



Guiding Design: Exposing Librarian and Student Mental Models of Research Guides

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abstract: This article details an open card sort study administered to undergraduate students, graduate students, and librarians at the University of Colorado at Boulder in order to reveal perceptions of library research guides. The study identifies user group preferences for organization and content of research guides, as well as themes emerging from the collected study data that contrast librarian and user mental models. Interested librarians will gain insights into student perceptions and use of research guides in academic libraries today as well as recommendations for guide design.

Introduction

Research guides are a common feature of many academic library websites. Also known as subject guides, pathfinders, or course guides, research guides often try to accomplish a complex set of goals, based on introducing digestible or tailored portions of library resources to library users. This may include teaching how to complete a given task, providing access to tools for actually doing it, promoting collections and services, educating users about the research process, and providing disciplinary context for in-depth research needs. New commercial and open source software facilitating the creation of guides, as well as greater customization and technological innovation, has been enthusiastically embraced by librarians. However, given the importance and variety of goals assigned to research guides, it can, from the authors' experience, be striking how little time is devoted to questions of pedagogy and design.

In spring 2010, four librarians from the Research and Instruction Department at the University of Colorado Boulder (CU) Libraries administered a card sort to undergraduate students, graduate students, and librarians at CU in order to explore research guide

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content and organization preferences as well as contrasting mental models of research guides. This study will detail the major user group similarities and differences exposed through the card sort, as well as the emerging themes in the collected study data. The authors also suggest changes for existing research guides. Through the authors' study, interested librarians will gain insights into student perceptions and use of research guides in academic libraries today. Finally, comparing the mental models of users and librarians will perhaps inspire reflection on pedagogical design of research guides.

Research Questions and Goals

The authors set three primary goals for this study. First, to determine which content or elements of a research guide are perceived as useful by undergraduate and graduate students. When users seek help on a library website, what do they expect to find? Is there particular content that users deem essential, extraneous, or unnecessary? In addition, do users want a research guide that teaches them how to do something, or simply directs them to the appropriate source for completing a given task?

Second, to understand students' preferred organizational scheme for such a guide. Do students prefer distinctions between material type (e.g. finding books, articles, etc.)? How would students categorize guide content or define relationships between content? What language or terminology would accurately reflect content from a students' perspective?

The third and more overarching goal was to ask librarians the same questions, to contrast student and librarian research guide design models. Previous research has demonstrated that students and librarians maintain different mental models of the research process, with students viewing the library and its services as a method for accomplishing a task (e.g. finding a given number of books or articles), while librarians see the library

as a place to, as Jerilyn Veldof and Karen Beavers put it, "learn about doing." Ultimately, the present authors aim to create research guides based on Veldof and Beavers' "mental model that works for students, and not one that simply suits librarians."¹ This study's comparison of user and designer choices provides a vivid picture of these

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Literature Review

Historically, much of the literature on library research guides has focused on the creation and content of the guides, with less attention paid to end-user evaluation or assessment.² Since the late 1990s, the technology used to create and maintain research guides

has emerged as a common topic, including the initial technology used to create online guides,³ the inclusion of Web 2.0 content,⁴ and the various software applications available to create and manage research guides.⁵ Others have studied methods of access for research guides, from the library's web page,⁶ the library catalog,⁷ course management systems,⁸ library help sites⁹ and searchable databases.¹⁰ Recent studies have focused on the evaluation and assessment of research guides using a variety of methods, including: analyzing usage data,¹¹ conducting focus groups,¹² administering questionnaires,¹³ evaluating guides using cognitive load theory,¹⁴ and task-analysis based usability testing of research guides.¹⁵

While there is an increasing emphasis on the assessment of research guides, the authors were more interested in users' mental models of research guides. Discussion of mental models began with Kenneth Craik's work "The Nature of Explanation" in 1943, where he discusses the process of thought and reasoning that "produces a final result similar to that which might have been reached by causing the actual physical processes to occur."¹⁶ The concept received considerable attention again in 1983, when three books devoted to mental models approached the concept from different angles: as a mechanism for solving verbal syllogisms (Johnson-Laird) as a representation of physical systems (Gentner and Stevens), and as a tool for comprehending language (van Dijk and Kintsch).¹⁷ Since these works appeared, the concept of mental models has been used with similar but not identical definitions by scholars in a variety of disciplines, including cognitive science, psychology, education, business, and human computer interaction. John M Carroll and Judith Reitman Olson's definition of a mental model from the field of human computer interaction is especially pertinent for the goals of this study:

