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Where Is It? How Deaf Adolescents Complete Fact-Based Internet Search Tasks

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WHERE IS IT?

HOW DEAF ADOLESCENTS COMPLETE FACT-BASED INTERNET SEARCH TASKS

A

N EXPLORATORY STUDY was designed to describe Internet search behaviors of deaf adolescents who used Internet search engines to complete fact-based search tasks. The study examined search behaviors of deaf high school students such as query formation, query modification, Web site identification, and Web site selection. Consisting of two fact-based search tasks, the study was done in four regional day school programs for the deaf. As students conducted two search tasks, they completed task analyses of the selected Web sites and gave reasons for their selections. The research also identified the processes used by deaf students to compensate for limited English reading abilities while navigating search engines results that were typically written well above deaf students' average reading level. The results demonstrated that deaf adolescents were unable to initiate, conduct, analyze, or validate effective Internet searches in response to fact-based search tasks.

CHAD E. SMITH

SMITH IS AN ASSISTANT PROFESSOR IN THE DEPARTMENT OF COMMUNICATION SCIENCES AND DISORDERS, TEXAS WOMAN'S UNIVERSITY, DENTON.

For those with disabilities or limited English skills, navigating the pathways provided by the Internet can be difficult (Walz, 2001). Long technical terms, lengthy lists of returned results, descriptions that are difficult to read and understand, uncategorized results vocabulary that has not been taught in class, and limited exposure to real-time reading literacy skills make Internet use tedious and difficult for second-language learners (Dumais, Cutrell, & Chen, 2001; Lyman-Hager & Davis, 1996; Schmar-Dobler, 2003; Sengupta, 2001; Soloway et al., 2000).

The last several years have seen an increase in computer and Internet use among programs serving deaf students.

Even though the average deaf student leaves high school with only a fourth-grade reading level, increasing numbers of educational programs serving deaf and hard of hearing students are employing the Internet in the classroom (Bowe, 2002; Clymer & McKee, 1997; Dew, 1999; Paul & Quigley, 1990). Search engines and their results typically require reading ability well above the fourth-grade level. Many deaf students, therefore, are unequipped to read search engine results. In a 2-year search of multiple databases, including but not limited to Index Medicus, ACM Digital Library, IEEE Computer Society Digital Library, Proquest, Wiley InterScience, ScienceDirect, and Wilson

Web, no published scholarly data has been located specifically addressing how deaf students perform Internet searches to find specific material related to fact-based searches.

Bilal (2000) defines a fact-based task as one that requires a lone, straightforward answer that may not require research to locate. The purpose of the present study was to provide insight into the Internet search behaviors employed by deaf adolescents completing fact-based search tasks. The study's framework was based on Bilal's (2000, 2001) work on children's Internet searches, as well as Slone's (2003) work on search effectiveness. I have attempted to identify how deaf adolescents initiate search queries and locate specific information from Internet search engine results that are published well above their typical reading level.

There are several possible reasons why the effectiveness of deaf students' Internet search skills has not been measured. One is the misleading idea that because students know how to locate such items and services as Web-based e-mail, instant messaging, chat rooms, and games, they may also be able to navigate the Internet successfully for research purposes (Eagleton, Guinee, & Langlais, 2003; Escoffery, Miner, Adame, Butler, McCormick, & Mendell, 2005; Jenson, 2004; Leu, 2000; MacGregor & Lou, 2004). Educators have overestimated hearing students' ability to conduct Internet research (O'Hanlon, 2002); it is probable that educators of the deaf have done likewise. Another possible reason this goal has not yet been met is the lack of computer and Internet skills of many teachers, and the fact that many novice and veteran teachers lack the confidence to use computer technology instructionally (Office of Social and Economic Data

Analysis, 2003; Ouzts & Palombo, 2004).

