AUDIENCE/ONLINE INFORMATION INTERACTIONS

NEW RESEARCH IN LEARNING PREFERENCES

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Abstract

This investigation proposes the need for a paradigmatic shift in the production of formal and behavioral online information to accommodate the differing learning preferences of its audiences. Developments in the presentation of information itself and the management of its complexity have not progressed at the same rate as the technology that produces it. Psychologist David Kolb (1974) found that the combinations created by an individual's perception and processing techniques form a unique learning style, which becomes the most preferred and comfortable way to process information for that individual. This project poses the question: In what ways can the redesign of online information presentations, formal and behavioral, support the different learning preferences of complex audiences? As a response I share my work-in-progress research into audience/online information interactions. This research emphasizes the need to acknowledge that information must be flexible and customized to enhance meaningful experience for different learners.

Introduction

This research project proposes that there is potential to turn the web, which is currently an information acquisition tool, into a cognitive tool that encourages meaningful learning for its users. It recommends a shift in the production of formal and behavioral characteristics of online information in order to accommodate the differing learning preferences of its audiences. It seeks to exploit the affordances of online interfaces by suggesting that the web not only promotes easy surface learning but also deep learning, revising search engines away from acquisition to meaning-making.

This paper poses the question: How can learning theories inform designers of online experiences as they provide search engine users with conditions for meaningful learning that turn the latter from online collectors to deep learners?

In order to investigate ways in which learning theories can inform meaningful user/information interactions, this paper will discuss learning in terms of technology, information, usability, design and learning styles. The investigation will explicate the current state of online information and delineate the problem. It will then offer an analysis of the existing taxonomy of research into user/information interactions, an existing taxonomy of technology that attempts to promote deep online learning, define variables and terms used in the research and share visual examples of learners sketching their desired interactions with information. Finally, it will provide visual suggestions of ways in which learning style theories could inform the design of conditions for meaningful online user/information experiences.

Project statement

Leung (2009) wrote, "Part of the service offered by experience designers is the process of making information meaningful for the user, but it is more difficult to ensure that users will turn such information to knowledge" (Leung, 2009, 17).

One of the misconceptions associated with access to information (online or offline) is that access to information equals access to knowledge. It does not. Wurman (2001) quotes Shedroff who described the continuum from data to wisdom in *Information Anxiety 2*. Data can be obvious or subtle. Data does not teach. Data is only data until it is designed, presented and organized for an audience when it then becomes information. Information, in turn, is different from knowledge.

Access to information does not make one knowledgeable. "What most differentiates knowledge from information is the complexity of the experience used to communicate it... By necessity, knowledge can only be gained by experiencing the same set of data in different ways and therefore seeing it from different perspectives" (Shedroff, 2001, 28).

Wisdom, according to Shedroff is the ultimate level of understanding that allows us to find patterns and meta-patterns that we can use in unexpected ways (29). Similarly Leung (2009) associated online information with surface learning and knowledge with deep learning. She speaks of short-term memory and long-term memory in relationship to surface learning and deep learning respectively. Deep learning involves a serious approach to learning in which students aim toward understanding. Surface learning is described as a superficial approach to learning in which learners are aiming to reproduce material in a test or exam rather than actually understand it.

While search engines provide instant results ranging from simple answers to more elaborate articles, users usually go to search engines to access instant answers to their questions—data and/or information—rather than to spend time reading elaborate answers or making sense of it—knowledge and/or wisdom. Krug (2006) wrote that search engines and interfaces are and should be designed for scanning, not reading (22). This investigation believes that in addition to accommodating for human cognitive limitations by promoting scanning among other behaviors, there is a potential for search engines to act as cognitive tools for deep learning. In *Cognitive Tools for Learning*, David Jonassen explained that

> ...cognitive tools are not designed to reduce information processing, but rather to provide an environment and vehicle that often requires learners to think harder about the subject matter domain being studied while generating thoughts that would be difficult without the tool. They are cognitive reflection and amplification tools that help learners construct their own realities (Jonassen, 1992, 1).

Current state of online search engines

With scholarship in mind, the search engine was originally invented in support of scientific research activities. In 1990, Archie, short for 'archives,' was the first search engine to be created. In 1980, Tim Berners-Lee's concept of hypertext's main purpose was the sharing and updating of information among researchers. Today's

search engines still maintain the same goal of allowing users to access and share information. Technological advancements have made this process much faster and accessible to a larger demographic from many more access points—computers, television, game stations and cellular telephones.

While there have been major developments in the information vehicle—screen, touch screens, cell phones, e-readers, electronic paper—not much has been done to the structure and design of information in the new information vehicle. Most of the changes made to the way information looks and behaves have been insignificant. While the web did provide for different affordances such as hyper-linking, book marking, fast copying and pasting and scrolling versus page turning, text online predominantly looks like the printed page.

Even so search engines have increasingly become the wellspring for data and information as well as the venue for many types of transactions. It is the place one goes to find out how to cook a turkey, to get directions to a destination or to purchase one's favorite song. In any situation, users gravitate towards search engines to find answers and explanations, to learn why, how, what, who and when. These answers and explanations manifest themselves in different forms—from images to videos, from casual forum conversation to scholarly articles.

Most importantly, today's search engines focus on usability, making access to information easy, seamless and instant. Usability and user experience are wrongly yet usually considered interchangeable. However, as Albert and Tullis (2008) wrote, usability is generally thought of as the "ability of the user to use the [search engine] to carry out a task successfully, whereas user experience takes a broader view, looking at the individual's entire interaction with the [search engine], as well as the thoughts, feelings and perceptions that result from that interaction" (Albert and Tullis, 2008, 4).

Jakob Nielsen (2009) wrote that designing for the web is designing for brainpower limitations. He notes that many usability guidelines are dictated by cognitive limitations of the human brain, which is not optimized for the abstract thinking and data memorization that websites often demand.

Usability guidelines such as these provide designers of online experiences the rules and/or principles they need to follow to provide conditions for better navigation which in turn contributes to a better experience; an experience that is uninterrupted; one that allows for seamless navigation and acquisition of information; one that makes sure users don't have to think to access information they need.

