If We Teach, Do They Learn? The Impact of Instruction on Online Catalog Search Strategies

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abstract: A usability study was undertaken at Penn State University to explore how students search the library’s online catalog after they have received library instruction. In 2004, eight first-year students received library instruction and were subsequently recruited for the study. Participants were recorded using the online catalog, and a think-aloud protocol was employed to capture students’ thoughts. Results were compared with nine first-year students observed in 2002, using the same methodology. Analysis of both groups revealed subtle differences in how they utilized the online catalog. Although these differences cannot be definitively attributed to library instruction, the evidence suggests that instruction can have a positive effect on user search behaviors. The article recommends strategies for increasing the impact of library instruction.

Introduction

Since 2002, librarians at Penn State University have conducted a series of usability studies concerning the library’s online catalog. Using screen capture software and the “think-aloud” methodology, novice and experienced users were tracked as they completed a set of assigned tasks in the catalog. Results from the 2002 study were published in College & Research Libraries. This article reports on a follow-up study conducted by the authors in 2004. The initial study identified areas in which users employed inefficient search strategies (according to librarians) or otherwise encountered difficulties with the library catalog. To determine the effectiveness of library instruction for improving user strategies, we observed a group of students after they had recently participated in an instruction session. The study was intended to explore the following questions pertaining to bibliographic instruction:
• Can instruction change user mental models and allow users to make more efficient use of online library catalogs as they are presently designed?
• Can instruction improve a user’s understanding of what a library catalog is and is not, and is it realistic to expect this outcome?

Based on the observations of users in this study, as well as post-task interviews, the authors provide suggestions for effective library instruction sessions.

**Literature Review**

The “think-aloud” or verbal protocol methodology employed in this study has been widely employed for usability testing of system design. Stated simply, verbal protocols are spoken records of people talking as they work. The methodological foundations for most protocol analysis studies appear in the seminal monograph by Karl Ericsson and Herbert Simon. Since this groundbreaking work, various textbooks have appeared that provide additional guidance on conducting think-aloud usability studies. The fundamental concept is that subjects are able to accurately verbalize their thought processes while attending to a task. These verbalizations can later be analyzed for cues regarding decision-making processes (for a demonstration of the method and recordings, see http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_video.mov).

Patricia Sullivan and Peggy Seiden are credited with being the first librarians to apply the methodology in the United States. After studying users in the Carnegie Mellon Libraries, the authors concluded that protocol analysis could be an effective way to identify major “blocks” to success in the use of the online catalog. Among the obstacles identified were that users were unaware of all the options offered by the system, had difficulty choosing when provided with too many options, and displayed a tendency to rely on prior searching experience. Experienced users might repeatedly employ a search strategy they were comfortable with, even if it were not the most efficient approach to the task at hand.

Since the study by Sullivan and Seiden, the “think-aloud” method has been widely employed to examine library systems, including online library catalogs. A published review by Anita Ondruskek of 163 catalog use studies includes a section on the protocol analysis method. A 1996 study by Carol Hert explored user information needs and goals when using an online catalog. She observed that users rarely adjusted their goals or strategies based on their interaction with the catalog. One explanation offered was that users wanted to spend as little time with the catalog as possible. In the words of the author, the catalog was a “barely tolerated evil”—a tool to be used to accomplish a task. In 1999, Heather Morrison asked library users if they would be willing to talk aloud while conducting their research. She determined that searching problems generally fell into three categories: materials not available, difficulties conducting subject searches, and navigation issues specific to the local online catalog. Most recently, researchers in the Netherlands compared two types of think-aloud protocols—retrospective and concurrent—to determine if one of the methods were more effective for analyzing library online catalogs. They concluded that both retrospective and concurrent protocols uncover comparable sets of usability problems, with some differences in the amount and type of information obtained.
The protocol analysis studies complement research done on information-seeking behavior utilizing other methodologies, primarily transaction logs but also observation, interviews, surveys, and focus groups. Prominent among these studies are articles by Patricia Wallace, Charles Hildreth, and Christine Borgman. These and other studies have consistently reported that library users encounter conceptual and navigational obstacles when using the online catalog. There are several persistent problems identified in online catalog use studies:

- Library catalog users value speed and simplicity.
- The many search options in online catalogs can be overwhelming to users.
- Users are unfamiliar with what a library catalog does, and they lack the basic conceptual tools to effectively and efficiently search the catalog.
- Users bring different levels of knowledge and search skills to the use of the library catalog. These have an impact on how they navigate the system.