Research Questions

The four research questions explored in the present study are based on Bilal's (2000, 2001) work with children's use of the Yahoo!igans! search engine and Slone's (2003) exploration of user goals and experience in relation to search effectiveness:

1. How successful are deaf adolescents in finding pertinent information for fact-based search tasks using the Google search engine?
2. How do deaf adolescents initiate Internet searches in order to locate answers to fact-based search tasks?
3. What elements of search engine results do deaf adolescents read when determining which Web sites to select while completing fact-based search tasks?
4. What behaviors do deaf students employ to compensate for a lack of reading skills when selecting Web sites from Internet search engines results?

Limitations of the Study

The completed study had several limitations. The size of the sample was one limitation. While it did include a diverse group of students, because of the various degrees of hearing impairment the sample was not representative of all high school students with hearing deficits. The presence of the researcher in place of a screen cam was another limitation of the study. The consistency and effectiveness of the individual school computer networks and filters, whose quality varied from district to district, also posed a limitation.

Literature Review Search Engines and Metasearch Engine Fundamentals

Contrary to popular belief, search engines do not search the entire Internet for information. Instead, search engines search individual databases for specific documents found on the Internet. Each search engine searches its own database for elements containing the keywords being searched (Killmer & Koppel, 2002). There are two basic search methods for exploring the Internet, search logic and Boolean logic. *Search logic* refers to the protocols that search engines apply to search phrases. Individual search engines may apply different protocols for search criteria. *Boolean logic*, devised by mathematician George Boole, is used to distinguish a relationship between search terms, such as containing both terms, or containing one but not the other, or containing either of the terms. Boolean search logic can include the words *and*, *not*, or *or*, as well as the + or - signs, in order to eliminate or add focus to specific search terms.

Children's Search Engine Use

Bilal (1998, 1999, 2000, 2001) conducted numerous studies of children's Internet search behaviors. Bilal and Kirby (2002) found that older students and children often experience similar difficulties when using Internet search engines. They also found that while adults are able to conduct and refine searches fairly accurately, children seldom enter multiple queries for specific search tasks; nor are they able to recover from difficulties they experience while creating search queries. Both authors questioned students' ability to employ adult search engines when 50% of their student subjects failed to locate a correct response from a search engine specifically designed for children.

Simply being able to navigate hypertext can play a vital role in whether students are able to locate information. Strategies that users employ to locate specific information within hypertext media are directly related to how well the user is able to process information learned from such media (Lawless, Mills, & Brown, 2002).

Status of Deaf Education Students

Increasing numbers of students are attending class in local public school settings. In a change from past decades, which found most deaf students at residential schools for the deaf, the U.S. Department of Education reported in 2002 that 84% of all deaf and hard of hearing students nationwide were attending some form of general education classes at least part-time. Toscano, McKee, and Lepoutre (2002) supported this finding in a study on the reflections of deaf college students on their English-language achievements. Toscano and colleagues reported that 76% of participants in their study had attended a mainstreamed program during secondary school.

Deaf Students' English-Language Limitations

The inability of deaf students to locate information from search engine results stems from a combination of two possible causes, low reading levels and the complexity of the Internet. D. Wood, H. Wood, Griffiths, and Howarth (1986) found that many deaf students read less than 40 words per minute, which indicates that what is being read is not being understood. Because of their low reading levels, many deaf students often rely on a basic visual matching of text with cues when responding to questions, irrespective of the sense made in their

responses (Beggs & Breslaw, 1983; Webster, D. Wood, & Griffiths, 1981; D. Wood et al., 1986). In a study of college-age deaf students, 90% of the participants could not accurately identify inappropriately constructed sentences; nor did they report any misapprehension with such sentences (Kelly, Albertini, & Shannon, 2001).

Looking past simple comprehension, Schirmer, Bailey, and Lockman (2004) reexamined the reading strategies of deaf students and found that such deaf students employed reading strategies but still lacked many of the strategies used by their hearing counterparts. Students in the project had difficulty explaining their purpose for reading and the strategies they were using. While some students were able to evaluate sections of the material they read, there was general difficulty in discerning author bias, recognizing propaganda, and understanding point of view.