While this project values usability guidelines, it is more concerned with providing meaningful user/information experiences that consider the entire system. It emphasizes the need for the complexities—different learning preferences—of the

learners to be taken into consideration for better user-experience directed toward meaningful and substantive learning.

In his article *Is Google Making Us Stupid?: What the Internet is doing to your brains,* Nicholas Carr (2008) explains the cognitive differences between accessing information from books and online portals.

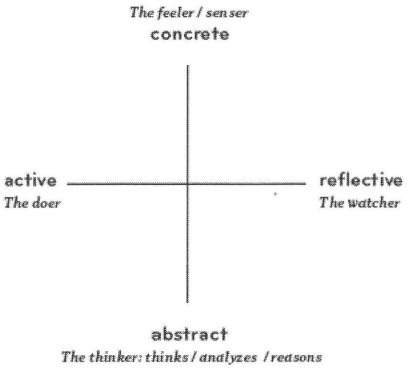
> The kind of deep reading that a sequence of printed pages promotes is valuable not just for the knowledge we acquire from the author's words but for the intellectual vibrations those words set off within our own minds. In the quiet spaces opened up by the sustained, undistracted reading of a book, or by any other act of contemplation, for that matter, we make our own associations, draw our own inferences and analogies, foster our own ideas. Deep reading, as Maryanne Wolf argues, is indistinguishable from deep thinking (Carr, 2008).

While the Internet is making information accessible, it might not be providing the conditions needed for users to turn words into knowledge, draw inferences and analogies and foster ideas. There could be a shift from search engines offering an environment that diminishes information processing to provide an environment and vehicle that encourages learners to think harder about the information being studied. A failure to promote this shift could result in a series of search engines that (maybe not intentionally) dumb down the next generation of learners by making them less autonomous and "not think."

Predictions showcased in a study, titled *Information Behaviour of the Researcher of the Future* (2008), commissioned by the British Library and the Joint Information Systems Committee (JISC) provided an intricate analysis of how the specialist researchers of the future—the Google generation/those born after 1993—are predicted to access and interact with online information in five to ten years. Educational concerns were raised regarding whether "having 'facts at their fingertips' and surfeit of information is at the expense of creative and independent thinking?" (British Library and JISC, 2008). The study further states that

> a one-size-fits all policy towards library or system design is not going to be effective: there is as much (albeit, largely unacknowledged) diversity in today's scholarly population as is likely to exist between today's scholars and tomorrow's. Without a detailed handle on these issues, it becomes impossible to target services effectively (British Library and JISC, 2008, 30).

Because it is unlikely that the Internet will stop nor should it stop providing information, and because the Internet is one of the main sources of information that



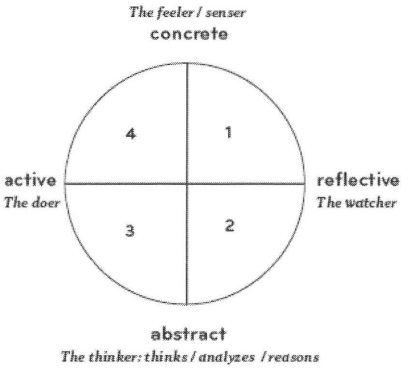


Figure 1: Concrete to abstract perception and active to reflective processing.
Figure 2: 4 quadrants showing 4 different learning styles

the "Google generation" will be relying on, it is important that the disseminators and designers of online information provide conditions for independent and critical thinking in our future learners.

Different learning styles

In the *4Mat System*, learning theorist Bernice McCarthy (1980) explained that all learners perceive and process information and experiences differently. While some understand information abstractly, entering content through theories and concepts, others absorb information concretely, using the senses and personal experiences (McCarthy, 1980, 25) (*see figure 1*).

In addition to perceiving differently, learners process information differently. Some process information reflectively by watching and thinking about things. Other learners process information through physical activity (*figure 1*). Psychologist David Kolb (1974) found that the combinations created by someone's own perception and processing techniques form their unique learning styles or their most comfortable way to learn (25). Kolb's learning style inventory in the *4Mat System* (*figure 2*) encourages teaching in all four styles to support students who move from quadrant

to quadrant, excelling when they are in their most comfortable quadrant and developing learning techniques they might not be comfortable in when in the other quadrants (Kolb, 1974, 55).

By acknowledging the different learning styles, search engines/the web takes a step towards becoming a cognitive tool that allows learners to construct knowledge/meaning.

> A learning style 1 individual values personal meaning and makes judgments based on that kind of meaning. She/he functions through social interaction and wants to be involved in important issues as well as be cooperative and social. Learning style 1 favors discussion as a teaching mode, is impressed by authority, and models behavior on those aspects (McCarthy, 1980, p. 33).
>
> A learning style 2 subject likes to know what experts think. She/he learns from reality and by thinking through ideas. Style 2 prefers to perceive information abstractly and process it reflectively. A data collector and an analytic learner, a learning style 2 individual will re-evaluate facts thoroughly if confused. Schools are designed for this learner who functions by adapting to experts (McCarthy, 1980, p. 39).
>
> A learning style 3 person seeks usability. Style 3 sees information abstractly and processes it actively. Using factual data to build designed concepts, this learner type prefers hands-on experiences, enjoys solving problems, resents being given answers, restricts judgment to concrete things, has limited tolerance for "fuzzy" ideas and needs to know how assigned tasks will help in real life (McCarthy, 1980, 41).
>
> A learning style 4 learner needs to know what can be done. Style 4 individuals learn by trial-and-error, self-discovery and adapts to change. This learner sees information concretely and processes it actively. A learning style 4 person acts and tests experience, makes things happen and brings action to concepts (McCarthy, 1980, 43).

Currently neither online or offline information allows interactions for users that support all the different learning styles. Designers of online information and experiences should rethink ways that content can be customized and adapted to support not only users of learning style 1 but also learning styles 2, 3 or 4. Learning style theories and categories can inform designers of online experiences as they try to provide conditions for audiences and collectors of online information to become deep learners that can move from learning style quadrants comfortably. It is this paper's assumption that if information were presented in a way that is the learner's preferred way, more meaningful learning would happen.

