

Information Competence Data Analysis

Using All Sources of Data Collected in Phase II

Prepared for:

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Systemwide Library Initiatives

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ACRL Standards for Information Competence

Appendix B

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Appendix C

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PART I. INTRODUCTION AND METHODS

Introduction

The abundance of anecdotes on how students conduct information searches constitutes a rich folklore in academia. But if we are to help students develop efficient and effective information practices, we need empirical data to inform us of their current practices, some of which may already be effective and efficient and others that could use improvement.

The nature of today's information resources must be taken into consideration when studying student practices. Today's student must be able to engage in human-computer interaction. On most campuses students must learn how to negotiate both the Electronic Library and the Paper Library even as libraries make decisions about where to invest their resources. Students must also be able to make choices about publicly available information on the World Wide Web, which is so readily accessible.

In short, students as well as working professionals must be able to negotiate three layers of reality: Primary Reality, the actual world of objects and social relationships in which information is obtained through direct experience and social interaction; Symbolic Reality in which information about real objects and social relationships is obtained from representations in print, including text and visual images such as photos, drawings, maps, graphs or blueprints; and Virtual or Electronic Reality in which limitless information is decontextualized and literally broken into bits. Moreover, interactivity is its distinguishing feature.

Though many cyberspace enthusiasts are already declaring the death of the Paper Library, not to mention public information media such as brochures, newspapers, museum artifacts, and other tangible forms of information, such visions of a totally virtual world are unsustainable. (Borgmann, 1999.) More likely, people and organizations will continue to obtain information through direct experience, social interaction, print materials and electronic media. Situational and contextual factors will determine which source is likely to be used by the same people at different times.

Because electronic information is a new form, we tend to take for granted the other kinds of information sources and the extent to which they are used. However, they are not irrelevant nor have they been replaced. Each modality of information has its limitations and advantages. Though direct experience is imprinted more deeply in our memories, relying only on direct experience for information would be extremely restricting to humans. The earliest secondary source of information, social interaction, is still used widely

today though trust is a necessary condition for accepting what another tells you. Direct experience and social interaction take place in Primary Reality.

When print came into widespread use, oral transmissions of information may have been devalued in some realms but they were not obliterated as a source of information. Teachers today still value students' oral and written skills and repeat orally what is found in textbooks. Print resources provide information not bounded by time or by the limits of one's personal acquaintances and those who commit ideas and information to paper can leave their work for unknown generations. Symbolic Reality is constituted by multiple ways of representing Primary Reality, yet it is limited when compared to the newest information technologies.

The benefits of electronic means for storing, retrieving and using information need hardly be elaborated here. Both praise and criticism of the new technologies circulate widely, often within the same treatise. (Brown and Duguid, 2000; Borgmann, 1999; Locke, 1998; Slouka, 1995; Stoll, 1999 are just a few of those critiquing the information revolution.) The salient point is that although it is the electronic information source that has caught everyone's attention, the other sources have not "gone out of style." As we will see below, our students still use them.

This report is an analysis of the activities of 16 students participating in a simulated information exercise and of how these student practices relate to the ACRL Standards for Information Competence. (See Appendix A.) It is also a beginning exploration of students' movement between the three sources of information, Primary, Symbolic and Electronic, and their emerging trimodal skills. Based on the data, it is proposed that expertise in moving fluidly between Primary, Symbolic and Electronic information media is critical for students and reflection is the essential metacognitive skill that allows them to do so.

The data come from a study conducted during the Spring of 2001 by the Social and Behavioral Research Institute for the CSU Task Force on Information Competence Assessment and the CSU Office of the Chancellor. Seventy-six students from 23 campuses participated in that study conducted at four CSU sites on four different occasions. Data was collected in multiple forms including: observational fieldnotes, simultaneous audio and videotapes, screen captures of computer work, questionnaires, open-ended essays and artifacts used by students such as disks, notebooks and photocopies.

The goal of the study was to inform the CSU of the practices students currently use to determine an information need, to search for information, and to organize, evaluate, synthesize and present information to an audience. The study was based on the premise that knowledge-in-action is significantly different than declarative knowledge and that only by looking at students

exhibiting knowledge-in-action could we discover what students know. Though there is a growing body of literature on information seeking on the Web, this study placed such activity within the larger context of information seeking through all types of media.

In the Phase II Information Competence Report, (October, 2001)¹ generalizations were made about the students as a group. These were helpful in identifying frequent patterns of activity characteristic of the majority of the participants in the study. However, the generalizations were based on separate sources of data, i.e., one set of generalizations was based on only the ethnographic fieldnotes while another set of generalizations was based on only the screen captures without integrating information from other data sources. Some of these generalizations do not hold true when all sources of data are considered.

A third part of the Phase II Report did use all sources of data to illustrate the difficulty in applying ACRL Standards to the activities of two students and furthermore, it empirically grounded an argument for the importance of context for information activities. It also argued that procedural and conceptual processes in information seeking are not separate activities, though one or the other may be foregrounded for analytical purposes. The multiple media through which students seek information and the ideas or content they pursue are constitutive of each other. It is this last point that will be developed in this report.

Before detailing the methods used in this current analysis of individual cases and progressing to the main body of this report, it is necessary to state clearly the theoretical assumptions and premises of the work that follows:

* Information competence is not something that resides within a student but is mutually constituted by both student interaction with people and specific artifacts (e.g., computers or books) within specific social and cultural contexts **and** the judgments of those actions by others identified as experts by virtue of their credentials and experience. Social interaction, artifacts, and social and cultural contexts provide “affordances” (Gibson, 1979) and constraints for student displays of information competence.

* Students’ information skills are not merely “cognitive” nor do students engage in purely “mental operations” or rely on “mental models” or “schema”

¹ This research study was designed by Richard T. Serpe in collaboration with the Task Force for Information Competence Assessment and the CSU Office of the Chancellor. Linda Shaw, Barry Saferstein and I refined the research process while R. Serpe was in charge of sampling, recruitment and logistics. A team of 12 researchers implemented the study including 4 ethnographers trained by Linda Shaw. The Phase II report was authored by Barry Saferstein, Nancy Hartwig Oiyee, Linda Shaw and myself.

purported to be inside their heads. Rather, students are viewed holistically, having not only minds/brains but also physical senses with which they perceive and act in the material world with tangible artifacts and do so as social beings immersed in cultures and communities.

* The computer is not merely a tool that students “use” like a slide rule or an abacus. Computers talk back. They are essentially mediators of a conversation between the designers and the student, implying how the designer expects the student to think. (Dourish, 2001) They also mediate between the physical/social world and an abstracted world of symbolic representations.

* The co-existence of electronic and paper libraries cannot be treated as background to a study of information competence. Both libraries provide the environments within which work is accomplished and furnish the artifacts that are part of student practices, yet each leads students to experience and make meaning of their experiences in different ways.

* Similarly, publicly available information accessed by Internet search engines or directories and Electronic Library holdings available only to university-affiliated individuals constitute two different kinds of electronic information sources. The distinction should not be obscured when analyzing information competence.

* Therefore, the unit of analysis is not the individual student but rather the dynamic interaction between the student, the particular task to which the student was assigned, other participants (including the other students in the group, the focus group facilitator-researcher, the ethnographers, and the faculty/librarian participants in focus groups), the library setting including the computers specially designated for the study and other elements of the immediate context and the imaginary context described in the task.

Students are constantly engaged in making sense of assignments and classroom activities based on their prior experience. In order to accomplish their work they develop certain heuristics to guide them in creating a product that they believe will satisfy class requirements or in some cases, products which they self-assess as unsatisfactory for the requirements. To make sense of students’ work, we need to understand their past experience, their heuristics for accomplishing work, and their understanding of the task they are given.

Because of this faith in student sense-making practices, and because the unit of analysis is not the individual student but the dynamic relationship of research participants, tasks, artifacts, and multiple contextual and environmental elements, this report does not try to judge student competence in information skills against the criteria set forth in the ACRL Standards. What

it does do in Part II is make a good faith attempt to “frame” (not judge) student actions within the ACRL Standards.

In Part III I propose a model of student work processes empirically grounded in the data on practices of participants in the context of this exercise. This model does not make generalizations that minimize or ignore cases not fitting the model; instead it accounts for all the diverse ways of working demonstrated by students. In the fourth part of the report, I raise questions about planning searches, discuss the two-pronged central problem for student searches and a possible solution, and address the issue of confidence. The report concludes with recommendations.

Methods

This report is based on case studies of 16 students who constitute a subgroup of the 76 students participating in a six-hour research event. The 76 students were selected from a representative sample of CSU students system-wide. Researchers randomly selected 16 students to be shadowed by an ethnographer while working on an information task. The subgroup included 6 Freshmen, 2 Juniors and 8 Seniors with seven different majors in the Humanities, Social Sciences, Biological Sciences and Business. There was one undeclared major.

The 16 students came from 13 different CSU campuses. The ethnic composition was: 11 White, 3 Latinos, 1 African-American and 1 Filipino. The two Latinas were bilingual and one was a recent immigrant. It is unknown whether the third Latino or the Filipino are bilingual. Ten of the students were between the ages of 18 and 23 while the other six ranged from 24 to 35. There were 11 women and 5 men.

The research team audio and videotaped the 76 students in groups as facilitators introduced the task and in focus groups after doing the task. In addition, students' computer work was recorded by screen captures, and all participants completed various written exercises and information forms before, during and after the exercise. For a complete explanation of the data collection procedures, please see Appendix B. For the four tasks, please see Appendix C.

Case studies differ from a group or population study in that individual differences are not minimized or subsumed under categories but rather highlighted to illustrate the diversity of activity patterns and to attempt to account for these differences. Difficulties in determining the boundaries of a case have been discussed in the literature. (Becker 1992; Ragin 1992; Vaughn, 1992.) Such boundaries, however, are always arbitrary.

next asked: what is it that students did? By not using the Standards but letting the structure of student work emerge from the data, I began to identify a general process that all students followed. This was done using a bottom-up strategy in which a model was tentatively constructed from three students' work processes. Each successive case was reviewed to see if it fit the model and if not, the model was enlarged to incorporate the case.