Method Sample

The present study used a sample of 22 ninth-grade through 12th-grade deaf students from four regional day school programs for the deaf throughout the Gulf Coast region of Texas. Supervisors of regional day school programs for the deaf were asked along with their teachers to identify students who would be eligible to participate in the study. This step was done to avoid the need to divulge personal health information that is restricted by federal guidelines. Student subjects met six criteria:

1. enrollment in a regional day school program for the deaf as directed by an admission, review, and dismissal committee
2. placement in either a self-contained classroom for the deaf or a mainstreamed classroom

3. 60–100 dB (moderate to profound) hearing loss
4. use of some form of sign language as their primary method of communication
5. the computer experience to navigate material found on the Internet
6. at least a second-grade reading level, so as to be able to at least attempt the searches

Students with language abilities that would prevent them from participating in any part of the study were excluded.

Twenty-two students participated in the study. More than half (54.5%) identified themselves as Hispanic; 27.3% self-identified as Caucasian, 13.6% as African American, and 4.6% as Asian.

Students self-evaluated their use of the Internet, as poor, average, good, or excellent. Of the 22 students, 4.5% rated themselves poor, 63.7% rated themselves average, 22.7% rated themselves good, and 9.1% rated themselves excellent.

Search Engine

Google, the search engine used in the present study, is the largest and most widely used commercial search engine, and has a search system that is designed to generate a lower incidence of the appearance of irrelevant material within search results, compared with other search engines such as Yahoo! and Alta Vista (Nowicki, 2000).

Task Analysis

A task analysis (Appendix A) that allowed students to identify Web sites and explain reasons for selecting these Web sites was created in a Microsoft Word document format. In an application of strategies much like those employed by Slone (2003), the study participants completed the task

analysis while seated beside me; I later evaluated their work.

Bilal's studies (1999, 2000, 2001) made use of a Lotus ScreenCam to track student query formation and Web site visitation. But because of the need to do the present study at several different locations within four separate regional day school programs for the deaf and the varying security and network protocols associated with each program's computer network, the use of screen cams was not an option. Based on Slone's (2003) post-search interview questions, the task analysis employed in the study documented student query formation and reformulation as well as each of the hyperlinks used and Web sites visited. It also gave students the opportunity to identify personal search selections, identify components of search results that prompted them to choose particular search results, and indicate if the selection was an appropriate choice.

Specific Procedures

The student participants were seated individually beside me at the computer to be used. I remained beside each student during the entire search to answer procedural questions that may have arisen, as well as to record any behaviors not captured in the task analysis, such as browsing. Each student was shown how to copy and paste elements from the Internet such as search terms and Web addresses into the appropriate location within the task analysis.

Participants conducted two fact-based searches in Google. Participants were first required to use Google to locate a Web site that answered the fact-based question *How long do alligators live in the wild, and how long in captivity?* the exact question used by Bilal (2000). The answer to this search task was located at http://www.npca.org/marine_and_coastal/marine_wildlife/.

The Web page [alligator.asp](http://www.npca.org/alligator.asp) is the alligator page for the National Parks Conservation Association. When that task was completed, the student then answered the question *How many autobiographies has author Maya Angelou written?* The answer to the second question, found off an internal link from the official Maya Angelou Web site, was located at <http://www.mayaangelou.com/LongBio.html>. While students were not required to find either of the two Web pages listed as answers in order to complete the tasks, they were expected to find answers identical to those I found at the two Web sites that were provided. Once the questions were provided, I showed the participant the questions as they appeared in the task analysis. Using American Sign Language, Signed English, or a combination of the two (depending on the needs of the individual student), I then signed the question to the student. Students were told that they were free to search for an item as long as they wanted. They were free to ask procedural questions limited to completion of the task analysis, but not about completion of the searches.