Existing research into user/information interaction

Research into user/information interactions but more specifically information search processes (ISPs) has existed for a long time. Professor T.D. Wilson (1994) in his paper *Information Needs and Uses: Fifty Years of Progress?* explained, "Most 'user studies' have been about how people use systems, rather than about the users themselves and other aspects of their information-seeking behavior" (Wilson, 1994, 2). Wilson defined two sub categories of research into ISPs—system studies and user-studies—and provided a detailed taxonomy of research into each domain. While the majority of the research pertained to system studies, "the field broadened out from the study of library systems to the study of behavior and attitudes of information users in general" (Wilson, 1994, 3). Wilson gives the example of a study carried out in three London Boroughs where 506 people were interviewed regarding their reading habits and gender differences in information use were discovered; in Baltimore, U.S.A, 1973, research was carried out into the information needs of ordinary citizens; in the special libraries sector, Mote (1962) attempted to categorize the user as a way to better understand their information use; and Palmer (1991) investigated the relationship between personality, discipline, organizational structure and information behavior in the field of agricultural research (Wilson, 1994).

More recently and closely related to this research paper, in *Web-based learning interaction and learning styles*, Sabry and Baldwin (2003), reinforced the significance of individual differences on learners' behavior. They acknowledge differences such as gender, system experience, cognitive styles but also state that "individual differences make designing Information Learning Systems (ILSs) a complicated task as it requires accommodating a wide range of characteristics (Galitz, 2002), and for these to be interactive, certain qualities and principles need to be related to different learners' needs" (Sabry and Baldwin, 2003, 2). They further explained that "much of the learning styles research has given little attention to influencing factors such as learner perception of different interaction types on the learning approach they take, and how this information can inform the design of effective ILSs" (Sabry and Baldwin, 200, 444).

In their research, Sabry and Baldwin used Felder and Soloman's learning style categorization—sequential and global learners—and concluded that

> an awareness of the pedagogical needs of different learning styles can result in more effective ILSs...a carefully balanced approach not only can help learners to respond more effectively to different learning situations, but also make the learning process more enjoyable and help in developing a more flexible and autonomous learner (Sabry and Baldwin, 2003, 10).

Furthermore, in their paper *The Learning Styles, Expectations and Needs of Online Students*, Mupinga, Nora and Yaw (2004) focused on determining the learning styles, expectations and needs of online industrial education college students. Their study explored how the individual characteristics can be incorporated in designing effective online instruction (185). They concluded, "No particular learning styles were found to be predominant among the online students; hence, the design of online learning activities should strive to accommodate multiple learning styles" (Mupinga, Nora and Yaw, 2004, 188).

The above highlighted existing research reinforces the value of acknowledging learning styles when designing conditions for online learning experiences. This paper shares the same conclusion. However, it approaches the problem and solution from an interface and experience design perspective and visualizes how educational theories can intersect with and inform design practice to create conditions for more meaningful learning experiences.

Existing taxonomy of technology—interfaces, plug-ins etc.

Search has been the focus for many search engines. With instant access to large amounts of information, search engines are finding popular ways to categorize information based on user search behaviors. This paper values effective search but does not place it at the heart of the research.

GOOGLE

Google (http://google.com) can be thought of as the most-used search engine. To make search more effective, Google has worked on enhancing different aspects of the search process. They have conducted spelling improvements, refined international results, advanced search options, provided search freshness and maps in search results, generated personalized suggestions and site links among other features. While Google has been focusing on the search process, its results feature and presentation has stayed mostly the same since its establishment. Currently

Google offers users the ability to filter search results based on the following criteria: everything, news, updates, videos, books, images, maps, shopping, blogs, discussions, size, type and color.

In addition to providing the search engine that we are familiar with, Google Docs, a Google product, allows users to create, share and collaborate on online documents, presentation and spreadsheets; Google Wave lets users communicate and collaborate in real-time and Google Scholar allows users to search scholarly literature across many disciplines and sources, including theses, books, abstracts and articles.

Google has produced so many products over the past years and while technology is a great tool for education, more time could be spent on making existing technology better by assuring that tools like Google Scholar becomes a space for further critical thinking versus a repository for information only. How can a search engine like Google Scholar not only provide information but create conditions for users to turn such information into knowledge?

NEWSMAP

While Google's result lists have not experienced a major facelift over the years, "Newsmap, an application (powered by Google) provides a tool to divide information into quickly recognizable bands which, when presented together, reveal underlying patterns in news reporting across cultures and within news segments in constant change around the globe" (http://marumushi.com/projects/newsmap accessed on June 15, 2010).

The visual relationships that are demonstrated through the use of color-coding and hierarchical categorization exemplify a new way to visualize information. While Newsmap is successful at instantly making complex information and patterns more visual, developments stop at the visualization stage. More effort could be placed on further guiding the viewers once they have been exposed to the visual grid of news. Information only becomes concrete when it turns into knowledge. In addition to making complex information visually concrete, how can meaning making be supported online? How else can information be visualized for learners with different learning styles?

VIEWZI

In contrast to Google whose focus has been on better search, Viewzi (http://www.viewzi.com/) takes the visualization offered by Newsmap a step further. Viewzi's interest lies in providing a better way to view search results. At Viewzi,

the visual demonstration of search results change based on the intent of the search. Viewzi provides users with different viewing preferences. Two of the most unconventional viewing modes offered by Viewzi are the Power Grid view and the Timeline view. The Power Grid displays information in a grid structure. The grid allows users to view image thumbnails or text. The Timeline uses results gathered from Google and arranges them chronologically on a timeline that can be scaled and manipulated. Viewzi's motto is to focus on one aspect of search—how people experience information.

