Metacognition & Conceptual Drifting in Interactive Information Retrieval: An Exploratory Field Study

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ABSTRACT
This study investigates patterns of topical migration, specifically interactional dynamics of conceptual drifting and metacognition as counteracting forces, in interactive information retrieval. “Think aloud” sessions of exploratory search conducted by five graduate students were recorded, and the audio recordings were first coded into semi-structured notes and then converted into flow graphs for temporal analysis. The study finds that conceptual drifting, driven by the searcher’s attempts to find more relevant results, unfolds as sequences of conceptual switching instances, with each sequence centering on a major concept (a focal point). As the search flow moves from one focal point to the next, it forms second-order patterns of conceptual drifting. Awareness of conceptual drifting typically occurs right after the changing of focal point, followed by metacognitive efforts of referencing the original search question or repeating the initial search. Metacognitive behaviors are found to be closely correlated to occurrences of conceptual switching. As more instances of conceptual switching occur, the searcher grows more likely to become aware of the shifting of focus and exercise mental efforts to regain control of the search process.

Keywords
Conceptual drifting, metacognitive behavior, interactive information retrieval, information seeking behavior.

INTRODUCTION
Users’ searching behavior has been a major research focus in the general field of information retrieval, including online searching, information seeking, user-system interaction, and web searching. Past research mostly focused on the rationale aspect of searching, assuming that each move taken by the searcher is designed to achieve the objective of locating materials relevant to either an explicit information question or implicit information need. Query reformulations (either by substituting a keyword with its narrower/broader/related term or by incorporating new terms picked up from found articles) are viewed as strategic and constructive moves attempting to locate more materials relevant to the initial search focus; and the user is assumed to be a rationale goal-achieving human being.

However, the user’s effort in identifying alternative search tactics and steps taken to reformulate and refine the search query may not always be constructive. While query reformulation may be an attempt to correct query syntax errors, use more effective search terms, or view the task in hand from a different angle, it is equally likely to be a reflection of unintentionally slipping away from the initial search direction. In the process of interactive searching, the user may find himself drifting off the initial search focus as a result of being distracted or unknowingly sidetracked by taking such revisionary steps. We suspect that there may be two counteracting forces at play throughout the process of interactive searching, one being the natural tendency of drifting away from the initial search focus, and the other being the user’s conscious effort of keeping the interactive search process on course in relation to the initial search question or information need. Henceforth, the former will be referred to as “conceptual drifting”1 and the latter as “metacognitive behavior”, for ease of discussion.

The phenomenon of conceptual drifting in interactive IR has been noted anecdotally by some researchers in the past as their research interests moved from single query transaction to session-level discourse analysis. In Spink and her colleagues’ studies of web search engine logs (Spink, Ozmutlu, & Ozmutlu, 2002; Spink, Park, Jensen, & Pederson, 2006), queries that did not have at least one keyword in common were assumed to be searching on different tasks. They noticed that users exhibited a behavior of entering search queries that appeared to be related to different search tasks, and consequently referred to such behavior as “task shifting” or multitasking. While multitasking is possible in interactive web searching, this

1 The term “concept shift” has been used in the field of text mining to refer to changed meaning of the same terminology/concept at different time and/or in different contexts, which is apparently different from the concept we are trying to establish here.
oversimplified assumption obscures the fact that changes of terms in query reformulation may well be a manifestation of conceptual drifting. Similarly, changes in search requirements noted by other researchers (Escudeiro, 2004; Rey & Jhala, 2006; Vallet, Fernandez, Castells, Mylonas, & Avrithis, 2006a, 2006b) may also be attributed to conceptual drifting. Furthermore, conceptual drifting (referred to as “topical shift” by some others) has been identified as a challenging issue in studies of interface and system design (Koychev, 2000, 2002, 2006; Koychev & Lothian, 2005; Koychev & Schwab, 2000) while developing algorithms to track users’ search interests.

This aspect of interactive information retrieval – dynamic interaction between the two counteracting forces of conceptual drifting and metacognitive behavior – has been completely overlooked in existing research. To bridge this gap, this paper reports an exploratory study of interactive searching (a pilot study of a larger research project) that analyzes audio recordings of “think aloud” protocol while focusing on the cognitive aspect. After stating the research problem and specific research questions, the paper documents the research design, data gathering and coding, and related methodological issues. Then, it proceeds to report preliminary findings from both qualitative and quantitative analyses, and concludes with discussion of future research direction.