A 2002 usability study conducted at Penn State yielded findings consistent with earlier catalog use studies. Nine first-year students with no prior exposure to the library’s online catalog (novice users) and nine experienced library catalog users were observed as they attempted to complete five tasks in the library’s online catalog. Analysis of the session recordings revealed that both novice and experienced users were relatively unsophisticated searchers. Participants strongly preferred keyword searches, even when looking for known items. They made minimal use of Boolean operators or other “advanced” catalog search features such as truncation. Both groups demonstrated a somewhat hazy concept of what is in a library catalog. For example, many expected to find individual articles in the catalog. Some performed journal title searches, thinking that they were looking for articles by title.

In spite of the wealth of research documenting users’ struggles with the library online catalog, few studies have attempted to determine the effectiveness of library catalog instruction. Even broadly speaking, it is difficult to detail the lasting impact of bibliographic instruction. Multiple studies have tackled this challenge, with each coming to different conclusions about the overall influence of library instruction. As Janet Webster and Loretta Rielly point out, instruction is “holistic. . . . Time spent in the classroom is only one component. If students and instructors succeed at learning and teaching, the library succeeds.”

**Study Description and Methodology**

The study reported in this article was conducted to address lingering questions concerning the impact of library instruction on the user’s ability to search the Penn State Libraries’ online catalog. Can user education efforts reduce search inefficiencies and confusion? If so, how much can be accomplished in the typical single 50-minute session? Whereas these are intriguing questions, the 2002 usability study was not designed to address them. A decision was made to conduct a follow-up study, focusing specifically on the effects of library instruction. The authors recruited a group of eight students from Penn State’s Learning Edge Academic Program, LEAP, which also served as the pool for the novice users in the 2002 study. LEAP is a first-year program designed to give incom-
ing freshmen a head start on achieving academic success. Although not a true random sample for such a study, the program is open to all incoming freshmen, and it attracts a cross-section of the Penn State undergraduate population. The eight participants in 2004 included the following potential majors as reported by these first-year students: international studies (2), advertising (2), secondary education, meteorology, engineering, and mechanical engineering.

Four different librarians taught the students in this study, and varying teaching styles and class assignments meant that all of the students had different instructional experiences. The following statements can be made about the library instruction that the study participants in 2004 received.

- The study participants received at least one librarian-led, hands-on instruction session in the library.
- The librarians focused on teaching the following concepts relevant to searching the library catalog: keyword versus browse searching, searching for journals and/or newspaper articles, and using subject headings to find relevant materials on a topic.
- The library instruction session was attended several weeks before the study was conducted, so it was still somewhat fresh in their minds.
- All of the students were actively working on research assignments as part of their course work, which ostensibly allowed them to employ strategies learned during the library instruction session they attended.

The main difference between the 2002 and 2004 studies was the timing of the observation sessions. The novice users in 2002 were observed using the catalog before they received any library instruction. The sessions in 2004 occurred after the students’ library instruction classes. Other than the change in timing, the methodology remained constant across the studies. The tasks for each group were fundamentally the same, and the online library catalog interface was unchanged. Both studies employed the verbal protocol analysis methodology. Participants were expected to continue talking throughout the session, describing their thoughts (for a demonstration of the method and recordings, see http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_video.mov). This running commentary provided a richer set of information for analysis than simply recording keystrokes. Students were asked to approach the tasks as they naturally would outside an experimental setting and were instructed to give up when they normally would. Post-task interviews and surveys were utilized in both the 2002 and 2004 studies to explore ambiguous actions or comments and to collect additional data on prior library and Internet experiences.