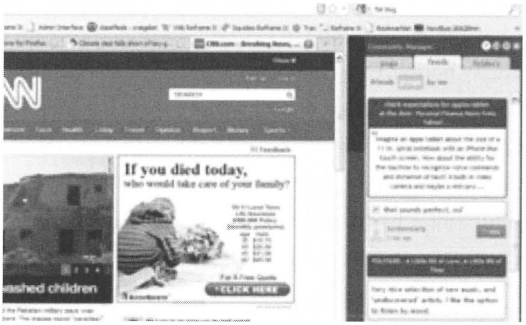
While Viewzi's effort to better visualize the result list is commendable and a well-needed shift in the search results landscape, how people experience information does not solely rely on the way information is visualized. The act of experiencing a good meal relies not only on the way the food looks, but also what it tastes like and the feeling one is left with after the meal (and the overall service). The same principles apply to information. Experience with information is meaningful if information is turned to knowledge—if the user gains meaning from the information after he views it. Conditions need to be set up for the user's processing preferences as well as viewing preferences so they can act upon the information being viewed. Information experience is about the search, the results and the knowledge generated from the results generated by the search.

COGNITIVE TOOLS/PLUG-INS

To enhance learning online, the Palo Alto Research Center (PARC), which focuses on interdisciplinary approaches to the development of innovative technology, makes prototype web-based services available for download by users. Annotation is an important part of any learning process. It is a strategy used by many learners to visually categorize content and bookmark pieces of information as a cognitive strategy. In an attempt to allow users to "easily and directly tag keywords, highlight snippets, collect tags/snippets in a personal notebook, and share notebook information while browsing web content," PARC created SparTag.us, a "social annotation system for paragraph-level tagging, highlighting, collecting, and sharing web content" (http://spartag.us/)(*see table 1*).

Firefox also offers annotating plug-ins that allow users to highlight content and take notes as they look at information. Reframe It (https://addons.mozilla.org/en-US/firefox/addon/5677/) is a commenting tool that lets people connect and share their thoughts online. These thoughts/annotations are juxtaposed with content anywhere on the web, without the permission of the site owner (*see table 1*). Diigo (https://addons.mozilla.org/en-US/firefox/addon/2792/) is an online

REFRAME IT
http://reframeit.com



SPARTAG.US
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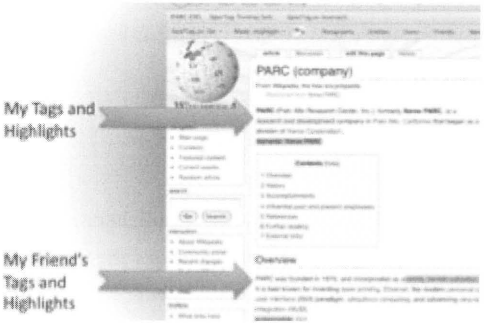

DIIGO
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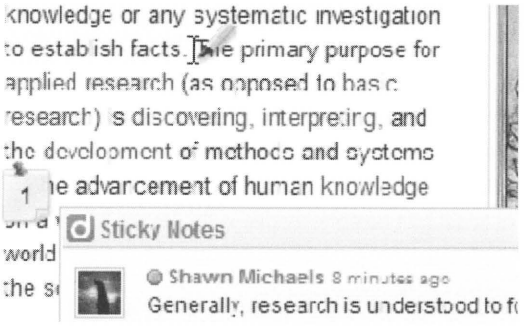

HIGHLIGHT
http://dev.reedmace.net

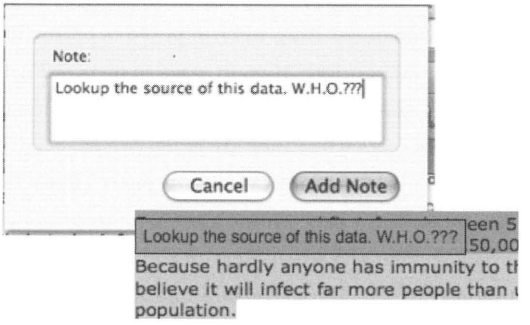

Table 1 : Online Sources (access date 6/14/2010)

highlighter and sticky notes plug-in that allows users to highlight as well as add sticky notes to any webpage. Diigo also allows users to save their bookmarks, connect and exchange with other users that have bookmarked the same content. Users of Diigo can also easily publish their bookmarks and annotations to blogs (*see table 1*). Highlights (https://addons.mozilla.org/en-US/firefox/addon/12676/) is a multi-color highlighting tool that lets users highlight text on web pages with a right-click. Highlights are saved and reloaded when the page is revisited (*see table 1*).

While this paper is not critiquing the effectiveness of each individual annotating device that exists, it does promote the development and integration of more tools that promote learning/critical thinking and information processing as well.

Research question

In *Three Types of Interactions*, published in the *American Journal of Distance Education*, Michael G. Moore (1989) describes the three types of interactions crucial in distance education. He lists them as: learner and content interaction; learner and instructor interaction; and learner and learner interaction. In this research project, I addressed interactions between learners and information and learners and interface.

Different learners construct meaning differently because they have different learning styles. Learners should have an interface that will allow them to turn information into knowledge. By taking learning styles and learning preferences into consideration when redesigning the behavior of search engines, one may be able to construct conditions that will allow learners, no matter what their learning preference, to not only access information but also process information in ways that will meaningfully inform.

In order to support deep online learning—the questioning of content, the construction of meaning when exposed to online information—search engines need to present information in ways that encourage learners to construct their own meaning—literally construct their meaning by manipulating online content. Users become learners when they are given control over the content. Users surf the web and collect information. Learners process information and create knowledge. The potential for deep online learning happens when users are given control of online content and when users step away from being the passive audience/viewers and instead become the learners and co-creators of content.

Then, how can the redesign—formal and behavioral—of online information support the different learning preferences of learners in ways that allow them to

turn from collectors of information to processors of information and creators of knowledge? In order to answer this question, this project poses the following sub-questions:

1. In what ways can learners become co-creators of their online experiences?
2. In what ways can the design of interactive tools allow each learner to customize their experiences based on their learning preferences?

Research methodology

USERS AS CO-CREATORS OF EXPERIENCES

Trends and changes in culture require that designers move away from making assumptions about what users want. Designers need not impose experiences based on their assumptions about users and instead set up conditions for meaningful user-experience. Designers can encourage meaningful user experience by including learners at the grass-roots level of the design process, therefore turning learners into co-creators of their own individual experiences.