**RESEARCH PROBLEM**

The research objective of this study is to investigate how the user, while conducting interactive search, cognitively behaves in maintaining the search focus. The research problem is about how conceptual drifting occurs and unfolds throughout the searching process, and in particular, how the force of conceptual drifting dynamically interacts with the user’s metacognitive effort of maintaining the search direction and keeping the searching process on course, in relation to the initial focus of information question or information need.

In the context of this study, **conceptual drifting** is defined as migrant changes from the initial search focus as reflected in the user’s thinking and query reformulation. **Metacognitive behavior** is loosely defined as the user’s conscious effort of mentally remaining focused on the initial search question or information need, including awareness of having gone off track or getting sidetracked.

Metacognition is a concept mostly developed in the research areas of child development and education to characterize deliberate, planful, intentional, goal-directed, future-oriented mental behavior that can be used to accomplish cognitive tasks (Flavell, 1979, as cited in Bowler, 2010a). Drawing on seminal works on child development and education, Bowler (2010a) identifies two aspects of metacognition, control process and metacognitive knowledge. Her studies of adolescents’ information search process (Bowler, 2007, 2008, 2010a, 2010b) and related works by others (e.g., Gorrell, Eaglestone, Fold, Holdridge, & Madden, 2009; Mason & Boldrin, 2008; Quintana, Zhang, & Krajcik, 2010;) are mostly focused on the metacognitive knowledge aspect, and particularly on employment of search strategies and tactics. In contrast, our study focuses on the “control process” aspect of metacognition (i.e., mental effort and behavior of controlling and monitoring the search process).

Specifically, we want to answer the following research questions:

1. To what extent does conceptual drifting manifest itself in the process of interactive information retrieval?
2. What noticeable patterns of conceptual drifting exist?
3. What kinds of metacognitive behaviors does the user typically exhibit in managing the searching process?
4. What characterizes the interplay between metacognitive behaviors and conceptual drifting?

The ultimate goal of this study is to gather preliminary evidence to confirm the anecdotal observation of conceptual drifting reported in previous studies and to understand dynamic interaction between conceptual drifting and metacognitive behaviors.

**METHODS**

The work reported here is in fact a pilot study of a larger research project – an exploratory field study – designed to investigate the cognitive aspect of interactive information retrieval. For the larger research project, data were collected from students in two graduate classes (LIBR202 Information Retrieval and LIBR285 Research Methods, in the spring and fall semesters of 2010 respectively), while they conducted searches for a term paper assignment (literature review for LIBR202, and research proposal for LIBR285). The collected data included audio recordings of “think aloud” protocol, query logs captured with the Lemur Query Log Toolbar, and cognitive style tests using the instrument of Felder-Soloman Index of Learning Styles.

Serving as a pilot, this study is limited to analysis of audio recordings of five students randomly selected from the LIBR285 class. Of the five students, four are female, four of age 28-39 and one above 50. In terms of ethnic background, three are white and two Hispanic. In total, ten search sessions (audio recordings) are analyzed, of which the session lengths range from 1,132 to 4,271 seconds, with the average being 2,783.5 seconds. The descriptive statistics of audio recordings analyzed for this study are summarized in Table 1.

In both classes, students were instructed to start audio recording their search sessions as soon as they were ready to search the literature and explore term paper topics or
### Table 1. Descriptive Statistics of Audio Recordings

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Sessions</th>
<th>Lengths (in seconds)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>2</td>
<td>1,132; 1,715</td>
<td>1,424</td>
</tr>
<tr>
<td>#2</td>
<td>1</td>
<td>4,271</td>
<td>4,271</td>
</tr>
<tr>
<td>#3</td>
<td>1</td>
<td>3,032</td>
<td>3,032</td>
</tr>
<tr>
<td>#4</td>
<td>4</td>
<td>2,806; 2,168; 3,179; 2,792</td>
<td>2,736</td>
</tr>
<tr>
<td>#5</td>
<td>2</td>
<td>3,336; 3,404</td>
<td>3,370</td>
</tr>
</tbody>
</table>

Table 1. Descriptive Statistics of Audio Recordings

research ideas. They were to verbalize their mental activities while conducting the search and continue audio recording until their search reached a natural conclusion. They were also instructed to avoid reading off the screen and focus on their own high-level thinking instead.