Students were free to query a search in any of Google's available services. Students were not prompted as to which service to use. Each student was also given a Word document to complete during the study. After being provided the first topic, students began the search. Each student was required to copy and paste the search queries, and query reformulations into the Word document. As the search results were produced, and each student read and selected particular Web sites from the list of results provided by the search engines, the student then copied and pasted the Web address from each search result item he or she had selected as a possible candidate. Once the Web site address had been copied onto the Word document, the

student had to explain why that particular site had been chosen as a possible option. Students were provided the opportunity to explain why they believed their choices did or did not accurately meet the needs of the search tasks. They were then allowed to view the Web site in search of the given material. Once the student determined whether the given Web page would produce the correct answer to the question, he or she returned to the Word document and explained whether the site met the appropriate goal. If the Web site did not meet the desired goal, the student was to continue selecting items from the search results until an appropriate Web site was located. When the student found a site that answered the given question, he or she was required to identify that site and explain why that site met the needs of the search. The student was to then begin the second search relating to literature. The same process was followed as the student began the second search and completed the same elements of the task analysis that were required for the first question.

Results

Query Formation

The primary search task posed some difficulty for every student who participated in the present study. None of the students recognized that the solution to the search task required two answers: a range of numbers for the age of alligators living in the wild and another range of numbers for alligators living in captivity. For the second search task, students were required to distinguish between the author's autobiographies and other books written by her.

Table 1 shows the frequency with which Internet search terms or queries generated by the students were used in each of the two search tasks. With a total of 28 searches generated, for the

first search the most common search term was “alligator(s),” with 8 searches, followed by some variation of the research question, with 7 searches. For the second search (24 searches generated), the most common search term, used in 13 instances, was “Maya Angelou” or a variation of Angelou’s name, followed by 7 instances of the use of the entire research question.

Of the 22 students, only 3 conducted more than one search on the first search task. The median number of searches conducted by students was thus one. Only 3 students reformulated search queries. On the second search task, 21 of the 22 students conducted only one search; the other student conducted three searches. The median number of searches generated by the students was two.

Web Pages Viewed

Data on the extent to which the students searched the Web in the two tasks is provided in Table 2. The median number of Web pages selected by the students was 1.0 for the first search task and 1.5 for the second. As Table 2 shows, during the first search only 8 students viewed more than one Web page. Among those 8 students, the median number of pages viewed was 3.0. Among the 11 students who viewed multiple Web pages during the second search, the median number of pages viewed was 2.0. For both searches, students perused a variety of pages that included text, hypertext, images, and advertisements. Students made no comments regarding the advertisement or commercial content that appeared in several of the pages they viewed. Students appeared to search the advertisements with the same intent and focus that they applied to text on the various Web sites. Several students read but did not select the alternative and commercial links that generally appear in a divided

Table 1

Frequency With Which Internet Search Terms or Queries Generated by Study Participants Were Used in Search Tasks

Search task 1	
<i>Search term or query</i>	<i>Percentage of uses</i>
“Alligators”	29
Variation on research question	26
“Alligator” with 1–3 descriptors	15
Research question	15
Unique, unrelated search terms	11
Web address	4
Search task 2	
<i>Search task or query</i>	<i>Percentage of uses</i>
“Maya Angelou” or variation thereon	54
Research question	29
Question related to Maya Angelou	13
Maya Angelou autobiography	4

column on the right side of Google search results. Six students selected Web sites blocked by school Internet filters. The most frequently selected site that was blocked by the Internet filters was www.digitaltermpapers.com. Even after examining the Web addresses and descriptions, the students seemed unaware of why the sites were blocked, and were unable to offer possible explanations for the blocking. Such misunderstandings only compound the difficulty of locating specific information from the Internet. Two students who arrived at the Internet filter screen decided to end their search at that point.