In this project, three methods were used to involve learners at the grass-roots level of the design process: *Process Similarity Analogies*, *Sketching for Interaction* and *Visualization*. Process similarity analogies are analogies about how objects, situations or actions are similar to one another. In this activity, participants brainstormed and listed processes that resembled the act of researching. The objective of the *Process Analogies* activity was to get participants/learners to express their feelings and thoughts about the research process using other processes that are meaningful and familiar to them.

The second activity—*Sketching for Interaction*—asked learners to participate in the design of their own remote control device with the following question in mind: "If you could use your remote control and do anything you wanted to do with the text, images or videos online, what would that be?" The intent of *Sketching for Interaction* was developed to observe and identify what features/functions learners value when researching, what their explicit needs are and how they might envision and prefer information behaving online.

The last method used—*Visualization*—involved applying knowledge about learning style theories with the results from the analogies and sketching exercises in order to visually suggest ways in which formal and behavioral characteristics of online information could be redesigned to meet the different learning preferences and allow collectors to become meaning-makers.

ACTIVITY ONE:
PROCESS SIMILARITY ANALOGIES AND LATENT NEEDS

The results of this preliminary study made up of nine communication design undergraduate participants at the University of North Texas showed that the analogies produced by the students related their own set of interests and experiences, thus reinforcing the ideas that some learning is personal. While some students made lists, others used techniques such as word map and matrices. User Tim for example whose preferences are linguistic carefully crafted his words and took time articulating his thoughts on paper, stopping a few times to reflect on the vocabulary he was utilizing. These analogies expressed some of the latent needs of the learners (*see figures 3 and 4*).

In Figure 3, could Jenna's reference to the patience needed to teach a child be hinting at the patience needed when faced with bad web usability and the struggles attached to bad navigation? In Figure 4, could Nora's desire to have web browsers be her version of an Indiana Jones express her latent desires for effortless yet deep and exploratory access to information?

ACTIVITY TWO:
SKETCHING FOR INTERACTIONS

Alan South (2004), in *Abstract Truth* talked about the different outcomes between empathic research and market research. While empathic research "uncovers latent user needs, 'market research' is only able to address explicit user need" (South, 2004, 119). He writes that empathic research "is not about doing a statistically significant survey. Carrying out a few observations around the edge of a user group is effective; it is particularly critical to observe users in the environment and context in which they will be using the product or service that is being developed" (South, 2004, 119).

Using empathic research to include users in the design process, students quickly sketched a remote control device to control different online media such as text, image and video with which they would normally interact when researching online. Participants were asked to answer the following question as they sketched their remote controls: "If you could use your remote control and do anything you wanted with text, images or videos online, what would that be?" Participants designed their remotes with the context being research. They were also encouraged to think of what tools they found useful when researching in the analog world. As they designed their remote control devices, participants assigned values/verbs to each button. Each value represented the behavior they wanted to assign to the information to which they were being exposed.

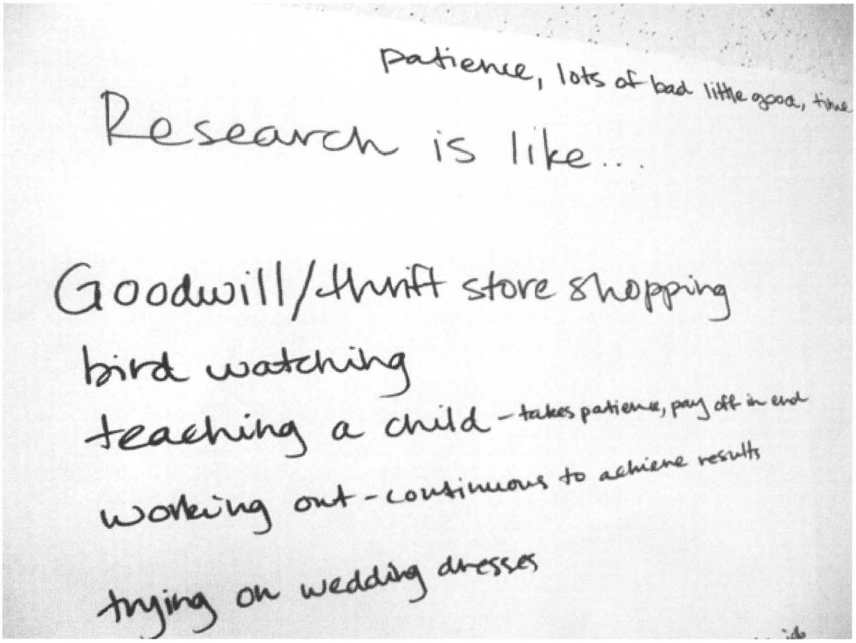

Figure 3: Participant Jenna's analogies: Research is like...

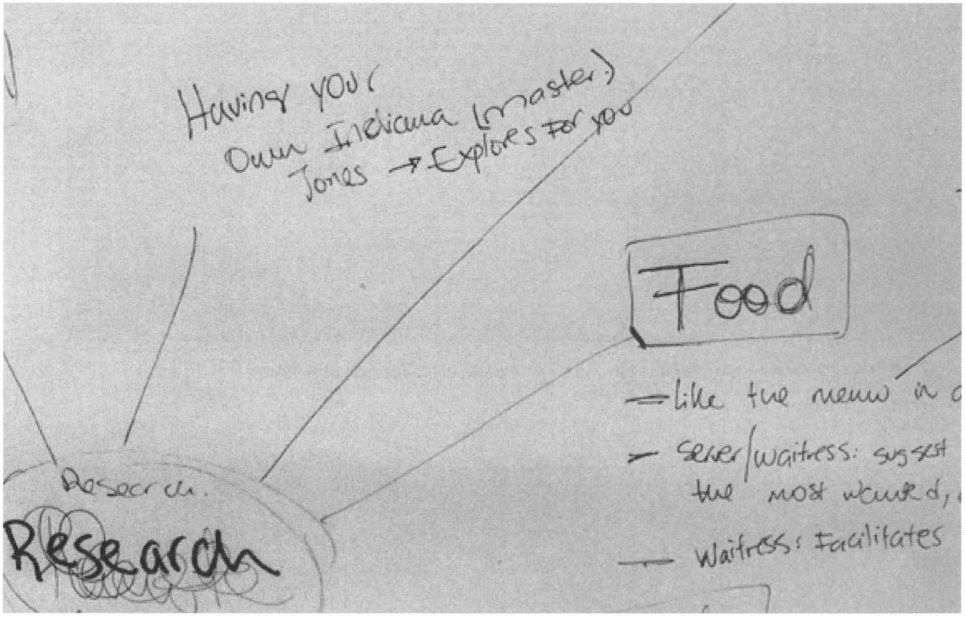

Figure 4: Participant Nora's analogies: Research is like...