Analysis of the audio recordings was done in two steps without transcribing: first, initial coding into semi-structured notes, and then constructing flow graphs and extracting categorical data from the semi-structured notes. With guidelines and exemplary coding of two sessions provided by the leading author, the second author (working as a research assistant) coded a third session twice to learn the protocol, and then finished coding the remaining sessions after having gained the confidence of maintaining accuracy and consistency.

The initial coding focused on noting instances of conceptual/topical change in the searcher’s thinking, tracking query reformulation, and detecting self-reflecting verbiage that signals metacognitive mental activities. Specifically, besides recording query terms, the coder recorded such instances with categorical tagging and supplemental description of specifics. Tags used include: EXPLORE, SWITCH, METACOGNITIVE, and QUESTION REVISION. Operational definitions of these tags are given in Table 2, and an example of semi-structured notes of initial coding (Subject #2) is given in the Appendix.

<table>
<thead>
<tr>
<th>Coding Tags</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPLORE</td>
<td>Exploration: Reflective thinking of exploring for alternative query terms, search direction, and strategy.</td>
<td>“Wonder what this would bring up … not good, but leads to another direction …”</td>
</tr>
<tr>
<td>SWITCH</td>
<td>Conceptual Switching: Committed change of key concepts, search direction, or information question.</td>
<td>“Not going anywhere with this. I am going to look into academic library instead.”</td>
</tr>
<tr>
<td>METACOGNITIVE</td>
<td>Metacognitive Behavior: Conscious effort of managing the searching process and trying to stay on track; self-awareness of search going off track.</td>
<td>“Initially I intended to search on ….” “Think I got sidetracked by ….” “Frustrating. I am lost …”</td>
</tr>
<tr>
<td>QUESTION REVISION</td>
<td>Search Question Revision: Revising the current search question or modified understanding of information need</td>
<td>“I started with the idea of … but now I really want to look into …”</td>
</tr>
</tbody>
</table>

Table 2. Operational Definition of Coding Tags

**STATISTICAL RESULTS**

Of the ten sessions included in the sample, the average frequencies of categorically tagged instances per session are: 3.6 of exploring, 3.2 of conceptual switching, 2.8 of metacognitive behavior, and 0.6 of question revision. The actual frequency distribution is given in Figure 1.

As shown evidently in Figure 1, a positive correlation exists between conceptual switching and metacognitive behaviors, which is found statistically significant (Kendall’s $\tau_b = 0.884, p=0.001$). The strong correlation suggests that conceptual switching and metacognitive behaviors are closely related to each other. Where conceptual switching happens more frequently, the searcher is more likely to become aware of having gone off track and make mental effort to regain focus in searching. In a post facto way, metacognitive behaviors seem to act as a matching force to counteract the natural tendency of conceptual drifting.

Visual examination of the data also seems to suggest partial correlation between explorative thinking and conceptual switching. Although theoretically it makes sense to think that more explorative thinking would lead to more conceptual switching, this proposition is not supported by results of statistical analysis. This potential pattern of correlation needs to be further investigated with a larger data set.

Finally, it is worthwhile to note that revision of search questions happened once or twice only in half of the cases, and that it does not appear to be correlated with either conceptual switching or explorative thinking.
Patterns of Conceptual Drifting

Apparently, conceptual drifting is a gradual process consisting of one or more sequences of conceptual switching instances, with each potentially moving away from the initial search question, varying slightly from the previous instance. Technically speaking, the pattern formed by its path may differ from searcher to searcher. It may even differ from session to session of searching done by the same person. However, from our analysis of the sample sessions, we find that it is not completely random, and we do see some general patterns emerging.

With the whole search session viewed as a temporal line, it is dotted with instances of question revision, metacognitive behavior, and in some cases, returning to the initial search question. We find that by using these dots as rough dividing points, the temporal line can be divided into segments. The resulting segments (i.e., sequences of conceptual switching instances) seem to form circles, each of which wraps around a focal point—an anchoring concept of a sort. For example, in the upper left corner of Figure 2, the initial search question leads into the first sequence of conceptual switching instances, where all variations of the search question share the common conceptual element of “information/technology literacy”. In the upper right corner, the second sequence wraps around the focal point of “public libraries”, the third sequence centers on “digital divide”, and the fourth on “Internet use”. Similar patterns are shown in Figure 3 as well. Visually, each focal point appears to serve as the anchoring concept of all conceptual switching instances in the corresponding sequence.