The mental model is knowledge of how the system works, what its components are, how they are related, what the internal processes are, and how they affect the components. It is this conceptualization that allows the user not only to construct actions for novel tasks but also to explain why a particular action produces the results it does.¹⁸

The knowledge of systems is based on previous personal experience,¹⁹ and those previous experiences inform user expectations for information systems. Understanding the patterns of expectations target user groups have of information systems is critical to selecting content elements that users would likely find productive as well as the goals, strategies, and problem solving techniques that form the users' information-seeking process.²⁰

Methodology

Given the key goals of this study, the authors chose to conduct an open card sort, commonly used by information architects to, as Angi Faiks and Nancy Hyland put it, "discover users' mental models."²¹ Card sorting is a usability technique that gives information system designers a better overall understanding of how users think information should be organized and labeled. Card sort data can guide content organization, categorization, decisions on what information should be included or excluded, as well as the terminology and labels that make the most sense to users.²² A card sort requires participants to take a set of cards, with each card representing example content, and to



sort the cards into categories. In an open card sort, the participants invent their own labels for the categories they create. In a closed card sort, participants sort the cards into pre-determined categories.²³ Experts generally recommend using at least ten (and up to thirty) participants of a particular user type, and anywhere between twenty and one hundred cards for the sort.²⁴

The card sort technique has been used in several studies within library and information science in the past decade (table 1). Primarily, these studies used the card sort

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technique to inform content selection and navigation design for library websites. The authors of these studies included a range of total participants (between seven and forty) and total number of cards sorted (between thirty-one and one hundred and eighty-five). The chosen methods of analysis also varied from the use of

statistical software to analyze the data and spreadsheets that make it easy to discern the key patterns that emerge from the collected data.

Following recommended best practices, the authors used posters, social networking posts, and email to recruit ten participants from each of the three groups of specific users: undergraduate students (U), graduate students (G) and librarians (L) at CU. In order to determine the content that should be represented on the cards, the authors reviewed existing CU Libraries' research guides and established a list of forty-three core content items (table 2). Content items were then printed on separate cards and numbered for ease of identification. During the card sort session, a facilitator invited participants to organize cards into categories talking aloud as they placed the cards. The facilitator encouraged participants to discard irrelevant cards and to ask for clarification of a card's meaning when necessary. After categorizing or discarding the cards, participants were prompted to name each category of cards. Finally, participants were invited to write any content elements or resources that were missing from their organizational structures.

The card sort sessions were recorded by two to three observers who were responsible for transcription of participants' verbal communications and body language. The recorders also collected each participant's organizational structure with a digital camera image and manual notation. The pre-session survey collected demographic and prior library experience details, while the post-session survey offered an opportunity for final comments and suggestions. The recorders' notes, as well as participant survey responses, were consolidated in order to enable consideration of all participant data collectively.

Analysis Tools and Steps

To generate a summary of the card sort sessions and view participants' results holistically, the authors chose to use the card sort analysis spreadsheet created by Donna Spencer.²⁵ The spreadsheet, designed to facilitate exploratory card sort analysis, records the cards included, cards discarded, card groups, and category names assigned by each participant, as well as correlating relationships between cards, categories, and participants.

Table 1
Card Sort Studies

Authors	Year	Page Types	# of Cards	Participants	Analysis Method
Faiks and Hyland	2000	Help pages	50	12	Spreadsheet + Statistical Software
Felker and Chung	2005	Main library website	90	Unspecified	Statistical software
Hennig	2001	Main library website	100	9	Statistical software
Lewis and Hepburn	2010	Main library website	93	15	Statistical software
McHale	2008	Main library website	44	24	Spreadsheet
Nikkel and McKibbin	2008	Main library website	185	26	Spreadsheet
Robbins et al	2007	Main library website	68	15	Spreadsheet
Rowley and Scardellato	2005	Teen gateway/virt. Ref. library	70	7	Spreadsheet
Turnbow et al	2005	Main library website	76	40	Statistical software
Ward	2006	Main library website	Unspecified	Several	Unspecified
Whang	2008	Main library website	31	15	Spreadsheet