Once a model of student work had been constructed from these 16 cases, I then sought other cases that might support or contradict the model, or exceptions that might help refine the model. I did this by searching the corpus of data on the other 60 students for confirming or disconfirming data. There were two of the 60 students who did not confirm the model but many more who did. (Some students did not provide enough data to be useful or recording devices did not pick up their voices.)

One student was an exception because of his extensive knowledge on global warming and the various political groups involved in the debate. According to his self-report, he had a well-constructed conceptual plan for his search and went to specific websites he knew well. From his account given in a focus group, the second exceptional student (not fitting the model) deliberated much more before and during his work and questioned things other participants took for granted. These students' accounts were supported in their written work.

The written work of the 16 students reported on in these case studies was not always typical of that of all 76 participants in the study. For instance, for Task #3, the four cases used in this report included students who wrote relatively brief and vague answers to the post-task questions about their findings. Yet among the other 15 students assigned to Task #3, seven wrote longer and more detailed answers with specific pieces of information and references for sources.

The model of student work is described in Part III. But first I show the results of attempting to frame student activities within a paraphrase of the ACRL Standards.

PART II: FRAMING STUDENT WORK WITHIN ARCL STANDARDS

In this section I frame student work activities within the broadly stated goals of the ACRL Standards, synthesized for this analysis. This was accomplished by searching the data, which included fieldnotes, videotapes of focus groups, forms filled out by students, and notebooks, disks and photocopies submitted by students, and attempting to map student actions and statements onto ACRL criteria. Working back and forth between the sources of data, I developed tentative inferences from one data source and then tested and modified them with the data from the other sources.

Because of the nature of the data, it was not possible to locate similar information on each student; rather what appears in the charts below is what was available in the data. For instance, I was able to determine how some students made decisions about what information to save because there were fieldnotes or statements made in focus groups about why information had been saved. However, for other students there was nothing in the data regarding their decision criteria. This does not prove that the students did not use any criteria. It only means that they did not explicitly state such, nor did the ethnographer or group facilitator inquire about the matter.

In addition, the interaction of facilitators and ethnographers with students played a role in shaping student strategies. Facilitators, who were all experienced faculty, did not have a script for presenting the tasks although they were given written guidelines. Thus, in explaining the tasks from one occasion to another, they gave slightly varied directions and explanations, which may have led to certain student variations. For instance, the facilitator for Task #1 on one occasion said: "we've given you a website to go to..." and indeed, the student followed by the ethnographer as well as most others in the group did go to that site. However, the facilitator did not make the same statement at other research sites, though the data is insufficient to say how all students responded.

On another occasion an ethnographer recorded that the facilitator for Task #4 seemed to be emphasizing the presentation aspect more than had been done at previous study sites. In addition, students raised different questions at each site leading to somewhat different topics elaborated on by facilitators. These inevitable variations are not just another factor for the student to contend with, but demonstrate why each case in this study is constituted not by individual students but the student in interaction with the group, the task and the physical and social environment. Each situation presents different affordances and constraints for student action.

For each task, I sought to find data that shed light on how students identified information needs, generated steps to find information, used tools and resources, monitored their progress, reflected on their accomplishments and challenges, and collaborated with, or considered, others. This last category was included because although the social aspects of information skills are more subtly embedded in the Standards than the other action steps, it became clear that most students were at least aware of the social dimensions of the task, if not actively taking them into consideration. Likewise, they were aware of the other participants in their group, if not actively consulting with them, and they were certainly conscious of the research team.

For all of the tables that follow, students' names appear in the order of the places at which they participated in the study, i.e., all of the first rows on the eight Tables are students who participated at CSU Fullerton on the first occasion the exercise was conducted. The second row of students in each Table participated at the San Jose State site, the third row at CSU Northridge and the fourth row of students at Sacramento State.

It should also be noted that students' actions did not necessarily occur in any particular order. Though the columns are organized in a way that might suggest linear movement from one activity to another, this is not the case. Students frequently moved between activities in no particular order. In the most extreme case, the student did not identify the information need until after completing her work.

On each Table students' age, class standing and major are provided along with the campus where they were enrolled at the time of the study (Spring, 2001). Mapping concrete activities onto abstract Standards is by definition an arbitrary activity and readers might disagree with what has been taken as evidence. As Brem (2002) points out, the very abstractness of Standards and critical thinking criteria makes it difficult for them to be applied in the real-world circumstances of student searches. Each cell contains any action that might count as evidence, directly or indirectly; often times these are direct quotes from participants or from ethnographer's fieldnotes, thereby accounting for the lack of parallel construction in phrasing across cells.

Tables 1A and 1B map the data on the four students assigned to Task #1 onto the reformulated and synthesized ACRL Standards. Task #1 was especially designed to elicit students' evaluation criteria of sources and specific information. Though each task was designed to elicit particular Standards outcomes, all tasks also were likely to yield evidence of other desirable outcomes as well.

TABLE 1A: TASK #1: DECIDING IF GLOBAL WARMING IS A HOAX OR REALITY

Student	Identifying the Info Need	Generating Steps to Locate Info	Using Tools and Resources	Considering Social Strategies/Aspects
Orfa 20, Freshman Business & Mgt. Pomona	Goes to anxietycenter.com At one point asks the ethnographer to clarify the goal of the task.	No record of explicit statements of what she is doing.	Encounters some difficulties with Internet and Lib. E-books. Looks for "proof." Uses notebook for findings.	Asks Ethnographer for the purpose of the info. - to talk with her friend or to write a paper.
Tim 22, Freshman Interdisciplinary Studies Bakersfield	Starts by asking another student who gives him misinformation, saying the goal is to decide what causes global warming.	Tries to get general info first. Stabbing around. Focuses on finding causes of global warming.	Judges credibility by domain suffix and by names and positions of authors. Stabs around on various search engines with no satisfactory results.	Oriented to "what they [the researchers] want." Consults with other students individually. Consults Librarian. Compares progress with others in group.
Rosa 19, Freshman Psychology ESL; in U.S. 1 year Monterey	Does not know what "hoax" means. Asks E. Looks for any info on global warming. Says she "hates science."	Usually works by source type: books, journals, Internet.	Has difficulty with spelling correctly, resulting in fruitless searches.	Very conscious of ethnographer - complains about her in group. Asks for her approval several times.
Ty 23, Senior Criminal Justice Sacramento	Seeks a wide range of resources which he can narrow down in order to compare the two views.	Usually works by source type: emphasizes books, journals; Internet as distant third choice. Seeks Sources outside Lib: Gov offices, Bookstore, Dept office	Records sources in handwriting. Had difficulty with copier - not clear whose fault it is, his or the copier's but results in not having material.	Talks with group members twice. (As a group)

TABLE 1B: TASK #1 (CONT'D)

Student	Monitoring Progress	Reflecting on Accomplishments & Challenges	Outcome/Product
Orfa	Stays focused on comparing two points of view.	Done in answers to written questions, not orally during the process.	Answers show consideration of both views as correct or as deficient.
Tim	Frequently compares his progress to what other students are doing but stays focused on finding causes of global warming.	Oriented to what other people in group are doing, what info they are finding, copying etc.	Reflects well on his process. Answers address two view points, obscuring the fact that most of his search was to determine cause of g.w.
Rosa	Stays focused on comparing two points of view.	Says we "could have observed a better student." States in group her challenge was being followed by ethnographer.	Limited English proficiency affects written answers and chance to talk in group.
Ty	Stays focused on comparing two points of view; uses multiple types of resources to compare & contrast info.	Says he would have used more sources; would have contacted organizations for info.	Focuses on sources/process more than content - believes the researchers were interested in process more than content.

Tables 2A and 2B show the data for the four students assigned to Task #2. This task was designed to encourage students to narrow the focus of a broad topic and to relate two concepts, islands and website, for an audience of a middle-school student.

As will soon become apparent, there were noticeable differences between the individual students doing each of the tasks but less variation between groups, i.e., when grouped by task, all groups had a range of variation though the patterns of variation were somewhat different. Thus we can say that the tasks themselves did not provoke any uniform reactions from the students, nor was any one task more challenging or less difficult for all the students assigned to it.

Tables 3A and 3B illustrate the data gathered on students assigned to Task #3. This task was especially designed to elicit how students identify keywords and appropriate disciplinary resources, and how they identify the question.

Tables 4A and 4B track the data for students assigned to Task #4. This task sought to elicit how students would gather and organize information for a formal presentation, considering both audience and media.

TABLE 2A: TASK #2: ISLANDS AND WEBSITE FOR MIDDLE-SCHOOL NEIGHBOR

Student	Identifying the Info Need	Generating Steps to Locate Info	Using Tools and Resources	Considering Social Aspects/Strategies
Jose 22, Senior Business Fullerton	Perceives task as advising neighbor. Refines problem as he goes along. Complains about the generality of the topic.	Immediately goes to computer. Proceeds without commenting on his moves.	Uses only a few search terms but is satisfied with what he finds. Prints out info.	Keeps neighbor in mind.
Erik 19, Freshman Undeclared Bakersfield	Identifies task as finding info on a specific group of islands after talking with group. Focuses on geological aspects.	Immediately goes to EBSCOHost using class experience. Continues to work using familiar search engines and tips learned in English and Geology classes.	Uses familiar dbs and several search engines. Knows EBSCO has full-text and prefers it. Looks for photos and maps in Library. (not online.) Uses notebook.	Does not refer back to task or neighbor but completes task like an academic assignment.
Amy 28, Senior Social Sciences, concentration in Geog. San Francisco State	Says she knows a lot about islands so will find info on websites. Revises info need after talk with other student over an hour into work.	Often depends on others to decide on action. States she always requests help from someone in doing assignments.	Hard time developing search terms. States she is "not very good at phrases." Uses notebook.	Calls friends for help. Seeks feedback from ethnographer frequently and consults one of 2 other grp members - works alongside her.
Tracy 28, Senior Biological Sciences Humboldt	Not sure where to start. Defines info need according to perceived expectations of Facilitator.	Defines task as finding general info. on islands. Has difficulty generating next steps.	Uses only a few search terms. Saves info on disk. Roams thru journal shelves without any specific J. in mind.	Collaborates because she says it's what the researchers want them to do. Would contact prof & others in real sit.