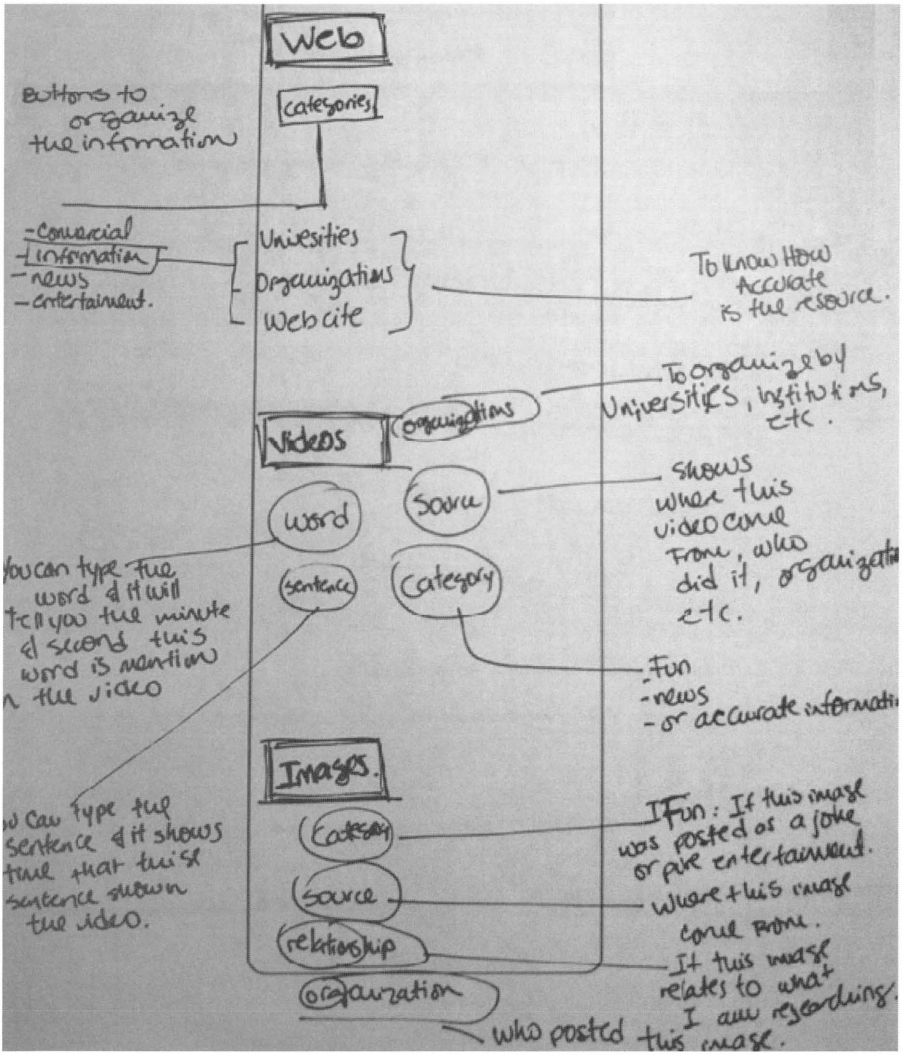

Figure 5: Nora's remote control sketch illustrating the interactions she would like to have with information.

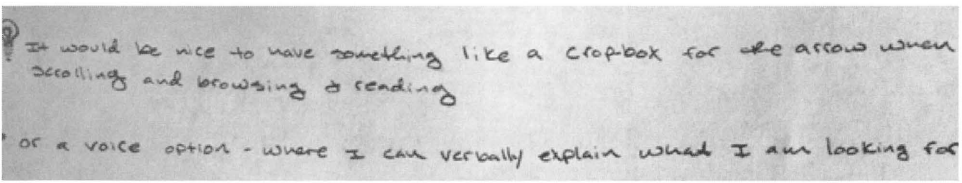

Figure 6: Andy's remote control list explaining his desire for a voice option and a crop box.

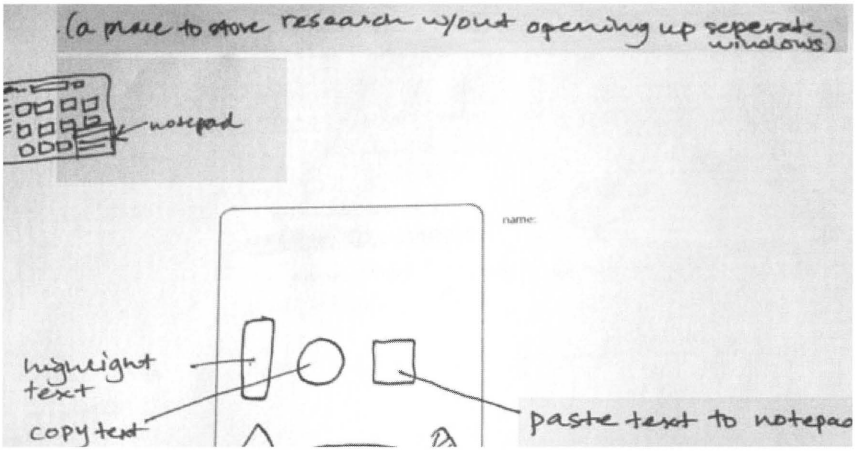

Figure 7: Jenna's remote control sketch illustrating her desire for "a place to store research without opening up a separate window."

