Datastore Match" values.



Top Best Datastore Match Values:

1. **Articles:** 477 (79.5%)(roughly 4 of every 5 queries)
2. **Catalog:** 406 (67.6%)(roughly 2 of every 3 queries)
3. **Online Journals:** 84 (14%)(roughly 1 of every 7 queries)
4. **Databases:** 15 (2.5%)(roughly 1 of every 40 queries)
5. **Guides and More:** 15 (2.5%)(roughly 1 of every 40 queries)

Summary

4 of every 5 queries (80%) resulted in a best datastore match in the “Articles” category, 2 of every 3 queries (68%) for results in catalog “Catalog”, and one of every 7 queries (14%) for results in “Online Journals.” “Databases” and “Guides and More” had very few best datastore matches at just 1 of every 40 queries (2.5%). In the top 100 searches, 20% of search queries were known item searches for specific databases or were exploratory or topical searches where highly relevant database results appeared in our “Everything” results. 31 search queries out of 100 had “best datastore matches” that included databases as a search category where there were relevant results displayed in the “Everything” results.

Our analysis confirms that 'Catalog' and 'Articles' results best match most users' search queries, as people primarily seek individual items like books and articles. In contrast, the 'Databases' and 'Online journals' search categories serve a different purpose - they allow users to discover containers of licensed or open access resources by title, subject area, or academic discipline. Rather than finding individual content items, searches for databases and online journals help users locate platforms where they can conduct targeted research. This usage pattern supports our interface design decision to position the more frequently used 'Catalog' and 'Articles' datastores in prominent left and top positions, ensuring these results receive priority visibility in users' initial search experience.

Match Relevance

Definition: Inferred level of relevance/accuracy for the item match in the "Everything" results view of U-M Library Search, determined by our team entering the search query into the search tool and reviewing the results. Relevance was categorized in four levels: exact, high (relevance), low (relevance), and no results:

- **Exact match:** If a known item exists in one or more U-M Library Search datastores (categories) in the "Everything" results view. For known set searches of an author's name, if at least one item by the specified author (with the exact name) appears in the results, it is considered an exact match.
- **High:** If it's likely there is a promising match for an exploratory search in the "Everything" results view. For known item and known set searches, this includes

cases where the search is vague, resulting in multiple possible matches appearing in the results.

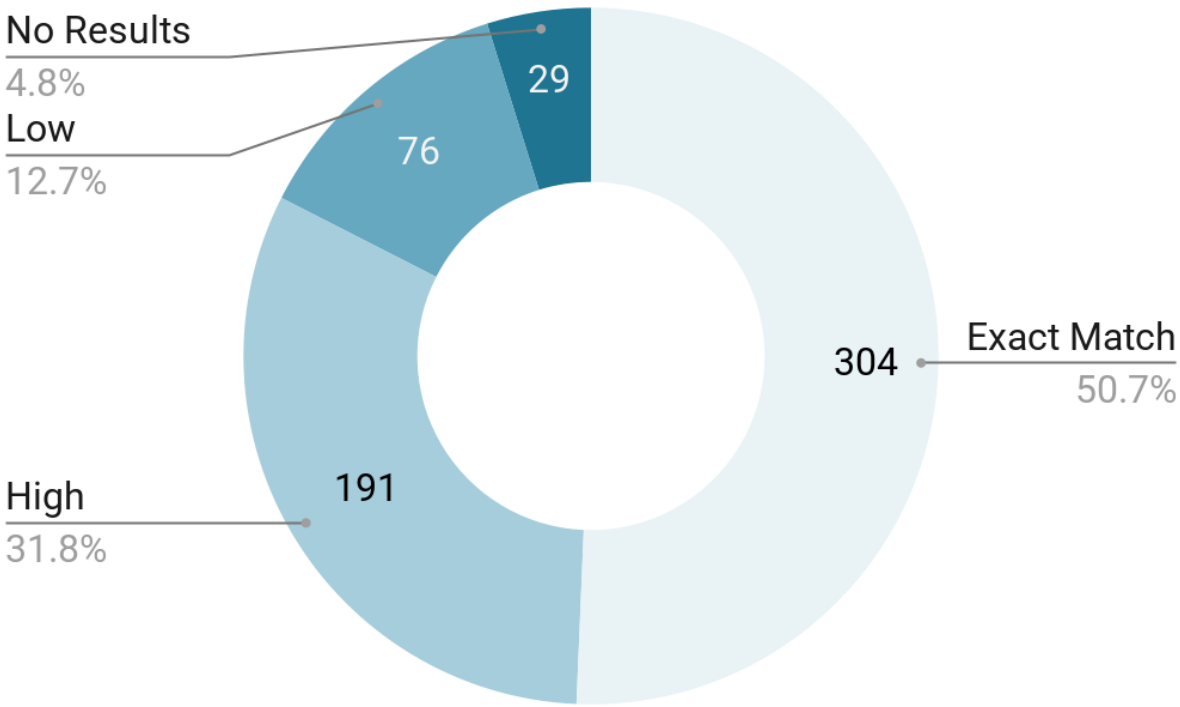
- **Low:** If there is no promising match in the "Everything results view.
- **No results:** If the user entered a query and there were no search results in any datastores.