TABLE 2B: TASK #2 (CONT'D)

Student	Monitoring Progress	Reflecting on Accomplishments and Challenges	Outcome/Product
Jose	States he has enough on islands after finding “perfect site because it has everything.” (Tho he has only looked at a few sites using one search engine.) Turns to web design. Find titles of books to recommend on Amazon.com	Finishes after 45 minutes and is satisfied with what he has to show the neighbor. Has accurately assessed his job as advising the neighbor not providing info. for her site.	Found a .com site as example of website. Thinks it’s a “great source and guide” because it has many links, even though it is oriented to tourist info, vacation rentals/ resorts etc. Written answers satisfactory: considers both islands and web
Erik	Makes written notes. Explains how the different pieces of info he is finding are related to one another, why important.	Is satisfied with what he’s found. Says he was uncomfortable in a strange library but did okay. Would normally work a few days for shorter periods of time.	Written answers address questions. Realizes topic needs to be narrowed and that there are various aspects of islands that could be looked at. No mention of web design.
Amy	Redirects search after working with other student.	No evidence of reflection recorded. Has difficulty explaining actions to Ethnog.	Written answers do not reveal difficulties in doing task. No hint of having researched web design for over an hour.
Tracy	Frequently expresses high dissatisfaction and negative evaluation of her activities.	States she has done as much as she can to find info but is clearly disappointed with results.	Written answers give no hint of difficulties. Articles collected are highly technical, last-minute choices.

TABLE #3A: TASK 3 - AGRI-BUSINESSES AND PESTICIDE USE

Student	Identifying the Info. Need	Generating Steps to Locate Info.	Using Tools and Resources	Considering Social Aspects/Strategies
Kate 19, Freshman Liberal Arts San Bernardino	Sees task as related to her interest in teaching and to agronomy - grandfather is well known agronomist. Will use what she knows from him.	Identifies keywords before sitting down at computer. Starts with agronomy, tropical regions, sanitizing. Uses a system learned in Junior High.	States she usually goes to Internet first for wider selection of info. Records citations for sources in notebook. Usually moves on after looking at 1/3 of hits.	Refers to "other students" in imaginary class. Would consult grandfather and professor for guidance. Wants her work to be unique.
Sara 27, Junior Psychology Fresno	No record of an explicit statement. Focuses on alternatives and health effects on children initially.	Pre-written plan emphasizes resources rather than content. Always starts with Internet.	Prints when the article has "enough useable content." Looks for .gov and .org sites "for credible statistics."	Wants "to dazzle audience with stats and colorful charts." Ethnog gives encouragement & redirects H's attention when discouraged.
Lea 24, Senior Letters Northridge	No record of identifying info need. At one point says she's looking for something with Cesar Chavez in it.	Pre-written plan focuses on content with tools secondary. Would have started with interviews with soil conservationist friends & farmworkers.	Records citations in notebook. Waits for "something to pop out."	Would have preferred to start by interviewing. Wants a unique slant that will help her grade. (if there was one!)
Jan 20, Junior Business & Mgt. Chico	Had "an idea in her head" that she wanted to find resources to support. Idea not explained. E. does not probe.	Pre-written plan focuses on resources. Starts with EBSCOHost and child farm workers. Internet after not getting enough info from dbs.	Cuts and pastes. Saves to disk. Knows several dbs and search engines. Comments on diffs between Lib dbs and Internet.	Comments on being bothered by Ethnog.'s presence. Gets advice from another student on computer question.

TABLE #3B: TASK 3 (CONT'D)

Student	Monitoring Progress	Reflecting on Accomplishments and Challenges	Outcomes/Products
Kate	Finds site with govt. regs - "boring but others might find it interesting." Finds Chicago Farmers site and is very enthusiastic about its value. Identifies info as "to be used" or "to be ... additional ref."	Is apparently pleased with what she's found. Thinks that combined with her grandfather's expertise it will make a good presentation.	Says she would have worked differently if she had known the questions the group would be answering. (Though they are the same as in the task.) Written answers don't address questions.
Sara	Likes Agro-K site even tho it's .com because of info on it. Wants diverse sources. Wants "professional" sites, not ones posted by anyone . Checks clock periodically.	Had been enthusiastic about what she was finding until unable to print refs. she has marked (her error). Goes to stacks but only 2 mag articles avail. , no journals she wants. Out of time. Disappointed.	Talks about "businesses" in written answers though apparently Agro-K was the only one she found. Somewhat vague answers.
Lea	Looking for "things to impress prof. and other students." Conscious of time at end.	She hoped she had what would be sufficient for discussion. Thinks she can do a good project with the info gathered.	Says she focused on "individual farmers" not agribusinesses. Repeats she would have done interviews.
Jan	Looks for "factual data" not just sensational headlines. Disappointed when not getting results from keywords. Goes to other sites.	Would ask librarians for help but is out of time.	Of these four students, writes the longest answers but with vagueness and no refs. for claims.

TABLE 4A: TASK #4 - PRESENTATION TO SCHOOL BOARD ON TOPIC TO BE INCLUDED IN HIGH SCHOOL ART

Student	Identifying the Info Need	Generating Steps to Locate Info	Using Tools and Resources	Considering Social Strategies/Aspects
Jane 35, Senior Interdisciplinary Studies with Lit and Writing concentration.	Realizes info will be used in a competitive situation. Keeps focused on School Board as audience and need to persuade them. Initially thinks topic is Jazz but rechecks task and sees it is Blues.	Begins by checking Lib floor plan and signs. Moves smoothly from one step to the next. Picks books that place Blues in context of cult and history. Gets call #s; finds books easily. Goes to dbs, then to stacks.	Asks librarian if J.s are in Lib. Lib. tells her to check on computer. Uses dbs with abstracts and later FT. Does not use WWW. Never uses microfiche because of time it takes. Bookmarks Lib sites.	Consults the librarian twice. Asks to be shown what librarian is doing so she can learn how to do it.
San Marcos				
Beth 23, Senior Business and Mgt	Says she has no plan but will just browse on computer. Never refers back to task sheet during the 2 hrs. Never refers to presentation to School Board.	Works aimlessly; wanders thru electronic search in the same way she wanders thru book stacks, hoping to find something. Last visit to Lib. was 2 yrs ago.	Says she is "very comfortable with computers" & does all her research on Internet, which includes Lib dbs. Single word searches. Complains about SJ Lib	Never refers to the audience for presentation. Consults Lib for "location of journals." Upset when Lib asks her for J. name. Wants to browse <u>all</u> journals.
Monterey Bay				
Eva 18, Freshman Psychology	"I'll find something on pottery." Later identifies task as finding content for high school class syllabus.	Wants one source for each group: Maya etc. Looks for pictures for this project	Says she uses online encyclopedias often. Usually researches via computer. Uses notebook.	Looks to E. for cues and approval. States she usually asks peers or teachers for help. Asks Lib for help.
Long Beach				
Sean 25, Senior Biological Sciences Humboldt	Searches for info for a syllabus, not a presentation.	If at home, would call teacher-friends. Goes to Google. Finds curriculum plans.	Cites reliability of sources from Harvard and other U.s.	Would call friends. "People like pictures."

TABLE 4B: TASK #4(CONT'D)

Student	Monitoring Progress	Reflecting on Accomplishments and Challenges	Outcome/Product
Jane	Searches for broad overviews, rejects narrow topics, e.g. specific Blues artists. Evaluates material for how it will help build a case. Keeps sources on disk and notebook. Checks pub dates & T. of Cont	Says the Blues are a great way to teach multi-cultural education. Has formulated a plan for presentation as she worked, starting while in book stacks.	Writes the longest answers of these four students. Cites some book and journal titles.
Beth	Searches for full text only. Never recognizes anything as being what she is searching for. Blames slow computers and being in a strange library.	States she has never seen bound journals before. Usually spends at least 15 hrs gathering info. "Only scratched the surface."	Writes that she did not find much info. No answer for 2 nd question. States she "would use people, museums and first-hand info." (cued by peer.)
Eva	Midway through says she doesn't have enough info. Keeps notes and uses copier.	Repeats she doesn't have enough info - would need more time to do this task.	Very brief, vague answers but put something minimally acceptable for each question.
Sean	Prints out information.	No reflective statements recorded. E. observes he looks bored, scattered. After coffee break, reviews what he's got and makes a plan for presentation.	Somewhat incoherent, vague answers and inconsistent handwriting. Apparently misunderstands Q#3 about how he remembered his sources.

By looking at if, or how well, students exhibited behavior stipulated in the Standards, we could say that students tend not to follow the ideal process for accomplishing an information task. (Please keep in mind that some data supporting displays of competence may be missing due to research methods used.) We might, in fact, label these students as “incompetent” to various degrees and conclude this report with a statement that students obviously need instructional programs to make them competent with subsequent assessments to see if the programs worked. End of story.

However, I am not willing to end the narrative here. The above conclusion is far too neat and predictable and not in line with the premises of this report stated in the Introduction. Let us consider instead: these students did not come back to the meeting rooms empty-handed nor did any of them give up. All of them answered written questions after working on the task, most of which would have received a passing grade if this had been a class assignment. (And given grade inflation, all would have received a passing grade!) During the two hours allotted them, only one of the 16 students finished early, satisfied with his performance. The other 15 continued to work in various ways at accomplishing the task.

The question then is: if these students were not following the proscribed path of the Standards, what is it that they were doing? If, for example, students were not “identifying an information need” early on in their work, what is it that they were doing that allowed them afterwards to answer questions and participate in a discussion?

When not trying to fit student action into a predetermined structure but rather letting the structure emerge from the data, we can better understand the organization of student activity and the ways in which students make sense of assignments while interacting with artifacts in actual environments.