Table 2

Labeled Cards

1 Research a person / author	16 Research a title – books	31 Keyword combination strategies
2 Printing	17 Research a title – articles	32 Evaluating information
3 Study rooms	18 Research a title –web	33 Refworks information
4 Copying	19 Researching background and history	34 Citation guides
5 Laptop checkout	20 Language resources	35 Research a theory –web
6 Course reserves	21 Researching a theory	36 Research current affairs – books
7 Chat with a librarian	22 News	37 Research methods
8 Off campus access	23 Research a theory – books	38 Data and statistics
9 Maps of libraries on campus	24 Research a theory – articles	39 Researching current affairs – articles
10 Maps of where to find books	25 Contact Information	40 Research current affairs – web resources
11 Researching a title/ work	26 Check out a book	41 Research background and history – books
12 Researching current affairs	27 Use find it at CU	42 Research background and history – articles
13 Research a person – books	28 How do I cite	43 Research background and history – web
14 Research a person – articles	29 Focusing a topic	
15 Research a person – web	30 Developing keywords	

The authors used this spreadsheet to gain a comparative picture of participant card sort sessions and patterns within and between participant groups, and relied on participant narratives and survey responses for additional detail.

Study Participants [B head]

The study included a total of thirty participants, forty percent male and sixty percent female, representing three user groups: undergraduate students, graduate students, and librarians at CU. The twenty student participants represented library users from the humanities (25 percent), the social sciences (30 percent), sciences (35 percent) and other departments (10 percent). Student participants represented a range in academic status: 2nd year undergraduates (15 percent), 3rd year undergraduates (25 percent), 5th year undergraduates (10 percent), masters candidates (25 percent) and PhD candidates (25 percent). With the exception of one undergraduate student participant, all participants had used the library web page previously and with some frequency (see table 3). Participants reported high levels of comfort with locating scholarly sources (see table 4), and most had experience with performing specific types of information seeking tasks. (see table 5)

The librarian participants ranged from recent hires with fewer than two years of experience to those with nearly thirty years of experience, but all were involved to some degree in the creation and design of research guides.

Results

Research Guide Content: Cards Included, Excluded, and Added

Overall, participants included eighty-six percent of the forty-three cards in the sort (see table 6). Of the cards included, the most popular cards were “keyword combination strategies” (30 participants), “citation guides” (29 participants), “developing keywords” (29 participants) and “contact information” (29 participants). Most undergraduate student participants included every card; due to this low discard rate (1 percent), the undergraduate students did not reveal favored or most popular cards (see table 6). Graduate student and librarian participant groups discarded with greater frequency; however, the most popular cards of gradu-

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ate students differed from those of librarians. The most popular cards included by all librarian participants indicated a prioritization of contact and informational elements, for example: “chat,” “contact,” “how do I cite,” “citation guides,” “keyword combination strategies” and “data/statistics.” On the other hand, the graduate students favored cards representing specific types of research and research materials. Cards used by all graduate students included: “research a person [books, articles, web],” “research background and history,” “keyword combination strategies” as well as “off campus access.”



Table 3
Frequency of Use

	Undergraduate N=10	Graduate N=10	Total
Daily	3	3	6
Weekly	4	4	8
Monthly	1	2	3
Rarely	1	0	1
Never	1	0	1
Other	0	1	1

Table 4
Comfort Level with Locating Scholarly Sources

	Undergraduate N=10	Graduate N=10	Total N=20
Very comfortable	1 (10%)	9 (90%)	10 (50%)
Comfortable	8 (80%)	1 (10%)	9 (45%)
Not very comfortable	1 (10%)	0 (0%)	1 (5%)

Table 5
Experience Performing Specific Tasks

	Undergraduate N=10	Graduate N=10	Total N=20
Find a book	8 (80%)	10 (100%)	18 (90%)
Find an article	9 (90%)	10 (100%)	19 (95%)
Locate full text	9 (90%)	10 (100%)	19 (95%)
Find help resources	4 (40%)	7 (70%)	11 (55%)

Table 6

Overview of Card Use

	Total	Undergraduate Students	Graduate Students	Librarians
Total cards reviewed:	1290	430	430	430
Total discarded:	186	3	86	95
Total included:	1104	427	344	335
Percentage discarded:	14%	1%	20%	22%
Percentage included:	86%	99%	80%	78%

The graduate student participants eliminated cards when the card content was not related to their field of study or personal information seeking habits. Half of the ten graduate students eliminated cards representing current affairs information sources because this content was not relevant to their field of study, as this comment surmises, "I don't know, it's [current affairs] important, but I don't research current affairs" (G). The graduate students' comfort level and familiarity with the standards of their field, like citation style or primary language, explained the elimination of other content elements like language, citing and statistics. While there were no significant patterns in librarian participant discards, their comments revealed a similar disciplinary approach. Noteworthy was the tendency for librarians and graduate students to eliminate cards practical in nature.