Example: The search query, *Along the Archival Grain: Colonial Cultures and their Affective States*, yields an exact (title) match for two books in the catalog datastore and for one book and review article in the articles datastore in U-M Library Search "Everything" results.

Data type: Ordinal *(*Each search query is associated with a single Match Relevance value.)*

Frequency distribution of Match Relevance data:

*Percentages represent frequency of result relevance variables within the total number of searches (600).

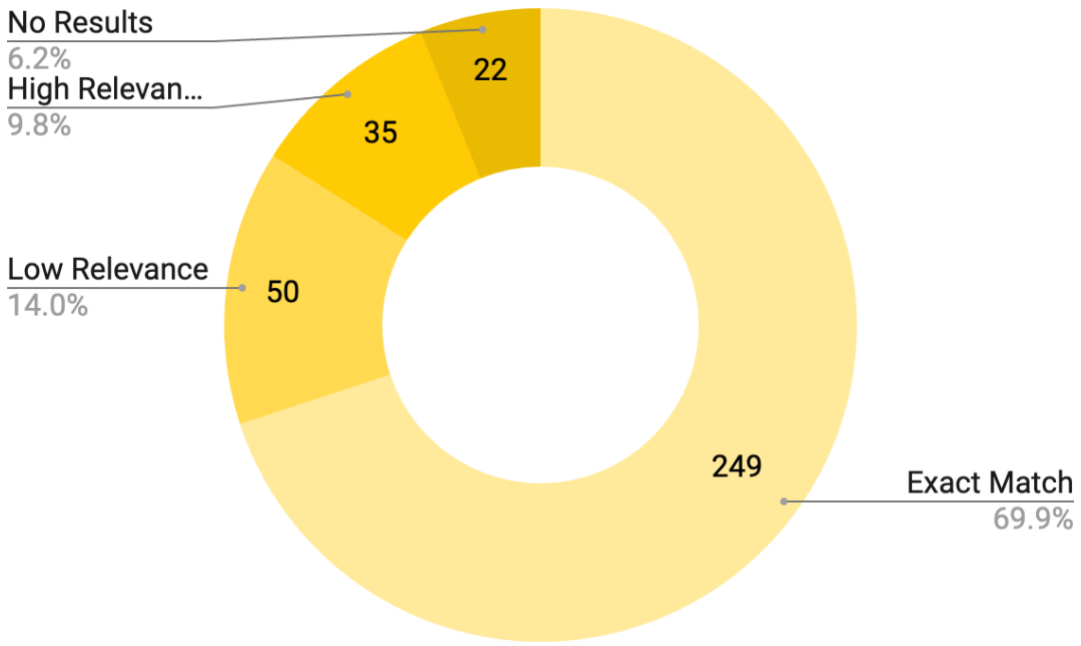


- **Exact Match:** 304 (50.7%)