A recent article opines, “Verbal protocol analysis may be the most widely used process tracing method today.” Although widely utilized, the methodology is not without weaknesses. There is some dispute regarding the accuracy of verbal reports for cognitive processes that never reach consciousness. Other researchers have argued that the requirement to provide a verbal report may alter the subject’s cognitive process, thereby changing his or her approach to the task at hand. In spite of the authors’ efforts, the nature of being observed probably led some participants to engage in search behaviors that differed from their normal routine.
To obtain the most valid and accurate trace of thought processes, participants in this study were asked only to verbalize their conscious thoughts. They were not expected to describe what they were doing or to explain why they were approaching a task in a particular way. Any additional explanatory information deemed desirable was obtained during the post-task interviews. When conducted in this manner, Ericsson and Simon found no evidence that the sequence of thoughts (as measured by task performance) changed when subjects thought aloud as they completed the tasks compared with subjects who completed the same tasks silently. As stated in a review of Ericsson and Simon’s work, “Verbal protocol methods may not be perfect, but they are a very satisfactory tool to include in the toolbox.”

To date there is no consensus on the minimum sample size for research using the protocol analysis methodology. A review of 18 protocol analysis studies found sample sizes varying from 1 to 90. In determining the number of students to observe, the authors were influenced by research indicating that a sample size as small as five users can identify the vast majority of the usability problems in a system. Additional test subjects produce diminishing returns relative to the investment of time required. The investigators ultimately opted for a sample size above the recommended five subjects. In 2002, nine novice users were observed; in 2004, there were eight participants. After completing several usability projects, the authors are convinced that this number of participants is sufficient to identify obstacles and general trends. After only a few sessions the patterns became clear. Each subsequent session largely reinforced earlier findings while adding only the occasional bit of new information.

Due to the small sample size, the results reported in this article may not be generalizable to first-year students in other settings or undergraduates in general. It seems reasonable to assume that additional differences exist between categories of users (for example, faculty and undergraduates) just as previous studies that have documented differences in the approaches of novices and experts. The small sample size also limits the ability to make statistically valid comparisons between the 2002 and 2004 groups observed. For that reason, the authors have opted to discuss general patterns instead of providing more quantitative results.

**Findings**

In the present study, the strongest evidence of the impact of library instruction is implicit rather than explicit. On rare occasions, participants did attribute a search strategy to formal library instruction (“My instructor told me to always put search terms on separate lines.”). Other evidence of the impact of library instruction can be inferred, although it must be conceded that factors other than library instruction could affect the differences observed in the two groups. That said, the authors believe that the behaviors observed are intriguing enough to warrant wider distribution in the hopes that the discussion will stimulate ideas and dialogue regarding library catalog usability and the impact of library instruction.
There were some differences apparent in the search strategies employed by the users in this study when compared to their cohorts in the earlier study. Notable among these was the use of the browse search feature. This was the most efficient strategy for locating known items, but almost all users ignored it in the first study, including the experienced searchers. The use of the browse feature in the 2004 study was not widespread, only three of eight students used it for the first task; but this represents an improvement from the 2002 study in which none of the first-year students employed browse for the same task. It seems reasonable to attribute this difference to the fact that students in the second group were shown the browse feature in their library session although other external factors cannot be ruled out. It should be noted that a powerful gravitation toward keyword searching persisted. Even those who began by using the browse search tended to abandon it in favor of keyword searching. This suggests that these users were more comfortable with keyword searches, an observation reinforced by comments made by participants during the study.

When looking for works on a subject, the 2004 group demonstrated slightly superior subject searching skills when compared to the 2002 study participants. These improvements were observed during task #5, in which participants were asked to locate books on a topic (see appendix A, http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_appendixA.doc, and a screen shot of the online catalog search screen, http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_catalog.tif). Although evident, improvements were highly personal—that is, each person demonstrated a grasp of one or two searching techniques not displayed by their counterparts from the first study. For example, some participants used quotation marks while searching for phrases, a strategy not usually employed by the 2002 participants who had not received library instruction. Of course, this could have been learned while using another database or an Internet search engine; but, on occasion, the participants explicitly stated aloud that they had been shown a specific search technique by the librarian who spoke to their class.