Participants discarded only three cards: "news," "data/statistics," and "research background and history." When undergraduate students did not discard the "news" or "data/statistics" cards, they frequently placed these cards in a category without additional cards. The "news" and "data/statistics" cards were each questioned by ten of the thirty participants, indicating confusion about what the cards represented or how one might use them for research purposes. Other highly questioned cards included: "language resources" (twelve participants) and "RefWorks" (ten participants).

During the card sort sessions, the authors asked the participants what content elements of a useful research guide were not represented by the cards. Several graduate student participants noted the omission of specific format types such as theses/dissertations, white papers, archival materials, and rare materials. Graduate students also recommended advanced keyword searching strategies and database-specific

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Table 7

Discards: Practical Cards

	All	Undergraduate Students	Graduate Students	Librarians
Laptop check-out	7	0	3	4
Study rooms	6	0	3	3
Course reserves	6	0	3	3
Printing	5	0	2	3
Copying	5	0	3	4
Check out a book	5	0	2	3

thesaurus and indexing help. Other students recommended that the focus of the research guide extend beyond the library and recognize the entire research process. For example, both undergraduate and graduate students suggested links to the campus writing center and more detailed information on the dangers of plagiarism.

Research Guide Organization: Categories and Naming

To begin the process of comparing participant organization results, the authors assigned standard category names applied to all user's categories that represented similar concepts, either in terminology or idea.²⁶ This process was relatively straightforward when participant naming was similar. "Citation help," "Citation management," and "Citing stuff" are examples of participants' original category names assigned to the standard category "Citation." However, other categories differed in original naming but were similar in terms of content. For example, the authors standardized labels such as "Finding things," "Practical," and "Nuts and bolts" into one category titled "Help – finding and services." The language chosen for each standard category either clearly represented category content or used consistent participant category naming terminology. A total of eighteen standard category names were assigned (see table 8).

The authors explored the standard categories in detail and generated category summaries, which included the number of participants who created a specific category, the average number of cards placed in a category, the original category names, and the unique or consistent cards in the category. During this stage of analysis, the authors referred to session notes and participants' narrative comments in order to identify other details such as the cards that prompted participants' questions. The authors identified core themes and significant observations seen in the category reports, including what reinforced expectations, what conflicted with expectations, and whether there was significant agreement or disagreement between participants and participant groups.²⁷



Table 8

Categories

Standard Category	TOTAL N=30	Undergraduate N=10	Graduate N=10	Librarians N=10
Research process	29	10	9	10
Help [Finding + Services]	18	7	5	6
Research [Author]	18	6	7	5
Research [Title]	18	4	9	5
Research [Theory]	17	4	7	6
Research [Background]	16	4	6	6
Research [Current affairs]	15	5	4	6
Citation	13	3	2	8
Contact	13	4	5	4
Help [Services]	12	4	4	4
Help [Finding]	10	4	4	2
Data/ Stats	8	1	5	2
Other formats	6	3	0	3
Course	5	0	5	0
News	5	5	0	0
Books	4	3	0	1
Web	4	3	1	0
Articles	3	2	0	1

The number of categories originally created by each participant ranged from four to twelve across all user groups. On average, undergraduate and graduate student participants created eight categories, and librarian participants created seven categories.

Importance of Format or Need Driven Schemes in Guide Design

Overall, participants demonstrated a preference for an organizational scheme driven by a specific research need as opposed to resource format. For example, only four participants (three undergraduate students and one librarian) created categories grouped under the standard label "Books" which included cards such as "researching an author – books," "researching a title – books," "researching a theory – books," and "researching background – books." When naming format driven categories, participants consistently assigned simple category names, such as: "Researching Books," "Books" (two participants), and "Book research." The more popular organizational strategy was to create categories like "Research an Author" which included cards such as "Research an author – books," "Research an author – articles," "Research an author – Web." While completing



the card sort, users often narrated their typical approach and a specific need they might be satisfying. For example, a graduate student in English explained how her process is typically directed by a need for information on a specific author or work. She would begin searching for the author or work with less consideration of the information's format (book, article, Web resources). Many users repeated this need-driven approach and only included cards that led to various formats (books, articles, Web) within categories for "Research – background," "Research – author," "Research – title," "Research – current events," or "Research – theory." When naming these categories, five participants assigned simple category names like "Person/ People," while six others mimicked the language on the original card and assigned names such as "Researching a person," still others applied unique names like "Types of research – person," "Do some research – person," "Find a resource – person." The results did not present significant distinctions in naming trends between user groups.