PART III: WHAT STUDENTS DID

The carefree, young college student supported entirely by parents is a vanishing species if, in fact, it ever existed on State campuses. Most Cal State students have jobs - some full-time jobs – and many have significant others, spouses, children and/or parents to care for. Some are immigrants or refugees, doing schoolwork in a second language while others overcome physical disabilities or learning disabilities. Some drive long distances in rush hour traffic to get to classes.

In focus groups, study participants repeatedly confirmed that with all their competing obligations and situational contingencies, their most valuable and scarce resource is time. In fact, there was not a single group in which time was not brought up (without prompting from facilitators) as a major constraint.

The research study replicated the time crunch students normally experience by setting a two-hour time frame for activities. The participants were not required to complete the task but only to make headway although on some occasions the facilitators conveyed ambiguous messages about expectations. Some students completed the task during the two hours while others felt they had barely scratched the surface. Still others fell in between, feeling they had made significant progress but had not completed the task.

Heuristics As Time-Saving Strategies

Striving to accomplish acceptable work in limited time, students develop heuristics for dealing with assignments based on their own experience both in and outside of school. Table 5 shows the most commonly used heuristics cited by the 76 participants in the study.

TABLE 5: COMMON HEURISTICS USED BY STUDY PARTICIPANTS

1. "Go with what you know." (Pertains to both methods and content.)
2. "Get as much as you can as fast as you can."
3. "Ask someone for help."
4. Find something that is "good enough," not something that is ideal.
5. In electronic searches, a lot of records returned (e.g., 3,020 or 5,778) is better than a small number of hits. (e.g., 7 or 12.)
6. After reviewing X amount of records returned, start another search. (X is either a percent or a number.)
7. Just browse until something jumps out at you. (True for PL and EL)
8. "When you're out of time, you've got enough."

N.B.: Some of these are representative quotes from students; others are paraphrases combining quotes from several students. Only the most common heuristics are included, based on statements made by all 76 study participants.

Sometimes these heuristics are extremely useful and contribute to student success. There is nothing inherently wrong with the heuristics but when interpreted with misinformation, or applied in contexts unlike ones in which they were developed, heuristics may become handicaps to accomplishing work efficiently. However, the alternative – following an idealistic process that assumes unlimited time to devote to one's studies – is impossible. (See Gigerenzer, Todd and the ABC Group, 1999 for a discussion of how and why professionals use heuristics at work instead of idealized procedures learned in school.)

Students plunge in, eager to do well but sometimes hampered by the very strategies they believe save time. So what exactly is it that they did during this exercise?

The Three Stages of Student Work Processes

When searching for similarities in participants' work, a pattern emerged from the data that was seen in all 16 students' activities. This pattern or process consists of three stages: an initial phase in which students search for and quickly discover a conceptual "thread" to get them started; a second phase in which they weave multiple activities onto the thread using it as a background support, and a brief third stage in which students tie a knot at the end of the activity pattern to conclude their work. I will explain each of these below.

Furthermore, students applied heuristics at various points in their information activities, a factor that not only contributed to variations in their

processes but also resulted in different degrees of success³ in meeting their goals.

³ Success is measured by students' own self-assessment. However, students identified expectations of the research team quite accurately and knew when they were close to meeting them, or failed to do so.

Stage I: Finding a Conceptual Thread

The single most important factor associated with student success in working on the task was whether or not the student was able to find an appropriate conceptual “thread” with which to enter activity. Class standing, major and age were not significant factors in student success nor was frequency of library usage online and/or in person.

It is difficult to gauge the impact of instruction in library use. The students were asked whether they had ever had instruction in using the Library for research. In response to this broadly worded question 15 of the 16 students said they had, but we don’t know if the instruction was a general overview or specific instruction related to a class. In focus groups, the 76 study participants differentiated between general tours or orientation classes vs. instruction specifically targeted to an assignment or discipline. They found specific instruction very helpful but general orientations not useful. Furthermore, as we will see, finding a conceptual thread for an academic task is more likely to be linked to classroom preparation than instruction on resources.

Is finding a thread the same thing as identifying the information need? Although there are some similarities, finding a thread differs in two respects. First, the thread appears as a flash in a moment of insight similar to the “Aha!” moment of inspiration for artists (Csikszentmihalyi, 1996) and second, it consists of a single phrase or word that acts as an organizing principle for the student’s initial activity and becomes the backdrop for the rest of their work.

Is finding a conceptual thread the same thing as deciding what the goal of one’s information search is? Again, the answer is no. Finding a way to get started may have a relation to a perceived goal for some students, but it doesn’t necessitate that the searcher has clearly identified a goal. In fact, we see instances of shifts in conceptions of the goal as students acquire new information. The thread allows them to initiate activity during the course of which they can define and redefine their goal.

The most interesting observation about this initial stage is that only one of the students ever rethinks their selection of a thread. As we will see later, this exception occurs because the student frequently uses the heuristic, “Ask someone,” adding her own special twist: “Ask a peer and do what they do.” But for everyone else, once the conceptual thread is decided on, there is no turning back. This works well for students who pick a strong thread, but for those who start with weak threads, it becomes their downfall. They are committed and forge ahead even when they encounter difficulties and warning signals that their work is in danger of unraveling.

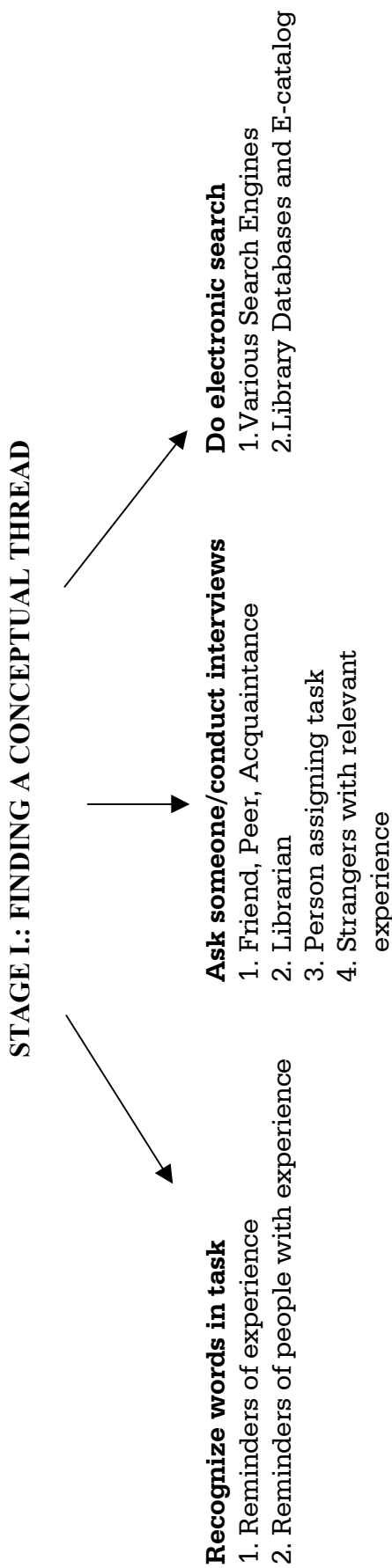
Students found threads in one of three ways:

- 1) By reading the task and recognizing reminders of their own past experience⁴ or reminders of someone with relevant experience whom they could ask. (Applying the “Go with what you know.” heuristic, sometimes combined with the “Ask someone.”)
- 2) By engaging in social interaction, asking others for advice or help, directly or indirectly. (Applying the “Ask someone.” heuristic.)
- 3) By using a word or two from the task as keywords and relying on the WorldWideWeb or electronic databases to “make suggestions” for ways to direct a search. (Applying the “Just browse until something jumps out at you.” heuristic.)

In this way, every student was able to do some form of information seeking even if they found little to retrieve and could not adequately answer the task questions at the end of the two hours.

⁴ I prefer the term “experience” for theoretical reasons. Others might use “background knowledge.”

TABLE 6: THE FIRST STAGE



Finding Strong Conceptual Threads

The fact that all students discovered a thread doesn't necessarily mean that their threads were the best ones for meeting the task challenges. Sometimes the thread was appropriately matched to the task. For example, in Task #1 Ty early on states he is going to be looking for "a wide range of resources" in order to compare the two views on global warming. By keeping this phrase uppermost in his mind, Ty proceeds smoothly from one source to another finding information on the two views. He is reluctant to use the Web, however, and does so only when a researcher misunderstands his question about the Library homepage and directs him to a browser. Ty explains that using only the Library resources will assure he gets credible information and will not be overwhelmed with too much information.

Ty uses the heuristic: "Get as much as you can as fast as you can." He does read and evaluate at least some of the material before copying it and in two hours alternates between talking to others, using the Paper Library, using the Electronic Library, going to the bookstore and going to the bulletin board in the Biology Department, which he discovers is locked on Saturdays on the Sacramento campus.

In Task #2, Jose relies on his experience in working in a computer lab at a high school tutoring program to identify his goal as **advising** the middle school student on how to construct a website on islands. Although many study participants defined the task as amassing as much information on islands as they could, Jose can place himself in this imaginary scenario quite easily because of his work experience and does not try to do the student's work for her. He used the heuristic: "Go with what you know."

He later uses the heuristic: "get something that 's good enough, not the most ideal." Jose completes the task in 45 minutes, the only participant to not take the full time allotted. He does not search endlessly for Web pages to serve as a model for the middle school student. Rather he chooses the *islandsmagazine.com* site after only looking at a few other island sites. As he explains, this site's content will interest the middle school neighbor and be more than adequate for explaining design principles even though it's a commercial site oriented to tourists.

In Task #3, Lea's thread would have been talking to soil conservationist friends as well as farmworkers she knows, using the heuristic: "Go with what you know." She continues to refer to this thread throughout her work even though the research design does not allow her to proceed in the way she wants. Reluctantly going to the computer, she is uncertain of where to search on the databases or Web and applies the heuristic: "Just browse until something jumps out at you." But at some point she thinks of a few connections to the thread she wanted to use.