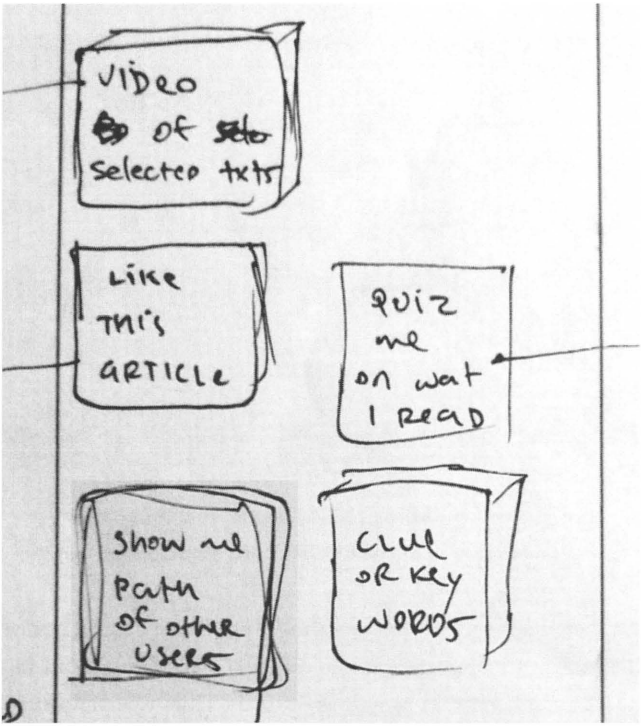

Figure 8: Bob's remote control list expressing his desire to see other users' search path.

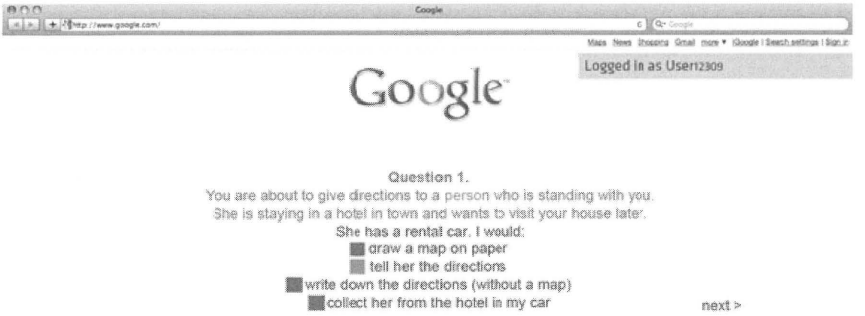

Figure 9 shows the user going through the learning style questionnaire before the research process.

Figure 10 informs the user that search results will be tailored to his learning preferences.

The results from the sketching session were revealing. The remote control device sketches displayed different learning preferences and different ways the students in the activity preferred to express themselves as well as different actions participants already valued and/or desired (*see figures 5 through 8*).

This directed sketching for interaction activity exemplifies one way in which learners can become co-creators of their online experience. By paying attention to

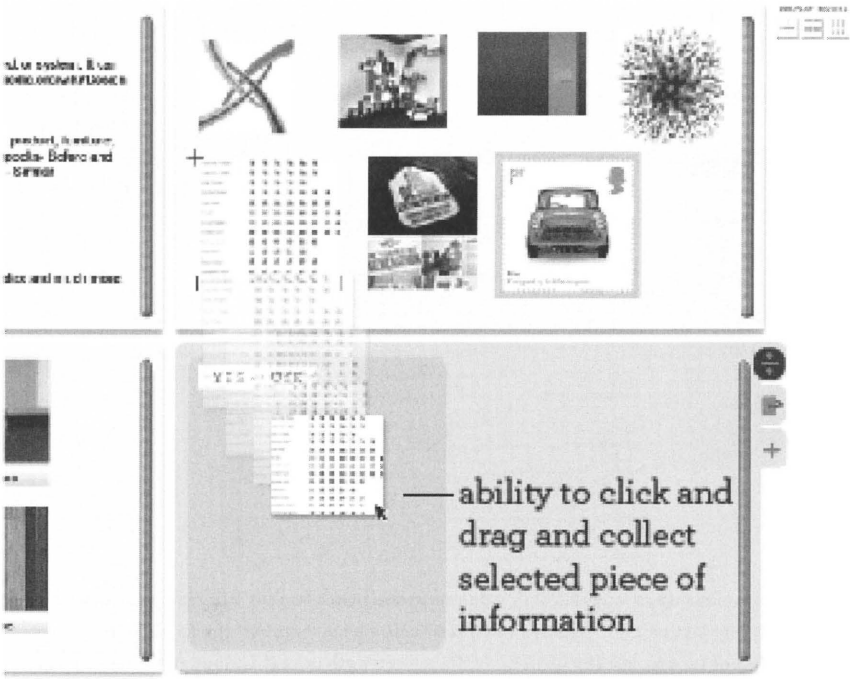

Figure 11 visualizes how the search engine can support Jenna's explicit desire—as seen in her remote control device sketch—for a notepad that is integrated in her search, thus allowing her to have a seamless workflow. The notepad becomes the user's collection as well as construction space. The visualization also shows the ability for the user to view different modes of information simultaneously. These different windows can be scaled up and down as desired by the user.

learners' learning styles and explicit needs, designers of online experiences can create more meaningful user-information interactions, thus answering this project's first sub-question: In what ways can learners become co-creators of their online experiences?

Both the process analogies session and the sketching for interaction activity were not meant to bring hard data about the users. Instead, they were more observational and qualitative in nature.

VISUALIZATION

In order to be able to provide for the different learning preferences of learners, this paper suggests the need to evaluate and assess each learner's learning style before he/she engages with any online research process. Users are asked to take a learning style test that comprises a set of multiple-choice questions before they start

Figure 12 displays ways in which Bob's desire to see other learner's search path can be supported. The left column displays the list of users who searched the same term—design. The center column shows user Jeff's search path in text format. This search path can be filtered by text, image or video. A user can also view multiple users' previous search paths at once.