Importance of Research Process in Guide Design [B head]

Analysis revealed that nearly all participants (29 participants) created a "Research process" category, which focused more on providing help within the context of the research process rather than on specific resources or resource formats. In addition to the near-universal adoption of this category, the most often used cards from the sort tended to be included here. Cards commonly placed in this category by all user groups included: "Focusing a topic," "Developing keywords," "Keyword combination strategies," and "Evaluating information." While there was agreement on the creation of the category, there was little agreement on what to name it. The original category names are included in table nine.

There were also differences in the way the participant groups approached the "Research process" category. The nine graduate student participants who created this category generally had similar approaches to the scope and selection of the cards included. Typically including five cards on average, the graduate students appeared to be more aware of the difference between the cards that referred to tools or resources and those cards that represented elements of the research process. Librarian participants also tended to include a small number of cards (5.2 cards on average) focused on the research process in this category.

When creating the category, one of the graduate students expressed his personal approach clearly as he sorted the cards:

I think I will approach this like a research project I worked on. The way I approach doing research is to begin with a broad topic or subject, and then move towards a specific approach, and then to an idea...So I start with developing keywords...I always start with keyword. And of course narrow. And aside from that I look for background and history.

Other graduate students also explicitly mentioned their personal or disciplinary research process: "I'm trying to think in my head normally how I go through the process" (G); "That's normally how I tend to research" (G); "So since I'm in Classics, I'd probably start with language resources" (G); "When I think about research methods, I'm not thinking about the library. I'm thinking about a literature review, the preliminary part of the research process" (G).



Table 9

Original Names for the “Research process” Category

Undergraduate students	Graduate students	Librarians
1. Help	1. Information organization	1. Get better at research
2. How to do research	2. Specific keyword strategies for resources	2. Subtopics
3. Research methods	3. Research methods	3. Developing a topic
4. Help	4. Revising/interpreting	4. Research strategies
5. Library help	5. Help	5. Developing a topic
6. General research	6. How to use the library	6. Getting started
7. Research tips	7. Focusing a topic	7. Research prep
8. Evaluate	8. Research process	8. Research help
9. Refine research/ honing your search	9. Dissertation help – Start/Finish	9. How do I research
10. Research tips		10. Help from a librarian

In contrast, for the undergraduate student participants, the “Research process” category appeared to be more of a “catch-all,” heterogeneous category that included both process-related cards and cards representing resources. The undergraduate students included fifty percent more cards (10.3 cards on average) and had three times as many unique cards in this category than graduate student participants and approximately two times as many unique cards as librarian participants.

The categorization of the citation-related cards and their relationship with the “Research process” category showed significantly different approaches between the student participants (undergraduate and graduate) and librarian participants. Both undergraduate and graduate students tended to see citation-related content as an integral part of their research process.

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participants (undergraduate and graduate) and librarian participants. Both undergraduate and graduate students tended to see citation-related content as an integral part of their research process. In contrast, librarians seem to see citation resources as separate from the research process. A few of the comments made by librarian participants speak to this: "I'm putting all the research stuff over there, and then... all the citation stuff over here" (L); "I'm going to break out citation information into a sort of subcategory" (L); "I sort of see an 'I've done my research group' - citation, Refworks" (L). This may reflect the librarians' "library-centric" view, since librarians are often not involved with student activity throughout the research process.

Importance of Help Elements in Guide Design

Also significant was the creation of "Help" categories by twenty-eight participants: all undergraduate student participants, nine graduate student participants, and nine librarian participants. The cards in "Help" categories included directions for finding and operating technology, such as copying and printing, instructions on accessing resources from off campus, and using the open URL resolver. Other cards included "check out a laptop," "study rooms," "maps," and "reserves." Eighteen participants chose to group all help-related cards together while others attempted to create one or two subdivisions. However, the distinctions between subdivisions were not necessarily clear to the authors nor were sub-divisions consistent between participants. One graduate student vocalized this struggle: "I'm trying to figure out what would go together, but I feel like I am getting too many. Should I separate a maps chunk, or a technology chunk?" (G), while an undergraduate student who grouped all cards together explained the association as "topics best answered by a librarian" (U).