Reasons for Web Site Selection

The students selected Web pages to review for a variety of reasons (Table 3).

The most commonly given reason for selecting a particular Web site during the first search task was the Web page description. For the second search task, the Web page description and nonresponsive answers were equally likely to be provided regarding page selection. Other students stated that they were simply curious, or offered nonresponsive reasons for selecting particular Web sites. Students were allowed to search as many or few Web pages as they wanted for as long as they wanted.

Scheffer and Rubenfeld (2000) offer numerous descriptors of components of critical thinking, including analysis and questioning, inductive and deductive reasoning, and reflection. The demonstration of appropriate critical thinking skills during an

Table 2

Web Page Viewings, First and Second Search Tasks

<i>Number of students who viewed . . .</i>	<i>Search task 1</i>	<i>Search task 2</i>
1 Web page	14	11
2 Web pages	3	7
3 Web pages	3	1
4 Web pages	0	2
5 Web pages	1	1
6 Web pages	1	0

Table 3
Students' Reasons for Selecting Specific Search Results in Each Search Task

Search task 1	
<i>Reason</i>	<i>Percentage of responses</i>
Web page description	31
Nonresponsive answer	23
"I was curious"	23
"I don't know"	13
First result found	7
Bold print	3
Search task 2	
<i>Reason</i>	<i>Percentage of responses</i>
Web page description	24
Nonresponsive answer	24
Web address	20
"I don't know"	16
Guessed / "I was curious"	12
First result found	4

Internet search task would include behaviors such as examining similarities in Web addresses to determine that because several pages with similar Web addresses bore no resemblance to the search task, future Web sites with a Web address related to those already searched would probably not return a positive result. Other forms of critical thinking would have been the selection only of Web sites whose Web descriptions included the search term and additional information from the search task. Reflecting on the information provided by a Web site and deciding to verify the information with additional searches would also have demonstrated critical thinking skills. No student examined the color of the Web links in the search results that had been visited by previous students on the same computer. With Internet Explorer in use, previously visited links in Google's search results from within the same browser appear purple instead of the typical blue. Students could have commented that since the site had been visited previously by other students in the present study, there may have been more or

less probability that the site provided the necessary information. No student identified any sort of deductive reasoning when making a selection. An example of such reasoning would be if a student identified a Web address that appeared to be from a reliable source such as a university or government agency, with a description that indicated that it discussed the life span of alligators, and the address appeared first in the list of results; then, it *might* be a possible choice.

Correct Responses

In the first search, no student recognized that the initial search task required an age range for alligators living in the wild and an age range for alligators living in captivity. Though one student did arrive at a partial answer of 60 to 80 years, no student correctly provided a two-part answer to the question. The remaining students either incorrectly answered the question, with answers ranging from 30 years to 100 million years, or were unable to locate any answer. Specifically, 72% of the students gave an incomplete an-

swer, 23% gave an incorrect answer, 5% gave a partial answer, and 0% gave the correct answer.

On the second task, two students correctly answered the search task. One of the links to a page on the author's Web site, <http://www.mayaangelou.com/LongBio.html>, provided the answer to the search task, as well as a list of the author's books and movie and television appearances, and biographical data. Several of the students simply viewed the list in part or whole and calculated a figure to be used as the appropriate answer: hence student responses such as "23 books," "150 books," and "14 autobiographies." Specifically, 46% of the students had incorrect answers for the second search, 45% had incomplete answers, and 9% had correct answers.

Search Times

Each of the student searches was timed so that the overall length of time a student spent perusing the Internet and completing the task could be determined. Because students were also completing a task analysis of the search process, the times presented include the minutes spent completing the task analysis. The median time spent completing the first task was 5.94 minutes (Figure 1), and 6.20 minutes for the second (Figure 2). The longest time spent on any search was 19.08 minutes (Figure 1), while the shortest search time was a mere 2.08 minutes (Figure 2).