In lieu of not being able to interview her farmworker friends she searches for “something related to Cesar Chavez” and turns up some relevant information. In lieu of not being able to talk to soil conservationist friends, she goes to the EPA site, an agency she has heard them talk about, and to Region 9, which includes the San Joaquin Valley she knows well. Later Lea uses the heuristic, “when you’re out of time you’ve got enough.” Although ambivalent about the information she’s been finding, in the end she decides what she has will be good enough for the afternoon discussion.

In Task #4 Jane’s thread is: a persuasive presentation competing with others. She has reformulated the task in her own words. Although we don’t have any data to explain her ease in perceiving the task and selecting a thread, we can conjecture that this 35 year-old Major in Interdisciplinary Studies has some experience to rely on. By keeping in mind the context of use, Jane is able to identify resources that will strengthen her argument for including Blues in the curriculum, citing the Blues’ connection to the history and culture of African-Americans. By incorporating this topic in the curriculum, Jane says, “students will be getting a multi-cultural education while studying the Arts.” She uses the heuristic “ask someone,” which she explains is a timesaving strategy. The person she twice asks for help is a librarian.



Figure 1: Search With A Strong Thread

Finding Weak Conceptual Threads

At other times, the thread is not well matched to the task but it nevertheless gives students a way to begin work. For example, in Task #1 Tim's thread is found by asking another participant in his group what they're supposed to be doing. She tells him "to find the causes of global warming" rather than what the task is actually asking: to decide whether global warming is a hoax or a valid concern. To find his thread Tim used the heuristic: "ask someone."

There's nothing wrong with the heuristic Tim employs, "ask someone," but it might have worked better if he had asked the group facilitator or a librarian. Students who typically ask other people for help must be sure they are asking a person who can supply the information. For them the critical issue is identifying the right person to ask. Tim asks another student in the group, presumably based on the fact that she appears confident, is older and talks with authority. Yet she gives him only a medium-weight thread, not the best one on which to hang his information activities.

Tracy's conceptual thread in Task #2 was "finding general information on all islands" based on her interpretation of the facilitator's statements. (This unique case is discussed at length in the Phase II report.) Tracy attempts to clarify the task by directing a question to the facilitator but the response does not answer her question. Rather than asking another question, Tracy struggles with the interpretation of everything that has been said in her group and the way the research project is set up with small groups and a computer room. She appears to be a student who wants to please the researchers and she perceives the researcher-facilitator's explanation as meaning she is not to narrow her focus but gather general information on all islands.

Again, the heuristic "Ask someone." does not have a negative value but Tracy's particular interpretation of it does. In her case, "Ask someone until you are satisfied with the explanation." would have been a better formulation. Thus, we see that in seeking information orally from other people, the inquirer not only needs to know whom to ask, as in Tim's case, but also how to ask.

Kate's thread in Task #3 was Agronomy and her grandfather agronomist. She uses the heuristic: "Go with what you know." In doing an electronic search, Kate uses the heuristic: "After reviewing X amount of hits, start a new search." This heuristic allows her to search until she "loses the scent." Although it's clear that Kate is a competent user of the Internet and Library databases and she uses an established process to find, retrieve and record information, her conceptual thread is weaker than she realizes and she is unable to answer the post-task questions. She remarks to the ethnographer that if she had known what the questions were going to be she would have searched for other things. Interestingly, the post-task essays ask essentially

the same questions that are found in the task. But Kate has not rechecked the task.

When asked to write down what she will do before beginning the task, Kate lists: "Look up info on Agronomy, look for info on pesticides, look at studies on tropical regions, see if there are previous studies of diseases in these regions, maybe look up info on current laws, child labor laws (what they can be around) and proper sanitizing measures." But though these topics are all related to the issue at hand, exploring them did not help in answering whether businesses realize that using pesticides is a problem and what alternatives farming corporations have while still making a profit.

Kate has used the heuristic: "Go with what you know." She tells us a few times that her grandfather is a world famous agronomist and she would get a lot of information from him and, in fact, knows something about the topic because of him. The task has reminded of her grandfather in whom she has a great deal of pride and what she has learned from him. However, the triggering of this personal link has interfered with considering other interpretations of the task. Kate proceeds confidently, thinks she has done well, and is only disappointed when she reads the essay questions.

Beth's conceptual thread in Task #4 becomes "just browsing for anything on pottery." She ignores the larger context of the task and how the information will be used. Her focus becomes finding information on Maya, Aztec and Navajo pottery and she uses a heuristic she has employed often in the past: "Just browse until something jumps out at you." Searching on the Web and in the Electronic Library, she uses the keyword "pottery" and when that is unsuccessful she adds "Aztec," "Maya" and "Navajo" one by one in front of "pottery." At a later point she uses "ancient cultures" as a keyword which seems to be gleaned from a website she's visited.

Sometimes she actually gets lucky and turns up some promising links but she scrolls quickly by. It's difficult to tell whether she doesn't see them because she's moving too fast or whether she discounts them because they don't actually say: Maya pottery or Aztec pottery. However, I tend to think it's the latter for two reasons: one, the speed with which she scrolls the page suggests she is looking for a specific word rather than reading the links on it and two, because several times this Business major cites her complete lack of knowledge about the topic as a constraint and thus, "Art Forms of Maya Culture" or "Art in Ancient Mesoamerica" may be meaningless to her. She does not generate any terms that would help her "drill down" in exploring this topic or place it in any larger context.

Midway through, Beth decides to use the Paper Library. She fares no better here because her attempts to get help are not worded in a way that conveys her needs to the librarian nor does the librarian attempt to clarify her

objectives. Since she has not been in a Paper Library in almost two years and has no sense of how it is organized, she wanders through the stacks becoming more and more frustrated and complaining that it is not like her home library at Monterey Bay that contains more electronic resources.

Each of these four participants' conceptual threads serves as their starting point and continues to inform and influence what they did during the two hours. Each student locates, retrieves and saves some information except Beth who does not save anything. Yet in the end, Kate, Tracy and Beth all evaluate what they have found as not being acceptable for the task. Furthermore, their search does not help them provide answers to the task questions. Tim is an exception.

Even though the thread Tim is using is not an exact match to the task, it is from a related area, which allows him to suddenly switch over when he sees the essay questions and provide appropriate answers on the post-task essays. The thread Tim has been using, "the cause of global warming," has given him the kind of information to decide whether global warming is a hoax or a reality.

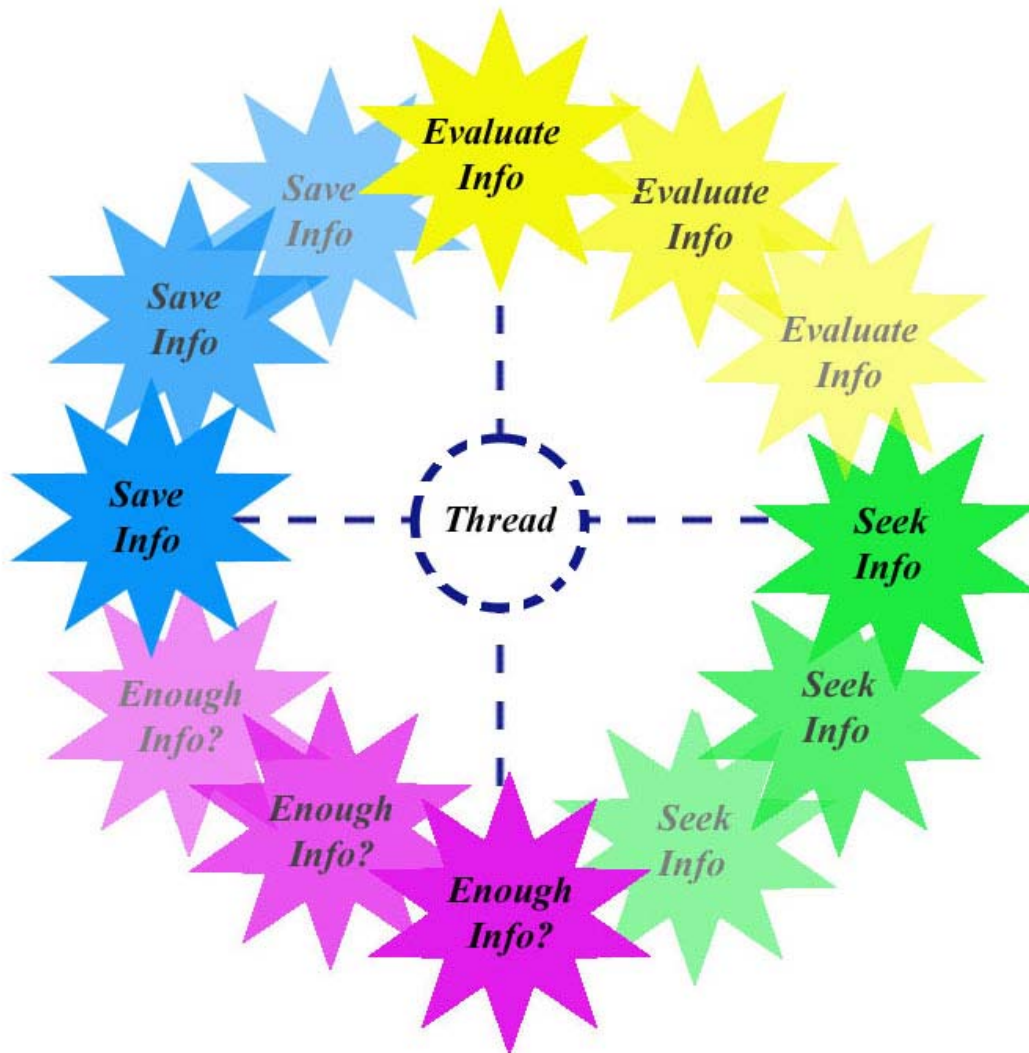


Figure 2: Search With A Weak Thread

The Importance of the Right Thread

Experience in academic and non-academic settings, interactions with others, and words in the task provided the conceptual threads for searchers. Once identified, the thread becomes a tacit theme running throughout the course of student work. But the thread needs to be strong enough to support the development of information activities. Even students who were savvy computer users and who selected and saved a number of online sources were not able to find information relevant to the task if the conceptual thread they had chosen was a weak one.