Overall there was not a high level of agreement on what to name or how to categorize help related cards, neither within nor between user groups. Original "Help [finding]" category names included terminology such as: "Where/What" (U), "Find it at CU" (U), "Maps" (U), "Research support - local" (G), or "How do I" (L). Original "Help [services]" category names included terminology such as: "Research support tools" (G), "Important information" (U), "Services" (U), and "Where things are" (L). And original "Help [finding and services]" names included terminology such as: "Library help" (U), "Useful links" (U), "Nuts and Bolts" (G), and "Practical" (L).

The lack of consistency was further underscored by participants' decisions to include or exclude contact information in "Help" categories. Several participants chose to include the "contact information" (13 participants) and "chat with a librarian" (11 participants) cards in the "Help" categories. However, thirteen participants created a separate "Contact" category which generally included "contact information" and "chat with a librarian." Undergraduate and graduate students named this category: "Contact" (U, G), "Real time assistance" (G), or "Contact Information" (U). One librarian replicated this naming trend: "Contact" (L). However, all other librarians (4) creating this category applied names that indicated help: "Help," "Getting help," and "Need more help."

Through extended analysis of participants' "Help" categories, the authors recognized that the "Help" cards varied considerably in terms of content, format, and detail. All of the included cards represented content designed to support a user's information seeking

process through user services, directional information, or extended learning opportunities. Broadly, all of the cards included in help categories are designed to assist users, but the users' end experience might vary significantly. For example, a link to "reserves" will take users to the reserve catalog where they may search for a course. Selecting a map will typically take a user to an image file. Choosing a link to "off-campus access," a user may view a four-minute learning video. Or a user may choose "chat with a librarian" where synchronous learning can occur.

If content were grouped together on a live research guide, this range and variety could make it difficult for users to anticipate and choose the help element appropriate for their needs and preferences. Many of the "Help" cards also varied in terms of detail and level of assistance, further complicating a

user's ability to choose appropriate content. Some users might expect simple instruction in the form of quick links and brief text, while others may prefer in-depth learning tools.

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Research Guide User Distinctions

Students: Needs and Preferences

Research guides are generally created to meet both introductory and advanced user needs. However, analysis of the students' "Research Process" and "Help" categories show distinct differences between graduate and undergraduate students. Consistent patterns show that undergraduate student participants had a tendency to include more cards. Yet, despite the one percent undergraduate discard rate, these results directly contradict undergraduate student comments, which indicated that library web pages appear cluttered, overwhelming, and do not present a clear path where to begin. Furthermore, undergraduate students included cards even if they did not know what the cards meant or had never before used what the cards represented: "A lot of these things I've never done – like talking to a librarian" (U). This contradiction indicates a lack of clarity about what resources undergraduate students feel they need for research and a lack of confidence in choosing appropriately. In contrast, graduate student participants were more selective, eliminating cards known to be irrelevant. Graduate student participants spoke extensively about the specificity of their research or disciplinary needs and they discarded accordingly. This demonstrates visible evidence of distinct needs between novice researchers and experienced researchers, and, by implication, the potential role of research guides to help bridge this gap.

Additional evidence of varying needs and preferences was gleaned from student comments during the card sort sessions, specifically related to tools for "doing" versus tools for "learning." Comments revealed a range in participants' mental models, including those who race through the research process and those who value learning and exploring while researching.²⁸ For example, one graduate student stated, "I want to just do it. I don't always need something showing me how... I'd like less text and instead



something that just points me to it and I can go" (G), while other students, both graduate and undergraduate, expressed the desire for advanced help and learning tools. Another graduate student described a design that integrated both, "So here's the tutorial information, and then the real-life trying" (G). It is also probable that a single user, novice or experienced, might want quick help at one stage, but in another scenario might need a more in-depth learning opportunity.

These findings emphasized the need for flexible research guides designed to satisfy these varying student demands. The authors concluded that users should be able to easily choose elements matching their desire to "do" or to "learn." To facilitate this flexibility, content should be clearly distinguished in terms of actions (learn/do), level (novice/experience), and format (text/video). In other words, students should be given clues as to what they will encounter, and, as Veldof and Beaver point out, "be adequately prepared to enter a 'learning' environment, rather than a 'searching' environment."²⁹ Furthermore, the authors concluded that help and learning elements interspersed throughout research guides would improve students' ability to choose learning opportunities where and when it matched their need. These revisions will demand extended user feedback and continued testing.