- **High (Relevance):** 191 (31.8%)
- **Low (Relevance):** 76 (12.7%)
- **No results:** 29 (4.9%)

Frequency Distribution of Match Relevance data (by Known Item Search Segment)

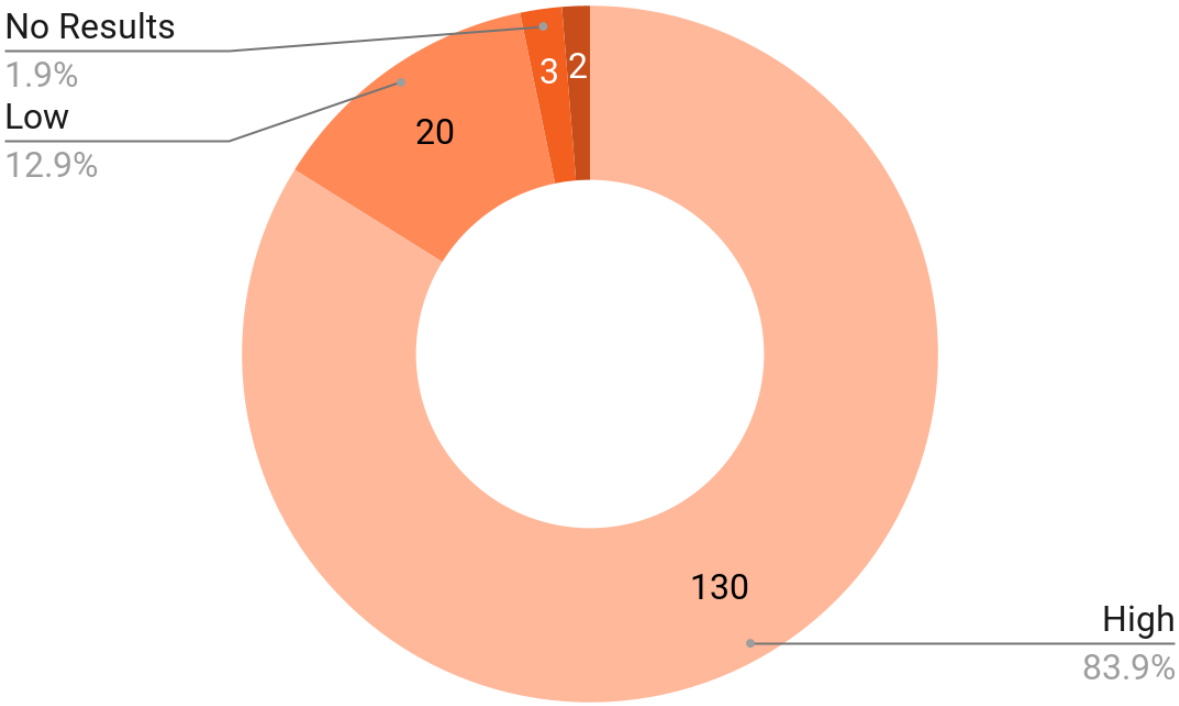
*Percentages represent frequency of result relevance variables within the total number of Known Item searches (356).