In examining both the number of pages viewed per student and the amount of search time for each student, it becomes apparent that several students searched only a single page on the initial search but took a considerable amount of time to complete the search. To better understand the discrepancy, it is important to examine the individual searches of the four student participants with the longest

Figure 1
Student Search Times: First Search Task

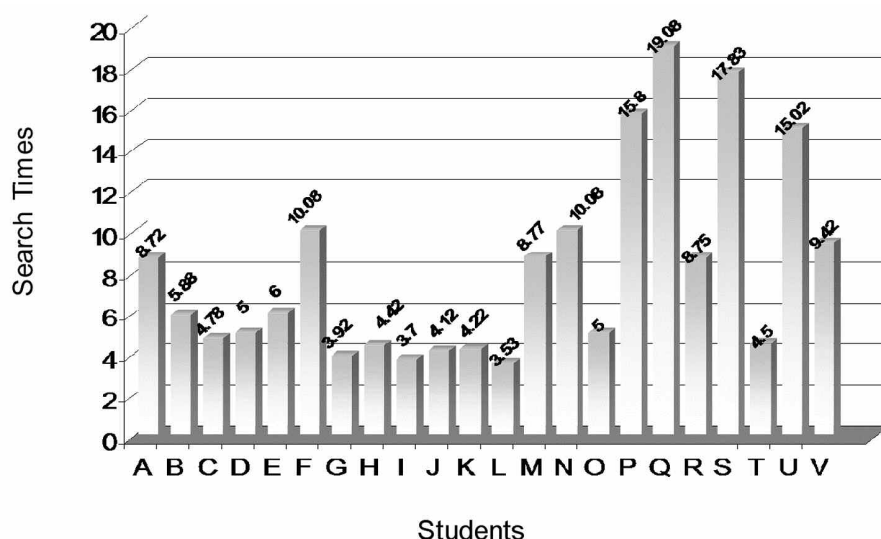
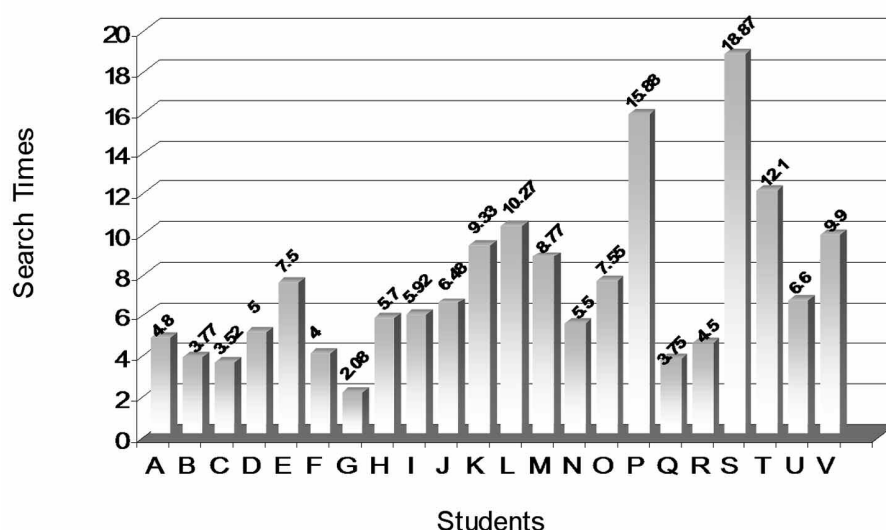


Figure 2
Student Search Times: Second Search Task



search times on the first search task. Several students in both searches searched a single Web page and had search times of greater than 9 minutes. Applying the research of D. Wood and colleagues (1986), which indicates that many deaf students read at a rate below 40 words a minute, in combination with a word count and Flesch-Kincaid reading level analysis of the four pages that were read, helps clarify the discrepancy.