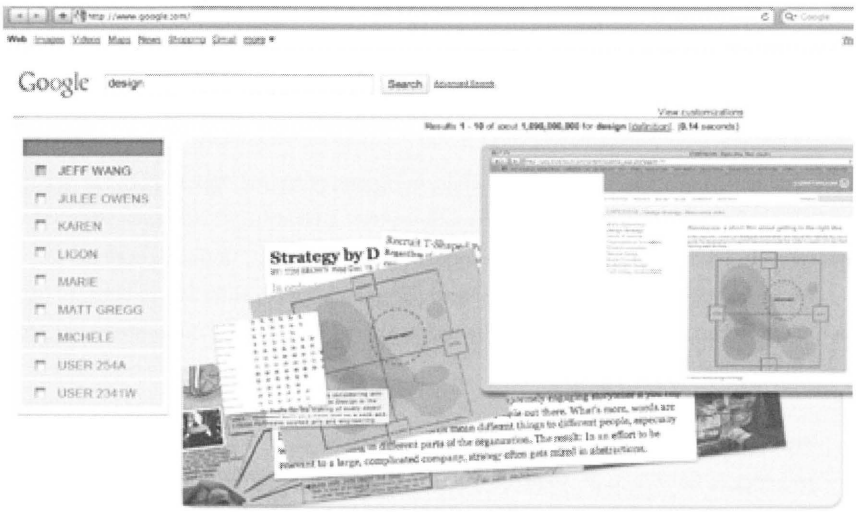

Figure 13 shows how users can also explore other users' collections.

their research process online (*see figure 9*). In this example, we use the Visual, Aural, Read/Write and Kinesthetic (VARK) questionnaire by Neil Fleming (2010). After the learner's learning preference has been identified, the search engine generates and presents information in ways that support the learner's preferences (*see figure 10*). The hope is that information display that is tailored to the learner's preference will be the first step towards motivating the learner to dig deeper.

With participants' explicit and latent needs in mind, different visual solutions have been designed. These designs have been informed by literature, existing research as well as the two activities—process analogy and sketching for user interactions—carried out with the different learners. The visualization stage visually proposes potential answers to the sub research question: In what ways can the design of interactive tools allow each learner to customize their experiences based on their learning preferences? (*see figures 9 through 13*).

Next steps and conclusion

The next step of this research project will be to run the same activities with a larger demographic of students—undergraduate and graduate—from different disciplines. The intent is to further include learners as co-creators of their own experience and gather more qualitative data that will inform the design of more cognitive tools and interfaces. Consequently it is the intent of this research project to build rough working prototypes that users can test. The prototypes will be designed to identify areas to be revised as student/subjects are observed interacting with information and with the prototype. While it might seem almost impossible to restructure existing information on the web to behave the way the prototype suggests it does, this project proposes that designers of future online experiences support deep learning as well as surface learning online. The proposed solutions demonstrate that designers of online interactions can allow for customizable experiences informed by individual learning styles. While still a work-in-progress, this research endeavor will inform both design practice and design education. Through understanding ways to set up conditions for all learners, academia may also understand how and what to teach the design students who will become the design practitioners of online information.

References

Albert, B. and T. Tullis. 2008. *Measuring the user experience: Collecting, analyzing, and presenting usability metrics.* Burlington, MA: Morgan Kauffman Publishers, 4.

British Library and the Joint Information Systems Committee (JISC). 2008. Information Behaviour of the Researcher of the Future. http://www.slideshare.net/ (Accessed December 20, 2009).

Buxton, B. 2007. *Sketching user experiences: Getting the design right and the right design.* San Francisco, CA: Morgan Kauffman Publishers.

Carr, N. 2008. Is Google Making Us Stupid?: What the Internet is doing to your brains. *The Atlantic.* http://www.theatlantic.com (Accessed December 19, 2009).

Fleming, N. The VARK Questionnaire. http://www.vark-learn.com/english/page.asp?p=questionnaire (Accessed June 15, 2010).

Galitz, W. 2002. *The Essential Guide to User Interface Design.* Hoboken, NJ: John Wiley.

Google. http://www.google.com/ (Accessed June 15, 2010).

Jonassen, D. 1992. What are cognitive tools? In Kommers, P. et al. *Cognitive tools for learning.* London: Springer Verlag, 1.

Kommers, P., D. Jonassen and J. Mayes. 1992. *Cognitive tools for learning.* London: Springer Verlag, 1.

Krug, S. 2006. *Don't make me think.* Berkeley, CA: New Riders, 22.

Leung, L. 2008. *Digital experience design: Ideas, industries, interaction.* Chicago, IL: Intellect Books, 17.

McCarthy, B. 1981. *The 4Mat system: Teaching and learning styles with right/left mode techniques.* Barrington, IL: EXCEL, Inc., 25–43.

Moore, M.G. 1989. Three types of interactions. *The American Journal of Distance Education,* 3, volume 2.

Mote, L.J.B. 1962. Reasons for the variations in the information needs of scientists. *Journal of Documentation,* 18, 169–175.

Mupinga, D.M., R.T. Nora and D.C. Yaw. 2004. The Learning Styles, Expectations and Needs of Online Students. Heldref Publications, 185-188. http://web.simmons.edu/~brady/CE/Reading%202.pdf (Accessed December 17, 2009).

Newsmap. http://www.newsmap.jp/ (Accessed June 15, 2010).

Nielsen, J. 2009. *Short-term memory and web usability.* http://www.useit.com/alertbox/short-term-memory.html (Accessed June 15, 2010).

O'Grady, J. and K. O'Grady. 2008. *The information design handbook.* Cincinnati, OH: How Books.

Sabry, K. and L. Baldwin. 2003. Web-based learning interaction and learning styles. *British Journal of Educational Technology,* 34.4, 443–454. http://www.homepages.shu.ac.uk (Accessed December 17, 2009).

Shedroff, N. 2001. An Overview of Understanding. In Wurman, R.S. 2001. *Information Anxiety 2.* Indianapolis, IN: QUE, 28–29.

South, A. 2004. Aircraft interiors international: Abstract truth, 119. http://www.ideo.com/ (Accessed December 17, 2009).

Wilson, T.D. 1994. Information Needs and Uses: Fifty Years of Progress? *Information Research Journal*, 3. http://informationr.net/tdw/publ/papers/1994FiftyYears.html (Accessed December 19, 2009).

Viewzi. http://www.viewzi.com/ (Accessed June 15, 2010).

Wurman, R. 2001. *Information Anxiety 2*. Indianapolis, IN: QUE, 28-29.

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