Furthermore, four students had little or no relevant experience to draw on and did not ask for information from appropriate others until satisfied. Instead they relied on the Web or Library databases by using one or more words from the task. These single words or phrases were very slim conceptual threads on which to hang information activities. When these students didn't make a serendipitous finding, as they hoped, they were disappointed that their largely unintentional searches were fruitless.

This particular group of students presents some interesting issues in Web and EL work. In addition, three students who were not able to follow their normal process of talking to friends first had similar issues arise though they were able to partially resolve them by remembering some remnant of what they knew from their friends or by talking to a peer

Stage II: Weaving Activities Onto the Thread

After settling on a conceptual thread, students then moved into a stage of alternating between several activities. At times this alternation is almost imperceptible because it is done so quickly and unconsciously. Yet the various activities become part of a single fabric of work. Thus the metaphor of weaving is used to describe the process.

In doing the tasks students wove together five activities: 1) seeking information, 2) assessing if and what part of the information had some degree of relevance to the task, 3) saving information in some form, 4) making connections between the pieces of information chosen and the task, and 5) deciding if the information obtained was sufficient for the purpose.

The data support that all students engaged in these activities with the exception of #4; there is no evidence for five of the students making connections between the pieces of information chosen or between the information and the task. Three of these students self-assessed their work as unsatisfactory and they clearly did not find information relevant to answering task questions. Data on the other two students is somewhat mixed.

In focus groups, some students volunteered that they did not follow a linear process in researching and writing class papers. Ordinarily they found themselves weaving back and forth between different components of the task. For instance, one student said she would often start writing the paper and then find she needed further information and so would do more research before continuing the writing.

Another student said she made “notes” as she researched, the notes actually being statements she would put in her paper, her thoughts triggered by reading. She continued that she rarely conceptualized her work as a linear process in which she completed the research before doing the writing, or that she used one resource such as the Internet and then went to other resources. Rather she worked back and forth between different resources as well as task components until pushed for time, she wrapped things up. Other students also spoke of this nonlinear process or offered evidence of having worked this way in the past.

The process the students describe is consonant with what we know of models of the mind. Our conceptions of how the mind works are influenced by the technology of the times. (Gigerenzer, 2000; Pulliam, 1993.) As Searle (1984) noted, in his day the mind was thought to be like a telephone operator’s switchboard. The later computational model of mind depended on the linear models of computing prior to the development of parallel processing and synthetic neural networks. Thus, in the 1950’s and ‘60’s it was much more common to idealize linear processes in which one step was completed before moving onto the next.

More recent thinking rejects the computational model of the mind and sees the brain/mind as a giant parallel processor (Pinker, 1997; Plotkin, 1997) or rejects parallel processing or any kind of computational model as telling the whole story of how the mind works. (Fodor, 2001) The brain is seen as consisting of thousands of circuits that light up at the same time, absorbing multiple inputs simultaneously.

Current technology not only serves as a metaphor for our models of the mind but through its use, it influences our thought processes. Thus, it is no surprise that students weave between various elements of a task in a day of “multi-tasking” when Windows allows us to work back and forth between three or four documents or have two or three windows open on the same screen. In short, students are adapting to the new technologies in the same way the rest of the computer-using population is doing, and their thought processes are being influenced by the ways in which computers work. What was conceptualized in the past as discrete activities are now understood as activities constitutive of each other.

Stage III: Tying Things Up

Running out of time was usually the impetus for this last stage. Without prompting, students usually made some summary statement evaluating the usefulness of what they had done. In this exercise, the context of use referred to was either the research discussion group or a mix of the research discussion and the imaginary context described in the task. All students also felt the impetus to bring some artifact back to the group in the form of printouts, photocopies or books located in the library so if they had not yet done so, they quickly selected materials.

Moving Between Different Realities

Weaving is not only conceptual but is accompanied by students' movements in physical space between various sources of information. Rare is the student who uses only one resource and wraps things up. Rather searchers move between sources of information in Primary Reality, i.e., information from their own experience and from social interaction with others, information sources in Symbolic Reality such as found in the Paper Library, and sources in Electronic Reality such as the WWW and the Library's Electronic databases. Table 7 shows the movement of students between these various types of information sources.

TABLE 7: Student Use of Primary, Symbolic, and Electronic Information Sources

Orfa	Tim	Rosa	Ty	Jose	Erik	Amy	Tracy	Kate	Sara	Jan	Lea	Jane	Beth	Eva	Sean
EPI	SI-P	EPI	SI-P	EPI	SI-P	SI-P	SI-P	EL	EL↓	EL2	[SIF]	SI-P	EL	EL	[SI-F]
EL	EPI	EL	E/PL	Task	EL	[SI-F]	EL↓	Save	EPI	EPI	EL	PL	EPI	EPI	EPI
SI-L↓	SI-P	Print	[PL]	Print	EPI	EPI	EPI	EPI	EL	SI-P	EPI	E/PL	EL	SI-L	EL
Break	EL	EPI	EL	Out	Notes	SI-2F	SI-P		Print↓	EPI	Print	SI-L	EPI	EL	Print
EL	Break	Print	EPI		SI-L	SI-P	EPI		SI-P			E/PL	EL	Task	Break
EPI	SI-P	PL	Out		PL	Break	SI-L		SI-L			PL	EPI	Copy↓	Plan
Print	SI-L		SI-P			SI-E	PL		PL			Copy	EL	SI-L↓	
E/PL	PL		PL			EPI	Copy		Copy			PL	E/PL	Copy	
PL	Copy		Copy↓									E/PL	SI-P	PL	
SI-L	Read		Out									SI-L	PL	SI-L	
												EL	SI-P		
												Save	E/PL		
													SI-L		
													PL		
													SI-L		
													PL		

{TASK #1 : Global Warming } {TASK #2: Islands and Website} {Task #3: Businesses & Pesticides} {Task #4: Presentation, Arts}

CODE: SI-P, SI-L, SI-F – Social interaction with peer, with librarian, with friend (Noted only when seeking info.)

EPI – Electronic Public Information (WWW)

EL – Electronic U. Library (databases, e-books, misc. online)

E/PL – Uses online catalog to locate books in Paper Library

PL – Paper Library

OUT – Goes outside library to book store, department bulletin board

Task – Checks Task

↓ Indicates unsuccessful attempt

| | Indicates what the student strongly preferred to do but couldn't due to research design.

General Observations About Students' Trails

Table 7 tells us that students do not use the WWW quite as much as we commonly believe, with only 3 of the 16 students beginning their work by going directly to the Web. One student never used the Web while another used it only because a researcher directed him to it though he does not normally use the Web for research. The chart also shows that students use social interaction to accomplish their work probably more than we realize, though more of it takes place with peers than with librarians. The Electronic Library and Paper Library are used just as much as the WWW.

Furthermore, students moving between these types of information sources show some dexterity in crossing between information modalities but at times encounter some difficulties. Some students prefer and actually are more proficient in getting information from other people, others prefer reading and handling physical artifacts while others prefer and are most proficient in using electronic resources. In the grand scheme of things, we must focus attention on all three modes and students' trimodal skills.

Preferences in information modalities bear some resemblance to learning styles, of which all educators are now aware. However in talking about students' modal preferences, it is important to avoid the pitfall of learning styles, i.e., interpreting learning styles to mean that students should not be expected to acquire abilities inconsistent with their styles or preferences. Though it may be more difficult for one student to construct good questions when seeking information face-to-face while another has more difficulty in generating good strings of keywords, this does not mean that both students should not strive to improve their skills in the environment in which they are weaker

Working in different modalities requires an awareness of the structures and affordances of each environment. Moving between Realities requires an adaptation of strategies for seeking, evaluating and saving information. The construction of the Electronic Library is not directly parallel to the organization of the Paper Library. Nor is the Electronic Library just like the WWW. Although there are similarities, the significant differences in organization and processes evoked by each can account for errors when students think they are the same.

Selected Cases Illustrated in Table 7 and What They Tell Us

This section highlights four examples of ways that students negotiate work between Information Realities. Sometimes procedures from different realities are integrated effortlessly. Sometimes students are able to compensate for what they don't know how to do in one by using procedures from another. At other times they are able to "repair breakdowns" in their searches by switching to another Reality. However this strategy can result in frustration when different information realities are assumed to be the same.

Librarians collaborate in the achievement of student success, sometimes providing more helpful information than at other times. How a searcher asks a question and how it is interpreted by a librarian play a part in students' achievement of competence. Librarians create a bridge between Primary Reality and Electronic Reality and collaborate with students in negotiating all three Realities.

Erik is an example of a student who uses face-to-face interaction, the Electronic Library databases and online journal articles, the Web, and the Paper Library, in that order. Only a freshman, Erik has done better than many other participants doing Task #2, recognizing the need to narrow his focus, the value of conferring with other group members, and using what he has learned about databases in an English class and about island formation in a Geology class at CSU Bakersfield. ("Go with what you know.")

Erik's notes serve him well but are an example of using practices from Symbolic Reality while in Electronic Reality. Rather than copying and pasting, and saving to disk, Erik saves the information he needs by copying from the screen in handwriting. This takes much longer but also gives him an opportunity to think about what he is finding. (Earlier when given a copy card and disk, Erik returns them, saying he doesn't use them.) Two of the other 15 students also use this way of saving electronic information. This "Reality-mixing" does not interfere with accomplishing their work.

The one difficulty Erik encounters is in asking for help in the Paper Library. Standing near the Reference Desk, he first asks the ethnographer whom he should ask for the location of maps. The ethnographer tells him the Reference Desk, whereupon Erik turns and goes to the Circulation Desk. The Circulation Desk points him towards the Reference Desk where he asks: "Where do I find atlases?" He is directed towards the back wall but cannot find the topographical maps he wants in the atlases. Instead he finds geographical, socio-cultural and road maps.

A more refined question from Erik or a query-response from the Desk staff might have led him to what he wanted. But at this point, it is about time

to wrap things up and Erik needs a break. He says he would feel more comfortable in the CSU Bakersfield Library than in the big Northridge Library.