Two of the students, U and V, both visited and read the site <http://www.nps.gov/ever/eco/gator.htm>, which when evaluated has a word total of 1,015 words and a Flesch-Kincaid reading grade level of 11.3. At up to 40 words per minute and with a reading grade level 7 to 8 years above the norm for deaf students, it could take a student as long as 25.4 minutes to read the entire page. For the second search, students I and O both searched the same Web page, located at <http://voices.cla.umn.edu/newsite/authors/ANGELOUmaya.htm>. The page had 2,112 words, which, at up to 40 words a minute with a reading grade level of 10.7 years, could take up to 52.8 minutes to read.

Response Assuredness

For those students who did manage to provide possible answers, all responded that they were either not sure or "did not know" if they had located the correct answer. Three students responded that they "were not sure." While five students responded that they were sure they had located the correct response, only one of the five students accurately answered the search task. For those students who answered that they were sure they had located the correct response to the search task, the reasons for their assuredness in the answer included such statements as "I can trust the Web page," "The section was labeled 'autobiographies,'" and "because all her books are listed." In examining such responses, it is apparent that students' application of critical thinking skills in determining the appropriate response to the search task was extremely limited. No student attempted to verify a response provided with any additional Web page or material. Nor did any student cite the organization that sponsored the Web site as a trustworthy, reliable source.

Conclusions

How successful are deaf adolescents at finding pertinent information for fact-based search tasks using the Google search engine? Student searches were relatively short. The median search time for the first search was 5.94 minutes, and 6.20 minutes for the second search task. Students visited a very limited number of Web sites in their quest

to locate answers to the search tasks. Students attained a median of 1.0 Web page in an attempt to locate an appropriate response to the first search task, and 1.5 Web pages for the second search task. The students evidently did not put forth much effort in locating search task answers.

Finally, the students as a whole were unsuccessful at locating a correct response to a fact-based search task. In the initial search no student correctly identified the two-part answer, and in the second search only two students, or 9%, were able to locate the correct response. The results demonstrate a significant deficiency in Internet search skills among deaf high school students.

How do deaf adolescents initiate Internet searches in order to locate answers to fact-based search tasks?

The students employed several basic strategies for initiating searches. Many simply located the main idea of the search task and used that term in the search tool. For the first search the term "alligator" was frequently used, and for the second search "Maya Angelou" occurred in approximately half of the searches initiated. Several students simply used the entire research question in their query. The students failed to use quotation marks for searches with more than one word. The students neglected to use any sort of advanced search techniques, Boolean logic, or alternate search features associated with the Google search engine. Such behaviors validate the need for additional classroom instruction on developing, initiating, and conducting effective Internet searches.

What elements of search engine results do deaf adolescents read when determining which Web sites to select while completing fact-based search tasks? The students identified various components of the search engine re-

sults such as the description and the address. Unfortunately, a majority of the students, 59% on the first task and 52% on the second task, were unable to reach a conclusion as to why they selected certain search results. Instead of being able to relate why a specific result caught their attention, students were either unable to explain their reason or simply could not express it. In either case, the need for improved critical thinking skills among deaf high school students is apparent. The inability to express or convey the reason for performing a specific task leads one to behave and perform quite randomly regardless of the specific task. Without basic reasoning and critical thinking skills, deaf students will never truly be able to successfully navigate the Internet in search of specific information.

What behaviors do deaf students employ to compensate for a lack of reading skills when selecting Web sites from Internet search engines results?

Deaf students, like many other second-language learners, are often taught strategies to help them cope with difficult reading tasks. Such strategies include using context clues such as the discussion topic, searching for specific text within a passage, examining known words in a sentence, looking at graphic or illustrated elements that correspond to the text, and attempting to gain an understanding of an entire passage rather than a precise word-for-word understanding of each sentence. Such skills are taught in the regular education classroom as well, but such skills become even more relevant to those who struggle with reading. I believed that such behaviors would be employed by students participating in the research, given the multifaceted nature of the Internet.