While completing task #5 (Find five books on the topic of teen smoking.), the 2004 students made use of more “exotic” strategies than their 2002 counterparts. Most remarkable is that a few showed a grasp of synonyms, a relatively advanced concept that even experienced users in the previous study did not employ. As a group, the 2004 subjects employed other advanced techniques, such as limiting searches by material type, truncating search terms, and using “or” for related terms. The traces are faint—typically only one or two of the eight participants used one of the techniques described above. Study participants in 2004 appeared to retain at least some of the search advice imparted during their library instruction sessions although each participant seemed to have remembered a different technique or tip. The aggregate effect was striking and does suggest that library instruction can change the search behaviors of attendees, at least at the margins.

It is interesting to note that the students who received library instruction were not noticeably quicker or more successful at completing the five tasks. As a group, the eight participants in the 2004 study performed the tasks at the same pace and with essentially the same success rates as the first-year students in 2002 (see appendix A, http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_appendixA.doc). An analysis of
the time-on-task reveals that this group actually spent slightly more time completing the five tasks than participants in the previous study. It is impossible to determine precisely why the 2004 participants took longer to complete the tasks. The time difference may just be a random blip caused by a small pool of participants.

A few extenuating circumstances must be noted. The serials tasks that were chosen were relatively high on the difficulty scale. The goal was to observe how users reacted when confronted with a complex record. Small changes also could affect success. A partial explanation for the lack of success on task #4 (Find an issue of the journal Civil Engineering, http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_engineering.tif) may be tied to such a seemingly mundane change. In the interval between the two studies, a new journal titled Civil Engineering was added to the library catalog. It began publication in 2000, and this date is posted prominently in the results display. Because participants were asked to find the 2000 issue, this new title attracted much interest and likely led some participants to erroneously conclude that they had located what they were asked to find. This hypothesis is supported by the average completion times. The 2004 users concluded this task more quickly than the novice users in 2002, suggesting that they were aborting their searches prematurely.

Ideally, library instruction would give attendees the tools to overcome these sorts of “distractions,” but clearly that was not the case for the group observed in this study. Interpreting a record is a typical element of our introductory instruction sessions, but the evidence collected here suggests that attendees did not retain this information. The authors are reminded of the practical limits of single-shot instruction sessions.

Discussion

The study was conducted to explore the following questions for bibliographic instruction:

- Can instruction change a user’s mental model and allow for more efficient use of online library catalogs as they are presently designed?
- Can instruction improve a user’s understanding of what a library catalog is and is not, and is it realistic to expect this outcome?

Through this study, the authors hoped to gain an idea of whether or not bibliographic instruction provides an introductory grasp of the possibilities that library catalogs offer to the user. The following observations describe trends that were apparent in this study and recommendations are made for broad ways in which library instruction can maximize students’ opportunities for learning about the library and its resources.

Students Transfer Knowledge Across Interfaces, Learning from Experience

Despite the fact that this study focused on the online library catalog, one of the concepts that the students retained best was that there was a large amount of full-text information available in ProQuest, the library’s largest database of magazine, journal, and newspaper articles. The frequency with which ProQuest was mentioned in post-task interviews clearly indicated that this source made an impression on the students. In several cases, students commented (either during the session or in the post-task interview) that a search strategy they employed in using the library catalog was something they had learned
while using ProQuest. This transference of such skills across databases reinforces the importance of teaching concepts rather than the intricacies of specific interfaces.

Brian Nielsen and Betsy Baker state, "Users are, on the whole, pleased with the online catalog, but for them it is but one tool among many and, more to the point, a means to an end rather than an end in itself. . . . A broader view may gain both better acceptance by patrons in general and better transferability to other systems." While it is easy for library instructors to immerse themselves in the how’s and why’s of a specific interface, to students it is just one more place to search for information. Reminding the students of searching strategies that work across databases and interfaces may help students remember specific skills later.

This observation also reinforces the importance of selecting several primary, concept-based goals for the instruction section and sharing those goals with students at the outset of the session. Then, within the demonstration of each interface, the instruction librarian should reinforce the instructional goals (for example, use of subject headings to find additional materials on a topic) and underscore for students the common elements of searching that exist across many different types of electronic resources. This helps students better understand the practice of transferring searching strategies across resources and emphasizes the commonalities rather than differences in the many disparate tools that the library provides.