Sara, on the other hand, encounters difficulties when she is unable to print the four most relevant articles she wants from the Electronic Library and decides to go find them in the Paper Library instead. She copies the information from the screen in her notebook. Asking the Reference Desk where to go for the specific journal titles, she is directed to the third floor journal desk. But the Reference Desk staff also tells her that only two of the sources she wants are available in hard copy. They are from “non-scientific magazines” and she is very disappointed at not being able to bring back professional journal articles to her group assigned to Task #3. She photocopies the two short articles saying that neither one would be good enough for writing a paper.

This example demonstrates that sometimes mixing realities is only partially effective or not effective. Although Sara may have checked for holdings online, she instead goes to the Reference desk where she is directed to the journal desk on another floor. Substituting the Reference Desk for the online library catalog still gets Sara what she wants. However, attempting to retrieve hard copies to substitute for electronic copies results only in disappointment. If Sara had not perceived the Electronic Library as a replication of the Paper Library, would she have worked harder to find out how to print out her articles? Unfortunately we can only conjecture, as there is no data to inform us.

Eva begins her work on Task #4 by checking the Humanities abstracts in FirstSearch. There seems to be some confusion, as she believes she is finding books, not articles, in this database. She copies down in her notebook three different references, one for Maya, one for Aztec and one for Navajo. She then goes on the WWW, saying it has a lot more information and you don't need to look at books. Accessing Google, she looks for something on Aztec pottery. Not finding anything, she says: “At least I have a book I can look at in the Library for the Aztec. I'll go to Maya.” On this occasion the Paper Library is seen as a backup when information on the Web is not forthcoming. (Since she never tries to locate these references, Eva never discovers they are journal articles, not books.)

Later, Eva decides to look in an encyclopedia to get the history of the cultural groups, which she has now decided is a relevant piece of information after seeing some sites that include history. She attempts to locate Encarta but can't. She asks for help from a researcher/facilitator/faculty member and he tells her he's not supposed to help her. So she asks the ethnographer whom she should ask. The ethnographer suggests a librarian, but Eva says: “No, that's Okay.” She proceeds to find Grolier's Encyclopedia online and

print out some excerpts. Apparently she has remembered an equivalent resource.

At another point in her search Eva consults a librarian about where to find pictures of Aztec, Maya and Navajo pottery. The librarian does a search for her in the library catalog and gives her the call numbers of a few selected books, which Eva writes in her notebook. She then directs Eva to the second floor. By asking for assistance, Eva has unintentionally circumvented searching the Library catalog and locating the stacks. By mixing methods from Primary Reality (talking), Symbolic Reality (writing notes), and Electronic Reality (searching the e-catalog) the librarian and Eva collaborate to find information that is exactly what she wants.

Working on Task #1, Rosa does not seek information through social interaction and has no background knowledge in science, which she says she “hates.” This Freshman from Monterey Bay limits herself to interacting with the computer to give her some direction. Furthermore, she doesn’t know what “hoax” means and asks the ethnographer after she is seated at the computer starting her work. The ethnographer tells her it’s something that’s “not true,” a definition that misses the subtler implications of “hoax.”

As a speaker of English as a Second Language and as an immigrant who has only been in the U.S. for a year, 19-year-old Rosa is at a disadvantage in Primary Reality. She is reliant on electronic sources but there also language is problematic. She seems to understand the task and stay focused on searching for two views of global warming. She has a fundamental understanding of the Web and the library databases but does not know how to access the Paper Library’s catalog.

Rosa often misspells words but doesn’t realize it and doesn’t correct misspelled keywords that yield nothing in unforgiving databases. Rosa is certainly not the only student to misspell search terms, and not the only person to not check her spelling when no results are returned. But since she relies wholly on electronic sources, it is a bigger obstacle for her.

She turns to the ethnographer for advice and assurance, which is given regarding procedural matters. Rosa is highly aware of the ethnographer’s presence because of the steady stream of questions she is bombarded with. Because of all the questions, she asks the ethnographer if what she is doing is wrong. (It may be she didn’t understand the ethnographer’s purpose.) In the afternoon focus group she complains politely about being shadowed, saying it was very hard to have this person always asking her questions. Because Rosa speaks softly and sometimes haltingly, the ethnographer falls into the routine of making a statement and asking her if that’s what she thinks. Rosa then answers “yes.” (She never answers “no.”) Interestingly, the facilitator adopts

the same strategy so we don't get to hear many explanatory statements from Rosa in the focus group.

There is one other immigrant student in the study who clearly speaks English as a Second Language. This 18-year-old Asian from CSU Sacramento is a computer science major who spent his entire two hours at the computer. He says it is the only way he ever seeks information. There are a few other students in the study who are bilingual but it is possible they grew up in the States learning both languages at the same time. Without data on language background, it would be unfair to compare these others with the two recent immigrants. At any rate, bilingual students might be a group of special interest considering California's demographics.

Summary

Participants in this study went through a three stage process in completing their work: 1) finding a conceptual thread, 2) weaving information activities onto the thread, and 3) tying things together with a brief self-assessment of the adequacy of their findings. Throughout the process they applied popular heuristics that they believe save time.

Students accomplished their work by working in, and between, three Information Realities: Primary Reality in which they obtain information through direct experience and social interaction; Symbolic Reality in which they use print media; and Electronic Reality in which they use digital sources. Participants mix methods from the three Realities to accomplish their work. This is sometimes effective and sometimes an impediment.

Students may have developed preferences for blending methods from different Realities and this should not be viewed as incompetence but rather a demonstration of proficiency in mixing Realities. At other times students mix procedures from different Realities when they haven't learned procedures consistent with the Reality they are in and also when they engage in "repair work" after breakdowns. Alternating between Realities is one solution to coping with a breakdown but its success depends on how analogous the Realities are.

Using procedures developed for use in one Reality while in another Reality does not necessarily impede student work. Sometimes it can help students accomplish their task. It only becomes problematic when students do not discern the differences between environments.

PART IV: THINGS TO THINK ABOUT

Conceptual Threads vs. Plans

Some readers may be alarmed that students did not spend more time in analyzing the task and planning a strategy to answer it before springing into action. However, a classic study in human-machine interaction (Suchman, 1987) shows the inadequacy of plans that do not, and **cannot**, take into account the moment to moment contingencies of situated action. In Suchman's work the plans were written by someone other than the person trying to execute them. But the same idea appears in work on organizations in which planners and executors of the plan are one and the same. Indeed Weick (1979) argues that the utility of plans is as an instrument to invoke after the fact rather than as a proscriptive for action. Korzybski, cited in Weick (1979), tells us: "the map is not the territory."

We also know that in self-reports, people make their accounts fit a familiar model, omitting the situated factors that led to actions not fitting the plan. And we have evidence that cognition is highly dependent on the situation in which it takes place; in fact it is constituted by the person, the activity and the environment. (Lave, 1988; Hutchins, 1995) Or as Dourish (2001, p.63) states: "No matter how clearly or carefully framed, a process description can never eliminate the need to interpret it for specific occasions."

In fact, most students had a plan stated in terms of the resources they would employ in conducting an information search but did not have anything resembling a plan of the ideas they would pursue or the conceptual apparatus they would build. Of the 43 students who wrote down how they would go about their work, 30 listed the resources they would use while only 13 focused on the conceptual paths they would pursue. Of this 13, only one had a step by step plan; most listed fragments of ideas or single words. A few wrote full sentences about ideas they would pursue but not how the ideas related to one another. (See Appendix D for examples of student plans.) Even those with a plan listing resources did not necessarily follow the plan once underway.

Because of the vast amount of information available to students, they cannot possibly stick with a conceptual plan, not knowing what they will encounter that may improve their concept or drastically reshape it. More realistically they can begin with an idea about the context of use for the information and plan where they will go in their electronic search to further their thinking. In fact, students recognized the contingent nature of their work, especially when using electronic sources. The excerpt below demonstrates that what might be interpreted as a plan is actually a description of the contingent nature of student work:

*She explained, once the search results were brought up on the screen she would be able to narrow the field of resources at her leisure. **If** something interrupted her, she could bookmark the page and return to the same spot without going back through the process all over again. The scanning process begins with the websites to see **if** they contain more than one of the keywords highlighted in the beginning of the process. **If** a site appears to be a possible source of information she would read the description. **If** this method rendered the result of more than one, [more than one result] she would click on the link... to determine **if** this was a keeper. **If not**, she used the key to move back to the list. **If** it looked as though it would be helpful, she saved it on disk. **If** she was not sure of either, she would bookmark... (Ethnographer's notes on Kate while working on the task; emphases in Bold blue are mine.)*

This is a statement not so much of a conceptual or procedural plan but of all the various contingencies the searcher needs to deal with as she proceeds in her search. Since there are a greater number of contingencies in an electronic search than in the library of yesterday, students do not, and indeed cannot, construct a specific plan prior to going online. However, the intention behind writing a plan – making a search goal-directed – can be preserved through reflection-in-action (Schon, 1983) while pursuing a strong conceptual thread related to the context of use for the information.

Thus I would argue that outlining a detailed conceptual plan before wading into the waters is a time-consuming activity that may have little relevance for actual searches. A conceptual thread, an idea with which to begin, may be sufficient **IF** searchers reflect adequately on their moment to moment choices. In yesterday's card catalog library, pre-planning made sense. But in today's interactive environments, having an idea with which to initiate activity, a strong conceptual thread, may be all that's needed. To be avoided are weak conceptual threads and this can be mitigated by substantive classroom discussion before a search.

This may sound like outrageous heresy to some but we are working in an era of high-speed change when in order to control how technology is used, we need to consider whether norms in use when only print media existed can be transferred to new media. Some norms may and some may not, but which is which? I am not advocating wholesale abandonment of long-standing principles but only an investigation into which ones work better than others in different media. I hope my suggestion spurs dialog in this regard.