Librarians: Beliefs and Practice

In contrast, librarians often have a very fixed view of research, which steers and legitimizes their research guide design. Nonetheless, previous research has shown that students and librarians have different mental models of the research process.³⁰ Veldof and Beavers, in their work comparing student and librarian mental models, write: "The logical extension of the belief that the librarian's model is the ideal to which students must aspire drives librarians to fight, cajole, motivate, and hope that students will eventually 'get it' and be liberated of their faulty working models."³¹ During card sort sessions, several of the librarian participants made comments that demonstrated an awareness of the difference between their "librarian" organization of guides versus what they think students would want: "Should I be thinking of this as a research guide for my research or for what I think students would like?" (L); "I would be interested to see how your students did this, because I'm sure it would be different" (L); "As a librarian I'm apt to start with the background stuff first but I don't think the students do, so do I force them to or put the things that they might use more first?" (L).

While librarians recognize that students approach research differently, research guides often reflect librarian models of research rather than replicating student preferences. A survey of current CU Libraries' research guides shows that most are structured by format (organized by finding Books, Articles, and Web Resources, for example) rather than by student assignment, need, or habit. This design con-

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tradicts a number of librarian comments recorded in the study: "Most important thing

you can think of is how the students will approach it" (L); "I don't think that students really... I don't think they seek out books specifically, I just think they seek out information, I think I'm going to switch that organization" (L). This contradiction is particularly significant because according to student card sorts, students do not approach research by format; it was the least popular card organization scheme.

A second contradiction between librarian comments and the existing research guides was evident in librarians' discard rate. Earlier in the card sort, students claimed that library web pages were overwhelming and cluttered. These observations would imply that librarians hesitate to eliminate content from research guides, yet, at 22 percent, the librarian participant discard rate was the highest of all participant groups. While the librarian participants clearly consider and recognize user mental models and needs, there remains a contradiction between espoused and enacted pedagogies.³² These findings highlight the need for continued and thoughtful conversation about instructional design as applied to research guides. In particular, the authors hope to encourage reflection among librarians on how user mental models and teaching pedagogy might be more accurately articulated in research guides.

Limitations of the Study

Through the analysis of results, the authors identified a few limitations of the study design and the card sort method. The card sort did not completely reflect complex and linked organizational schemes, which often characterize web-based resources. For example, several participants arranged categories in a pyramid-like structure, with "research process" at the top of the pyramid and subcategories for "research an author," "research a title," "research background," and "research a theory." Once data was in the card sort analysis spreadsheet, however, these complexities were flattened to enable numerical totals and comparison. Additionally, participants often expressed the desire to place cards in multiple locations and to customize for context. For example, participants might place appropriate maps with specific research needs, or place "Ask us" in several locations, but the physical card sort required users to choose only one location for each card. While the category and card figures may not reflect these complexities, they are present in the narrative documents and will contribute to future directions and studies.

The authors also learned the importance of carefully naming and defining cards when designing a card sort. In this study, several cards began with "researching a [person, title, theory, current affairs, or background and history]." It is conceivable that the repetition of language may have encouraged participants to group those cards together. How participants interpreted the meaning of a card may have also impacted sorting results. The session facilitator instructed participants to ask questions when a card's meaning was unclear, at which point, the facilitator would provide a verbal definition and clarification. In future studies, the definition and content type could be carefully defined on the back of each card, which would improve consistency in how participants interpreted cards.

Despite these limitations, the card sort method successfully explored which components of research guides participants find productive and useful. Furthermore, the method successfully revealed participant mental models, including their strategies and



problem solving techniques applied to the research process. The authors recognize that these results are not generalizable and instead provide richly nuanced details about local user populations. This exploratory study improved the authors' understanding of users at their institution and generated hypotheses that will guide future research guide iterations and future user-driven studies.

Changes Inspired by Study

The authors identified both actionable and ideal changes that could be made to research guides based on the results of this study. Overall, the research showed that guides must reflect student's mental models of the research process rather than the librarians' mental models. This is manifest in three key areas: First, users need to understand what type of research guide is being provided (learning tool, a list of subject resources or something else completely). Second, users need research guides to fit in better with the user's research process and context. Third, users require research guides to be flexible and adaptable enough to meet the different levels or needs within individuals' mental models.