Recognize and Address Students’ Preexisting Search Techniques

Watching participants complete the tasks, the authors observed a phenomenon that was also evident in the previous catalog study. After conducting a search, there was a tendency to only casually peruse the results and then rapidly revise the initial search rather than reading the results carefully and examining why the initial results were unsatisfactory. There was little inclination to peruse more than one page of matches after conducting a search. A recent study of Web searching behaviors suggests that a key difference between novice and expert searchers is the amount of time spent analyzing and evaluating search results. Put simply, novices spend more time typing and exploring by trial and error. Experts were observed to spend more time monitoring the search, reflecting on the search process, and planning a search strategy.

For this group, if the results were not immediately satisfactory, the working assumption seemed to be that the problem was that the catalog needed more information about what was sought. The most common attempt to correct this deficiency was to make the search more specific. For subject searches, this often meant adding more keywords. For journal searches, the date of publication or volume number was added when the title words failed to produce an obvious match. The mindset seemed to be that more information would yield better results.

The behaviors observed suggest that library instruction sessions must address students’ preexisting search behaviors. Users’ search behaviors are molded by far more
than their experience with library information retrieval systems. For many users, Internet search engines are the dominant influence on their information-seeking techniques.\textsuperscript{26} Google searchers are typically rewarded for making searches more specific, and users may transfer the same strategies into library databases expecting similar results. Simplifying library catalog instruction to focus solely on how to execute basic searching techniques can help users build the skills they need to effectively use a tool that is quite different from the Web search engines they frequently use.\textsuperscript{27}

**Library Instruction Must Relate to Needs and Capture Students’ Attention**

Library instruction must be tied to students’ primary needs. Students are far more likely to learn special concepts and basic tricks of the trade “when there is an immediate need to know.”\textsuperscript{28} Several students in this study mentioned their boredom during the library instruction session. One student, when asked about her instruction experience, was unable to recall the specifics of her session. She attributed this to the fact that it was a nice a day during her BI session, and she did not want to be inside. Another participant indicated that she could only concentrate for about 30 minutes and saw several classmates “zoning out” during the hour-long session. Whereas library instruction cannot always be timed to the precise point in the semester when students have an active assignment requiring use of library resources, students are more likely to pay attention if the library instruction is linked and tailored to a specific assignment.

An example of the important role of relevancy on attention span can be found in low success rates for tasks #3 and #4 (see appendix A, http://muse.jhu.edu/journals/pla/v006/supp_open/6.2novotny_appendixA.doc). It was hoped that the students who had the benefit of instruction would be better able to interpret the (admittedly) complex serials records in The CAT (Penn State’s online catalog). This is regularly covered in library instruction sessions, but it does not appear to have penetrated the minds of the participants of this study. The popularity of ProQuest may partially explain the students’ poor performance locating issues of print journals in the library. It is not implausible to imagine a student “tuning out” a discussion of finding print journals after being shown a resource containing thousands of full-text magazines and journals. Why bother worrying about tracking down dusty old volumes after learning that?

In order to present a session that is most appropriate to students, librarians must be realistic about what can actually be accomplished in one instruction session and make every effort to tie the instruction to the students’ current research assignment.\textsuperscript{29} Unnecessary details should be curtailed. The boredom factor cited by several of the students in this study could possibly have been avoided by consciously scheduling the library session when the students were tackling a research assignment and customizing the session to the students’ immediate needs.
Do Not Underestimate the Value of Pre-College Library Instruction

The majority of the study participants reported receiving library instruction in high school before arriving at Penn State. Nielsen and Baker observed, “In the case of learning to use a library catalog, cumulative learning is especially salient: many users are exposed to repeated instruction in the use of the catalog in elementary school; many users rely on experience as the most available (if not most efficient) teacher of library use skills.”

Whereas students’ high school library research experience may be quite different from what is expected of them in college, it is relevant to their learning curve as beginning researchers embarking upon mastery of a wide range of library resources.