One may get the impression from our discussion above that sequences of conceptual switching instances are clean cut, which is certainly not what we intend to suggest. In fact, two sequences are more likely to overlap, with the new focal point appearing before the previous one disappears. The overlapping—a sort of “fading away” and “phasing in” effect—accentuates the gradual nature of conceptual drifting, a point that we will revisit later from a different perspective.

If we focus on focal points (anchoring concepts) in the diagrams of session flow, second-order patterns of conceptual drifting would emerge. In Figure 2, we see unidirectional movement from one focal point to the next, leading to a different search question at the end. In one case (Subject #1, diagram not shown), there is only one focal point, and the flow path loops back to the initial search question. In another case (Subject #3, again diagram not shown), the flow path alternates between two focal points. The most interesting case is Subject #4, of which all four sessions are plotted in one diagram (Figure 3), starting with the first session in the upper left quadrant and then going clockwise. The theme of “digital reading behavior” persists through all four sessions. Instead of moving from one (secondary) focal point directly to another, the flow always returns to the theme line (major focal point) after wandering off into a side branch. (For the sake of clarity and simplicity, returning paths are not plotted in the diagram.) In other words, the searcher periodically steps back after exploring an alternative concept/idea for a brief period, revisits and ponders on the initial search question, and from there thinks of new possibilities to explore systematically.

It seems that the second-order pattern of conceptual drifting appearing in a search session depends on a complex interaction between multiple factors. These factors may include searching task (on a given topic vs. exploratory), the searcher’s metacognitive skills, and perhaps, if one to speculate, his or her thinking style (divergent/associative vs. convergent).
Factors Inducing Conceptual Switching

In an attempt to identify potential factors inducing conceptual switching, we examined each instance of conceptual switching in its context and analyzed events immediately preceding it. The analysis was qualitative and informal. Ideally, formal analysis (e.g., computing Markov chains) should be conducted to supplement and validate the findings, which we would have done had time permitted.

It seems that conceptual switching frequently occurs after a search locates few relevant articles. When the current search yields few relevant results or none, the searcher becomes strongly motivated to come up with alternatives, by either brainstorming or selecting new concepts from found articles or a list of suggested terms. They not only try to identify other terms of the same concept, but more importantly, also explore alternative angles of looking at the central issue, and even different (though related) ideas. As a result, conceptual switching takes place. The case of Subject #4, as shown in Figure 3, demonstrates this point.

Traditionally, studies and training on online searching focus much on adding, dropping, and substituting query terms as searching tactics, assuming that the search question (concepts) remains unchanged in spite of query revision. This assumption seems questionable. Even if the major search question remains the same, concepts at the query level would be changed as a result of adding, dropping, and substituting search terms in the name of query reformulation. Unless the searcher sticks strictly to syntax/spelling variation and the substitution of synonyms, such revisionary acts inevitably introduce semantic change to the concept represented by the query. The semantic change of search concepts can be in scope, as in the case of broader/narrower term substitution, or in denoted substance of meaning. The latter happens most likely when a substantial keyword is added, dropped, or replaced with a related term. Needless to say that “e-book” and “e-book + publishing” communicate different search concepts, with the latter referring to only a partial segment of the whole semantic domain of “e-book”. Due to the reasons stated above, all instances of adding/dropping a substantial keyword were (and rightfully should be) coded as conceptual switching.

While adding or dropping a substantial keyword (conceptual component of the search question) is a more detectible (and often larger) change in the search concepts, substitution of related terms leads to a more subtle change in meaning, especially if the substituted term is not a major keyword but a modifier. In such cases, conceptual switching has likely taken place, although gradually and of a nuanced nature. To appreciate this point, one only needs to take a look at this example -- a chain of related term/phrase substitutions extracted from the session by Subject #2: “information literacy” => “computer literacy” => “technology literacy” => “digital divide”.

Disguised as query reformulation, conceptual drifting takes place as the searcher adjusts the search query by adding, dropping, and/or substituting a substantial keyword with a related one. While all these actions result in conceptual switching, related term/phrase substitution seems more likely to cause conceptual drifting by shifting the search focus, often with the searcher being unaware of its happening. What we found is that the searcher typically starts by changing modifier terms/phrases while keeping the keyword/phrase of major concept intact, but sooner or later
he or she starts playing with the major keyword/phrase as well. As the searcher keeps playing with the “old” major concept, a modifier term/phrase becomes established and emerges as a new conceptual focus of searching. Then, this practice is repeated in another sequence of concept switching instances, and the process continues as the searching moves on from one focal point to another, forming a wandering path of conceptual drifting. The searcher may or may not become metacognitively aware of the shifting of search focus. In some cases, it ultimately leads to revision of the search question.