Faced with these identified requirements, the authors established a list of feasible revisions given the technology and time challenges at CU. First, to provide clarity between the learning and doing aspects of the research guide, the authors plan to ensure greater definition regarding what type of resource is being provided through the research guide. The central focus within this goal will be on improving help documentation and, more specifically, how to distinguish between different types of help, such as that between "Where is the printer" and "How do I use the printer." The authors propose to offer more contextualized help tools, for example, maps or tutorials at the point of need, which a user may choose to use or ignore depending on whether their focus is "learning" or "doing." The authors will also look at the introduction of visual cues for different types of help, to clarify these help distinctions to the user. All these plans necessitate continued attention to appropriate vocabulary choice, and, in particular, greater precision when using the words *Help* and *Contact*. These changes, while quite feasible, to be effective will require collaboration between all librarians who create research guides.

Second, to better represent the users' process and context, the authors propose to rethink the format-based categories (e.g. division by books, articles, etc.) currently serving as the primary organizational scheme for research guides at CU. The authors will explore alternative organization methods, such as the stages of the research process, or a specific assignment, task or goal. The authors will also include campus services such as the Writing Center as an additional means to situate guides within the user process from research to writing.

Finally, to accomplish the goal of making guides adaptable enough to meet various levels and representations of mental models, the authors plan to investigate branching options within the research guide that would adapt to an individual's need or level. This could include presenting users with a selection or menu of potential elements of the research process that could be adapted to fit their own mental models. Another potential solution would be the creation of specific, core undergraduate research guides. Reaching these goals could be challenging within CU's current technology infrastructure, without a content management system or other tools for creating and maintaining complex subject guides.

Additional Questions and Analysis Needed

The authors learned a great deal about local user preferences and behaviors, and this study provides several avenues for additional research. Responses from the post-session survey revealed a need for greater user education and outreach to promote existing services. Participants frequently suggested services the library already provides (like reference services via instant messaging) or suggested additions to the content of library web pages that were already present. Additional

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education and outreach efforts, along with a careful streamlining of all library web pages, not just research guides, could greatly increase student awareness of available services. Research guides could also be promoted as a resource for both learning and doing, depending on user needs.

The authors also see a need for creating an iterative evaluation cycle for research guides. Future evaluative efforts could include faculty, teaching assistants, or other user populations not included in this study. As part of the evaluation cycle, changes to guides inspired by this and future studies must also be tested. Such testing could take the form of paper prototyping, situational task analysis, and other methods to determine if changes adequately meet user needs.

A second part of the recurring evaluation process should look at advances in technology. This study focused on traditional Web-based research guides. However, with the growing number of mobile devices on campus, as well as increasing numbers of mobile friendly research resources, it is evident that the design of mobile research guides may be equally important in the future. The few studies that have examined student mobile research habits point to an increased reliance on “info snacking” or short, discrete and less task-based interactions.³³ Combined with the physical and connection restrictions of mobile devices, it is clear that mobile research guides cannot merely be miniature versions of full size subject guides. While studies like this one will prove to be a good starting point, designers will need to adapt their concept of instructional design, information literacy skills and even, perhaps, usability methodologies considerably in order to meet these new challenges.

In addition to future directions for research outlined above, the authors also anticipate the eventual necessity of examining local resources available for the creation and maintenance of research guides. The diverse requirements of target user groups reveal a demand for more flexible and functional technology than currently available. If recommended changes are not feasible or practical given current resources, new tools might be required, including various open source or commercial products.

Conclusion

This study illustrated that undergraduate students, graduate students, and librarians do indeed have differing mental models for the inclusion and organization of content in



research guides. As one might expect, both librarians and graduate students tended to create research guides designed to meet specific disciplinary needs. In contrast, undergraduate students demonstrated less confidence in their ability to choose appropriate resources for their research need. Interestingly though, it was undergraduate students and librarians who showed significant differences in their espoused versus enacted preferences during their card sort sessions. While undergraduate students professed a desire for simpler, leaner research guides, they discarded almost no cards. Librarians' behavior and comments during their card sort sessions did not always match existing guides. Nonetheless, all three groups demonstrated a need for greater attention to basic components of the research process, such as refining a topic and choosing keywords, and the need for providing avenues to seek additional assistance while in the midst of research. Findings also revealed a need for flexible research guides able to meet the needs of a spectrum of users, from novice to expert.

The authors plan to implement and assess changes to research guides inspired by this study, including clearer distinctions between guides for learning and guides for doing, guides organized by methods other than material format, and guides for specific user populations or skill levels. The authors believe that continued assessment will result in higher quality research guides better able to meet the needs of diverse users.

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