The Central Problem

By widening our lens to see the big picture, we find the source of students' difficulties is twofold: both foundational skills (e.g., spelling, reading comprehension, seeing relationships) and metacognitive skills (e.g., reflecting

on progress, monitoring time, generating steps) are necessary to completing information work successfully. It has also become apparent that rather than trying to move all students towards working exclusively in Electronic Reality, the challenge instead is to assist them in becoming trimodal. Reflection and other metacognitive skills are essential to developing trimodal fluency, which bears some resemblance to trilingualism.

Computer searches and saving to disk are believed to be more efficient ways of accessing and retrieving information. Yet the sheer speed of using electronic media results in a tradeoff in reflection and generating one's own ideas about where to search and what information is needed.

Using electronic media can also be less efficient if one's search is well targeted; in the cases of Jane and Ty, they chose to not use the Web as a way to avoid being overwhelmed with irrelevant information. They preferred the Library catalog to the electronic databases because they had specific ideas of what they were looking for. If one has a craving for spaghetti, why go to Home Town Buffet, when Angelo's Pasta House is across the street from it?

Learning how to use electronic resources effectively is certainly an important goal but even more important is learning how to think and reflect about information in any mode. If an individual cannot accurately assess whether information is relevant to their purpose or what additional information is needed, it little matters if they are using electronic sources or the paper library or obtaining information through interviews or conversations.

Electronic media encourage quick decisions and deprive students of opportunities to reflect as is required when working with print sources. In the Symbolic Reality of the Paper Library, a student must decide where to go next while on the Web, suggestions abound for where to go next. As one student put it:

"With the computer and the Internet, the search just takes on a life of its own. You start on one page and click on and you just keep going. What I had planned to do – it just didn't turn out that way. You just go with the flow and take a look at all the information you got. Just keep clicking on links – it's hard to stop."

The key to student success is not pre-planning but reflection-in-action. When working in the Paper Library or conducting experiments, observations, or interviews in the field, a student may reflect on where to go next or may consult a peer or librarian. But in the process they usually don't fully explicate their thought process. Thus, despite the drawbacks of electronic media, they have one saving grace, and it's a big one.

A Possible Solution

Electronic media allow for intervention **during** an on-going search unlike what is possible during a search in the Paper Library or an investigation in the field. In this way, student searches can be subtly guided in such a way as to maximize foundational skills and metacognitive skills. Thus, the quick, nonreflective action encouraged by electronic media can be countered by changing the affordances offered by the Web designers. Other designers can counter the passive affect currently induced by the Web and to a lesser extent, online Library resources. The Web does not have to shape student searches if we develop scaffolding⁵ tools to promote thoughtful use of electronic resources.

Scaffolding software can be a subtle support for student work. It allows the searchers to stay focused on their task. It can help them articulate the processes they usually do tacitly and elicit reflection on what they are doing. It does not have to be accessed by a separate menu but can be an integrated part of student work.

Traditional software helpers or assistants stand apart and need to be consciously accessed; the student then needs to apply the general all-purpose directions they give to a specific piece of information, source, or search process. Tutoring programs also have the same design in that they are accessed through a menu that then leads students through certain questions or things to consider. But a scaffold becomes an integrated part of the search interface, being less obvious and subtly leading students to think through if and how each piece of information chosen in a search relates to the task or question. It can also help in identifying the conceptual relationships between different pieces of information.

The major problem with scaffolds is the question of how to fade them out so that students start doing naturally what they were formerly supported in doing. However, it's not an unsolvable problem. Another issue might be whether the scaffold could be used for a search in **any** disciplinary content for **any** type of assignment. However, that is also the problem of all-purpose tutorials that require adaptation for specific assignments. A scaffold might actually be able to skirt these issues of adaptability and be more flexible.

General Comments About Solutions

⁵ The notion of scaffolding learners' activities was first introduced by Russian psychologist L.S. Vygotsky (1896-1934) and taken up by a host of psychologists, educators, cognitive anthropologists and more recently, computer scientists. The analogy of a scaffold rather than a bridge suggests there is a structure against which the scaffold rests to support learners in moving from current knowledge to integration of new knowledge.

How can we reconcile the discrepancies between the ideal model of work practices set forth in the ACRL Standards and the actual practices of students, especially the ones that prove effective?

The solution necessitates a practical approach, which recognizes that students have limited time, can easily be overwhelmed with information, and seldom engage in deep reflection on all alternative sources of information. (And I dare say that this applies to faculty and staff as well.) Processes that worked well in a print media library in an era when college students were single 18-22 year olds may not work in the Electronic Library used by an increasingly diverse population moving through multiple realities at an accelerating pace.

The solution also takes into account the very real probabilities of computers or servers going down, books missing from shelves, copy machines being out of order and savvy librarians being unavailable, thus throwing students into a search for alternative ways to get or save information. In other words, it recognizes that in the everyday world, people, processes and artifacts are fallible.

Students are in the process of lifelong learning and during their lifetimes the acceleration of technological change will continue. In the long run, our ideas of ideal processes will have to change as technology changes and faculty, librarians and students must be astute enough to adapt to these constant changes.

Librarians and faculty need to examine the print and electronic environments for how they are analogous, where the analogies break down and with what implications for advising and teaching students. Librarians should also take another look at the Standards and determine which ones apply more to print environments than to electronic media. For instance, writing a question or thesis statement before beginning one's search may not be necessary, or may be necessary only in certain disciplines. However, consulting with one's fellow students and professors may be more critical prior to electronic searches than PL searches.

The conclusions in this analysis are based on a small number of students, and are restricted by incomplete data and at times, poor quality data. However, two things become obvious after spending months of close inspection of the data on all 76 participants. First, there is a great deal of variation in students' information skills: some students are quite skilled in identifying the information they need as they work and accessing relevant information. Some students have great difficulties especially in the interactive environment of electronic media. Still others are somewhere in the middle. Therefore, few generalizations can be made about all students and a one-size-

fits-all solution for teaching and learning information competence is not advised.

Second, students know well how to assess their own performance on individual tasks. Such self-assessments then lead to a feeling of confidence or a lack of confidence.

Confidence

When taking a careful look at the data, we find students may be confident about some aspects of their abilities, such as how to do an electronic search, but they also are able to assess when they have not accomplished their purpose. Thus, when surveys ask students to think about their experience in doing electronic searches in general (not tied to any specific task) one can get quite different self-reports than when students engage in a task and talk about different aspects of it. Through micro-analysis of qualitative data we are able to see the areas where students express confidence and the areas where the same students admit they fell short.

Confidence emerges as a reaction to an experience. It is not a static quality that people have or don't have. It can wax and wane. As we saw, Kate and Beth started their searches quite confidently. But by the time they had finished, Kate realized she had not done as well as she had believed and Beth was not confident about what she had found though she was still confident about her ability to use a computer. Sara was confident until she was unable to print the articles she had worked hard to locate. Lea started the task somewhat dubiously since she couldn't talk to her friends but ended the task feeling that the information she's obtained is good enough for the afternoon discussion.

When our students talked about their "usual experience" in conducting searches some of them are more confident than when discussing their experience in the simulated exercise. But this is a feature not so much of their memory or self-appraisals but of the methods used to elicit the data. Even if surveys or focus groups ask students to only consider their experience in the last semester or last month, that method still calls for ranging over the entire period and making a summary statement not related to any one specific assignment. Forced to quickly make summary statements in a phone interview or in a focus group, students (or anyone) no doubt will appear to overestimate their skills. But when their remarks are focused on a specific experience and aspects of it, they assess their performance quite accurately with confidence levels matching performance.

An Interpretive analysis of data on processes can reveal the subtler nuances of human practices that fall through the net of macro-level studies. Case studies using an Interpretive approach reveal the variation and

complexities usually obscured by large-scale studies and researchers who are eager to make generalizations. Or as Howard Becker puts it: “survey analysts do not know as much about the many cases they gather as qualitative analysts do about the few cases they gather.” (Becker, 1992, p.214) This analysis has endeavored to reveal both complexity and variation in student information seeking behavior.

PART V: RECOMMENDATIONS

1. As university libraries make decisions on how to organize and prioritize print and electronic sources, it is important to teach students how to choose between types of sources, and how they relate to one another.
2. The Paper Library and Electronic Library are **not** direct parallels of each other. We need to consider where the analogies between the two libraries break down, consider whether research practices used in Paper Libraries are transferable to Digital Libraries, and with what implications for assisting/teaching students.
3. Faculty play a crucial role in directing the use of electronic media as well as giving students the background knowledge helpful to a search. Instruction about how to find, select and evaluate electronic and print resources needs to be integrated into disciplinary curricula. Time devoted to course content should not suffer because of a focus on resources; rather the two should be blended.
4. Librarians play an important collaborative role in students' information work. Conducting a reference interview is essential to students' clarification of their needs and goals. More subtle strategies can also be employed to assist students such as circulating in the library to signal one's availability and inquiring indirectly about student work.
5. Librarians and faculty would benefit from true collaboration, proactively seeking out opportunities to share what they do with each other and give/host presentations to classes related to specific assignments as only part of the ongoing collaboration. Students would be the benefactors of such arrangements.
6. Our definitions of ideal processes of information seeking will have to change as technology changes and faculty, librarians and students must be astute enough to deal with these constant changes. As a lifelong skill students need to learn to reflect on their own activities, to develop and practice metacognitive skills.

7. In order to counteract the quick, nonreflective action encouraged by the electronic sources, construct an online scaffold for student searches with an option to turn it on or off. An online scaffold tool should aid students in two ways: 1) help them accomplish their current task and 2) **help them learn from their efforts.** (Reiser, 2002)
8. Create unobtrusive scaffolding software that helps students reflect on their searches while in the process of searching; for example, as part of a more extensive software program, display four windows on one screen: one for displaying search findings, one for assessing relevance of the information to the task, a third for making connections between pieces of information and a fourth for assessing if the information amassed is sufficient.
9. The design of portals and scaffolding software cannot compensate for instruction by faculty and librarians. **This point cannot be stressed enough.** Students require frequent reinforcement of lessons and opportunities to practice their emerging skills.
10. Libraries should focus their attention on instruction related to specific classes and assignments rather than on broad overviews or tours. Students benefit more from a targeted approach that is coordinated with faculty instruction.

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