- **Exact Match:** 249 (69.9%)
- **Low (Relevance):** 50 (14%)
- **High (Relevance):** 35 (9.8%)
- **No results:** 22 (6.2%)

Frequency Distribution of Match Relevance data (by Exploratory Search Segment)

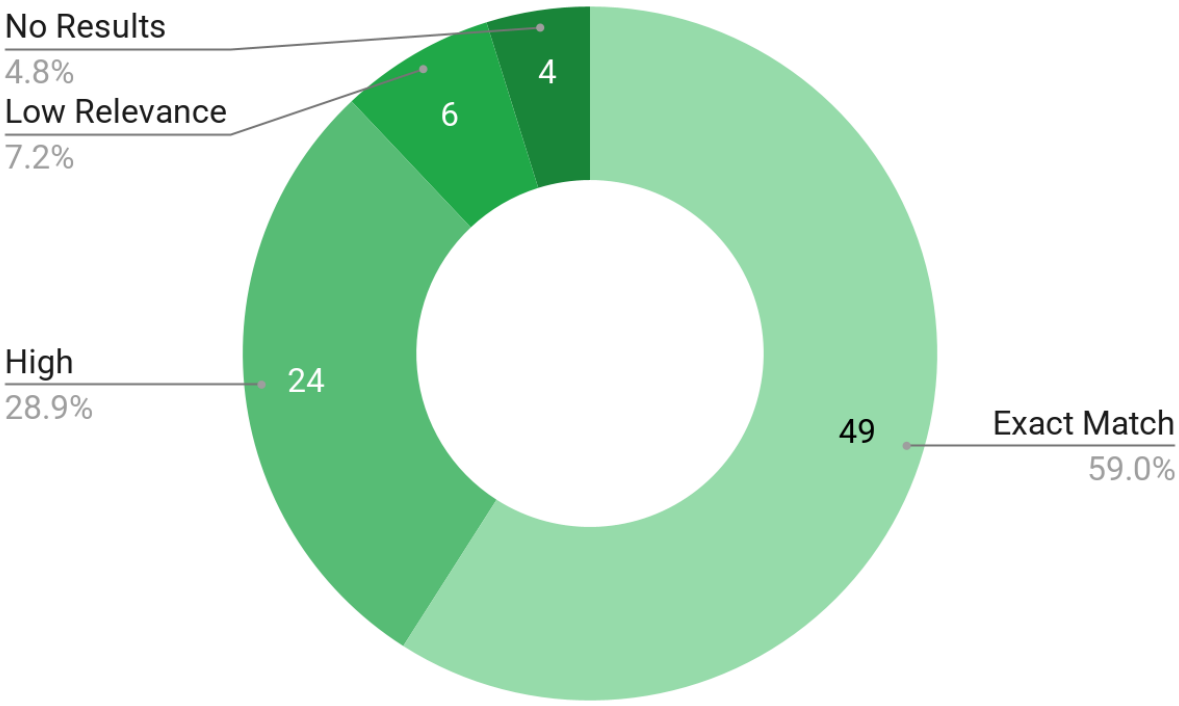
*Percentages represent frequency of result relevance variables within the total number of Exploratory searches (155).



- **High (Relevance):** 130 (83.9%)
- **Low (Relevance):** 20 (12.9%)
- **No results:** 3 (1.9%)
- **Exact Match:** 2 (1.3%)

Frequency Distribution of Match Relevance data (by Known Set Search Segment)

*Percentages represent frequency of result relevance variables within the total number of Known Set searches (83).



- **Exact Match:** 49 (59%)
- **High (Relevance):** 24 (28.9%)
- **Low (Relevance):** 6 (7.2%)
- **No results:** 4 (4.8%)

Summary

Relevance of “Everything” search results for our sample of search queries is very high with nearly 82% of all searches for all search intents (Exploratory and Known Item searches) yielding “Exact Matches” (50%) or High degrees of relevance (31.8%). Only 4.9% of all searches (Exploratory and Known Item searches) returned “No results” and Only 13.3% of searches had Low relevance in the “Everything” results view.

For “Known Item” searches, 69.9% of search queries yield “exact matches” in everything results, 14% yield low relevance results, 9.8% yield high relevance results, and 6.2% yield no results.