It is mentioned earlier that when trying to come up with alternatives after finding few relevant results, the searcher may pick up new concepts from found articles or a list of suggested terms. In fact, we saw in several cases that the searcher jumped at new concepts picked up from the titles of found items, relevant or not, even when the search was going well. As a result, the search path swung into a side track. In the case of Subject #4 (Figure 3), the searcher frequently explored new concepts picked up from the sidebar list of suggested terms, but quickly returned to the original course after tucking away found articles for later examination. This suggests that viewing displayed items or suggested terms in the middle of searching may be another factor inducing conceptual switching.

**Metacognitive Behavior: Types and Dynamics**

Management (or lack thereof) of the searching process – the “control process” aspect of metacognition – is of particular interest to us when investigating conceptual drifting. Bowler’s (2010a) explanation of the “control process” aspect of metacognition emphasizes proactive mental effort of monitoring goal-driven courses of action, interpreting it more as “control of the process”. In the context of this research, metacognitive behavior is defined as a broader concept, including not only proactive mental effort of monitoring/directing the search process, but also passive, post facto mental awareness of the search process going off track, as well as subsequent effort to bring it back on track.

Proactive metacognitive behaviors were observed only in the case of Subject #4. There were several occasions where as soon as a new concept/idea was explored, she would state something to the effect of “this is something interesting … though not directly related to my topic … kind of unrelated … but I am going to tuck it away”. Afterwards, she would immediately return to pursue the original searching direction.

In contrast, post facto metacognitive behaviors (passive mental activities) were observed much more frequently in the sample of audio recordings. Subjects suddenly became aware of having gone off track, but only after their search focus had already drifted well away from the original question. Such sudden awareness typically came at the point of sensing a major conceptual switching from the current focal point to next, or at the end of explorative thinking. Subjects often spoke of this realization with frustration and a sense of feeling lost.

What happened next -- after realizing that the search had gone off track -- differs from searcher to searcher, and from instance to instance. In some cases, the searcher continued searching with the “off-track” concept, and in other cases the searcher made mental effort to regain focus.
Two tactics were employed by subjects to regain the focus of searching. One is to mentally remind oneself of the original search focus by referencing the initial search question. The other is to repeat the same search he or she did at the start of the current session. While the first tactic was more commonly used, one subject repeatedly employed the second tactic throughout the search session.

In all the cases, the dynamic interplay between conceptual drifting and metacognitive behaviors as two counteracting forces determined the course of searching action, and created fascinating patterns of flow path, as illustrated by the two diagrams included in this paper.

CONCLUSION
In summary, this exploratory study of metacognition and conceptual drifting in interactive information retrieval produced the following major research findings:

(1) Metacognitive behaviors and occurrences of conceptual switching (a minute step of conceptual drifting) are strongly correlated. This suggests that as more instances of conceptual switching occur, it gets more likely for the searcher to become aware of the shifting of focus and exercise mental efforts to regain control of the search process;

(2) Conceptual drifting unfolds as one or more sequences of conceptual switching instances, with each sequence centering on a major concept (a focal point). As the search flow moves from one focal point to next, a significant step of conceptual drifting takes place. Movements from one focal point to the next form second-order patterns of conceptual drifting, which differ from searcher to searcher;

(3) Conceptual switching is driven by the searcher’s attempts to find more relevant results by searching with alternative terms or approaching the search question from a different angle, especially when few relevant results are found with the current search. Substitution of keywords with related terms is more likely to cause a gradual shifting of search focus, leading to conceptual drifting the searcher is unaware of; And finally,

(4) Metacognitive awareness of conceptual drifting is typically post facto, occurring just after the change of focal point has already taken place. To counteract the force of conceptual drifting, the searcher tends to reference the initial search question as a mental reminder, or repeat the same search done at the start of the current session, in an attempt to regain control of the search process.

These findings are preliminary, and need to be taken with consideration of limitations of the study. First, the sample is small, and the analysis was done only of audio recordings. Second, the recordings analyzed were all from students conducting searches to develop a research proposal (the term paper assignment of the research methods course).