Referencing prior library experiences, particularly those in the high school library environment, can be critical. The students in this study were just a few months past their high school graduation. Discussing the differences and similarities between an academic library and other libraries that students may have used in the past can help them reference and place their past searching and library-related experiences within an appropriate context.

Students Appreciated Librarians’ Assistance and Felt Very Positive About the Library

Do students see library instruction as something truly relevant and useful to them in developing research skills, or do students see it as a “nice” perk that allows them to connect with helpful librarians?

The responses of the students participating in this study highlight the emotional impact of library instruction. All of the study participants clearly liked the librarians who met with their class. Nearly all of the students involved in this study reported following up with their librarian for individual research assistance. Students kept in contact with their assigned librarian throughout the summer via various communication modes including e-mail, instant messenger (IM), at informal gatherings (one librarian attended her LEAP Pride’s “pizza party”), and during in-person visits to the library. It was obvious that the instructors were successful in conveying that the library is warm and welcoming. Throughout the study, students were very reluctant to say anything negative about their library instructors.

The librarians in this study forged a positive connection with their students, demonstrating the importance of focusing on affective, emotional skills in library instruction. While cognitive skills often take precedence in the classroom, the emotions that students experience as they learn how to navigate the research process also influence their ability to succeed.

Several studies have shown that students who are not confident library users are less successful overall in finding the information that they need to complete an assignment. If students are afraid to articulate their frustrations and ask for help, they may be unable to complete the work and, ultimately,
will not master a learning process requisite for lifelong tasks. Library instructors must work to establish a classroom that is a welcoming and not an intimidating environment in which students are not afraid to ask for and receive help with the research process.

The library instructors working with the students in this study were successful in helping to build students’ positive feelings about the library in general. A concentrated effort to focus on building affective skills helps ensure that students will come back to the library for assistance, even if they do not retain all that was taught in their instruction session.

Wallace states that an additional benefit of focusing on students’ feelings regarding library research: “Confidence in the outcome of the search is essential, and good instruction builds toward that psychological edge.”

Conclusion

The evidence from the small group of students observed suggests that library instruction can have an impact on online catalog search behaviors. The group observed in 2004 differed in subtle, but important, ways from their 2002 counterparts. For known items, at least some participants made use of the more efficient browse option. When looking for subjects, they employed strategies rarely seen in 2002, including the occasional use of synonyms or truncation. These techniques suggest that the 2004 group had a better conceptual grasp of the library online catalog. In some cases this knowledge was explicitly attributed to library instruction. The influence of instruction can also be inferred by the absence of these strategies in the earlier group of students.

The endorsement of library instruction is not without qualification. The evidence indicates that undergraduate users may still struggle with aspects of the online library catalog even after receiving library instruction. Particularly alarming were the high failure ratings assigned for the serials tasks (#3 and #4). For this group, at least, a single library instruction session did not provide sufficient tools to correctly locate and interpret complex serials records. This finding reinforces the point, familiar to all instruction librarians, regarding the limits of memory and attention. As librarians, we can teach as many concepts as can be squeezed into 50 minutes, but we must recognize that those attending will often retain only a fraction of what is imparted.

This article includes suggestions for getting the most out of each instructional opportunity, but even the best instructional program can be stymied by a complex online catalog interface. While library instruction may have an impact on students’ ability to use information resources and construct searches, a single session by itself cannot provide all the tools students need to search efficiently and effectively. The flip side of library instruction involves work behind the scenes and out of the classroom. Actively working to change user interfaces so that they reflect how library users search for and access materials will increase students’ searching success in ways that library instruction never could. In other words, instruction librarians must become involved with helping to create interfaces that inherently teach the user how to search the catalog without benefit of formal library instruction. Stanley Wilder, author of a much-discussed article titled “Information Literacy Makes all the Wrong Assumptions” in the Chronicle of Higher Education states, “Librarians need to use their expertise to make the library’s
online presence approach the simplicity and power of the Internet.” Only then, notes Wilder, will it become “more likely that reference and bibliographic instruction will get to the heart of the matter: connecting students with information.”

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Notes
11. Novotny, 529.


15. Novotny, 526, 537.


27. Ibid., 178.


33. Wallace, 251.


35. Ibid.