For known item searches specifically:

- The probability of achieving High Relevance or Exact Match is 79.78%
- The odds of success are 3.94 to 1
- Known Item searches are 15.76 times more likely to be successful than unsuccessful

For “Exploratory” searches, 83.9% of search queries yield highly relevant results in Everything results, 12.9% yield low relevance results, 1.9% yield no results, and 1.3% yield exact matches.
For “Known Set” searches, 59% of search queries yield exact matches in Everything results, 28.9% yield high relevance results, 7.2% yield low relevance results, and 4.8% yield no results.

Overall, this shows that U-M Library Search has high search relevance for Exploratory searches. Search results also show high percentages of exact results and highly relevant results for Known item and Known set searches. Despite constraints and challenges around complex cataloging and vendor data, multiple algorithms and search indexes, the majority of searches yield exact and highly relevant results for Library Search users.

However, across all search intents, there are notable opportunities to improve precision and retrieval to reduce low relevance results and no results.

Next Steps

By conducting this descriptive analysis, we uncovered several key findings about Library Search, highlighting both current strengths and areas for future improvements. Primarily, we found that most searches (approximately 75%) are for known items or sets, rather than exploratory searches. While the system is predominantly effective in uncovering exact

match resources for known item or known set searches (approximately 70% of the time), there is potential to further improve the system's ability to identify relevant resources. In addition, we found that 14% of exploratory searches yield low relevance or no results, further emphasizing the potential for improvement. Overall, this analysis shows the importance of optimizing the system's exact matching capabilities to better support resource discovery.

This descriptive analysis provides a foundation for a more in-depth analysis, allowing us to dive deeper into the impacts of user search behavior on search result relevance. In our in-depth analysis[20], we aim to answer questions such as:

- Which user search behaviors are most effective across different search intents?
- Which user search behaviors are most detrimental across different search intents?
- Which specific search query missteps correlate with lower match relevance outcomes?
- How do these query missteps impact search relevance across various datastores?
- What is the impact of specific advanced search features on search relevance?

The results of both this descriptive analysis and the in-depth analysis will contribute to a roadmap for future improvements to Library Search.

Areas we'd like to explore in future research:

1. **Search behaviors and mental models with different researcher audiences:** How different audiences (Undergraduate students, Graduate students, Faculty in different academic disciplines, Library employees) carry out known item and exploratory searches and their feedback about search relevance for different types of searches.
2. **User approaches and expectations for refining keyword and query-based searches vs conversational prompt-based interactions related to research:** Our study focused on initial search queries but did not investigate the sequences of search query refinements within and across sessions or applications. We want to observe and

[20] Hirawat, Howell, and Karabakal, "U-M Library Discovery System: Search Query and Results Evaluation - Part 2: In-Depth Analysis," 1.

better understand how researchers approach research questions and research material discovery in the context of natural language prompt and generative AI powered tools.

3. What “jobs” would people “hire” Academic Library Discovery Systems to carry out or what problems are they best at solving? What issues do researchers encounter when trying to use Library Search and what/who do they turn to for help?

Appendix

Technical Reports

1. **Hirawat, Suviksha, Ben Howell, and Suzan Karabakal.**
   U-M Library Discovery System: Search Query and Results Evaluation – Part 1: Descriptive Analysis. Technical Report, University of Michigan Library, August 20, 2024. https://doi.org/10.7302/25382.
2. **Hirawat, Suviksha, Ben Howell, and Suzan Karabakal.**
   U-M Library Discovery System: Search Query and Results Evaluation – Part 2: In-Depth Analysis. Technical Report, April 30, 2025. https://doi.org/10.7302/25407.
3. **Hirawat, Suviksha, Ben Howell, and Suzan Karabakal.**
   U-M Library Discovery System: Search Query and Results Evaluation – Part 3: Methodology Guide for Replication. Technical Report, 2025. https://doi.org/10.7302/25406.

Supplementary Materials (Available via Shared Google Folder)

- 600 Search Queries Dataset
- Codebook and Classification Schema
- Data Dictionary (Variable definitions and values)
- Analysis Logbook (formulas, classification notes, and decision points)
- Google Sheets charts and tables supporting figures in the report