Although students worked on different topic ideas, their search tasks are of the same nature. Third, except for the non-parametric correlation test, most findings are drawn from qualitative analysis, thus lacking the rigor of statistical testing for significance. Finally, the approach of semi-structured notes taking, instead of using a software tool, was employed for initial coding of audio recordings. This approach lacks an effective means of linking coding entries back to segments of recording, making it difficult to check for coding consistency and accuracy.

Conceptual drifting in interactive information retrieval is an issue that somehow has completely escaped researchers’ attention in their extensive studies of information seeking. We believe that this research project opens a fresh window to investigate information searching processes and initiates a new research direction in the general field of information seeking and retrieval. In spite of the limitations outlined above, this pilot study identified interesting issues worthy of further investigation, and its findings will serve as material evidences for developing theoretical concepts and hypotheses for future research.

REFERENCES


APPENDIX

Sample of Semi-Structured Notes of Initial Coding (Session by Subject #2)
[earlier session of 45 minutes lost due to recording error]

[explain previous search]

QUESTION:: academic libraries offering information literacy workshops to university staff, specifically for non-teaching staff

[got to refine. instead of "workshop", conducting outreach for staff, on information literacy. originally it's highly specific, limited to LA county. now including whole USA, still hard to find evidence].

now look at info literacy for faculty, hopefully alluding to staff as well.

information literacy + academic libraries + faculty => none found. switch to Google Scholar. several maybe relevant. (self reminding about geo limit)

trying to find more recent.

[reading snippet of one article -- trend and issues of information literacy for faculty. potentially interesting. reading outline. too short. not what looking for]

[limit to journal of academic librarianship]

information literacy + faculty + workshops => no result.

EXPLORE:: information literacy + faculty => only 1 found. seems very relevant, published in 2006. [reading first paragraph]. review, not good, but leading to another direction ...

[thinking for alternative search terms => computer literacy. reviewing where started, and explain why moved to this]

computer literacy + academic libraries => [ switch to Google Scholar. tempted to exclude "student", but not.]

METACOGNITIVE:: worried about being sidetracked.

SWITCH:: new term "technology literacy" caught attention. noted as direction to explore later.
[frustration while finding nothing good]

[recalling last session. decided to forget about academic libraries, but focus instead on public libraries. recalling previous knowledge about pub libraries offering computer literacy workshops. a completely different direction could/should be taken.]

SWITCH:: academic library -> public library

public library + computer literacy + workshops

public library + information literacy + workshops => [82 found in Google Scholar. taking a break.]

METACOGNITIVE:: review of search path traversed and the change from original focus to "public library + information literacy".]

QUESTION Revised:: why academic libraries use the public library model to provide information literacy workshop to university non-faculty staff. => post facto rationalizing

Research interest stemmed from field observation while coordinating info literacy workshop at workplace, describing the workshops there as explanation.

[back to previous search]

academic library's approach adapted to pub library => not good

Malaysia ... not good

METACOGNITIVE:: what I am NOT looking for ... is library instruction. instead, looking for "computer literacy workshops" -- how to use the keyboard/mouse, software program, Google, email account etc.

METACOGNITIVE:: I am at a loss of what to search .... wanting to focus on public library + computer literacy + workshop ...

EXPLORE:: + California => just to see what it brings up

SWITCH:: new term "digital divide" caught attention. completely forgot about this term earlier, which is completely relevant ... reasoning that such workshops are response to digital divide.

[elaborate understanding of "digital divide" concept]

public libraries + digital divide => [look at one article on "digital inequality"]

[Google Scholar to Wilson]

public library + digital divide => limited to the public library journal => only two found. surprised. no good.

[view article on survey of digital divide/public libraries in Colorado]

METACOGNITIVE:: self awareness of frustration

SWITCH:: "what impacts Internet use" -- actually that's something I am interested in, definitely related to my research topic. income/educational level/age ... that's very useful.

QUESTION revised:: Why academic libraries don't play a bigger role in addressing these same concerns [of bridging digital divide].

METACOGNITIVE:: recalling/attempting to connect to original interest => although academic libraries traditionally serve faculty and students, some do claim to serve staff in their mission statements. [citing one university library as example].

[back to save the article about Colorado public libraries found earlier]

SWITCH:: academic library + digital divide => "digital divide" searched in the Academic Librarianship journal

[view a few results found]

Concluding that research focus has become clearer as a result of searching.

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NOTES

1. Apparently the person became confused and disoriented, possibly due to frustration from finding no article directly addressing his initial interest.

2. Noticeable effort of trying to connect the "ending" point back to his start point, albeit having drifted away quite a bit.