While the students may not have realized the specific reading level of the material being explored, intrinsically they were probably aware that the text

was difficult to read. High school students are regularly exposed to situations in which they must confront and cope with a reading level that may be beyond their mastery. From tests at school to road and location signs, restaurant menus, notes or instructions from parents and teachers, and forms such as driver's license or identification card applications, both deaf and hearing high school students must confront their environment on a literary level even if their reading skills are insufficient to handle every word in the given environment. Such literary confrontation and development of coping strategies prompted the development of the fourth research question.

Lawless and colleagues (2002) found that how well users are able to process information learned from such media is directly related to the strategies such users employ to locate specific information within hypertext media. In examining deaf students' effectiveness at navigating the search results, it is important first to understand what the students were viewing. Taking into account that the average deaf high school student has a third-grade reading level, the Google search results were posted far above their reading level. Using the most frequently searched elements for each task, "alligator" for the first search and "Maya Angelou" for the second, the students were having to interact with a group of results posted on a 12th-grade reading level. As such, most of the search result documents were far above what most deaf students are accustomed to reading. It was assumed that such deaf students employing search engines would attempt to circumnavigate those reading difficulties by employing coping strategies such as those used in reading classes. Unfortunately, such was not the case with the student participants in the present study.

The students who participated in the present study were unable to locate pertinent information from search engine results regarding specific search tasks. Similarly, the students demonstrated no alternative behaviors while attempting to compensate for a lack of reading skills. The results of the study reflect those of Graham and Metaxes (2003), who observed that deaf study participants displayed a lack of critical thinking skills and basic reasoning ability when making decisions about the reliability and usefulness of specific Web material while attempting to complete fact-based search tasks. Likewise, I was unable to observe any coping strategies or compensatory behaviors to help deal with any reading deficiencies.

Students also failed to employ basic hypertext media functions available to them on the Internet. For instance, at the Maya Angelou Web site, the home page contained a link to the rest of the official Web site that was embedded in a digital image of Angelou. Many students failed to recognize the link as they viewed the Web page despite the cursor change as the mouse moved over the image. Given the approximate size of the image, 755 pixels squared, and its prominence in the center of the page, such a failure of recognition is troubling. It indicates that many of the student subjects were not interested in seeking alternative assistance in locating the answer, or delving further into a Web page, but simply wanted to locate a typed answer provided for them in plain view.

Implications of the Study

The results of the present study demonstrate the dramatic inability of deaf high school students to create search tasks, search, navigate search results, and locate specific responses to search tasks on the Internet. Un-

fortunately, while the reading levels of search engines are often far above the abilities of their users, educators and their students use them nonetheless. For educators, there is a need to prove that there is a relationship between reading level and search engine results. Now educators have a foundation on which to build future studies. The results of the study show an inability on the part of deaf students to accurately use Internet search engines as a research tool. The most immediate implication would be the need for classroom training of deaf students on how to use Internet search engines and their results. While students expressed interest in using the Internet for a variety of personal tasks, the same students exhibited an inability to complete one of the Internet's most basic functions.

Recommendations

There are ample possibilities for future research on deaf students' use of Internet search engines. The present study focused on the ability of students to complete fact-based search tasks. The context for future research should fall into one of four categories: search types, Internet behaviors and navigation, subgroups of the deaf population, and search efficacy. Because of the difficulties associated with reading and navigating complex text found on the Internet, the use of graphical search interfaces by deaf students should be explored. The effectiveness of presenting search result material graphically to deaf students, as opposed to textually, should also be explored. Deaf students may be more apt to glean a better understanding of what is being presented in search results if these results are presented in a format that does not mandate the level of reading that current search engines require.

Note

The present article is based on a recently completed doctoral dissertation study with the Graduate School of Computer and Information Sciences, Nova Southeastern University, Ft. Lauderdale, FL. Correspondence concerning this article should be addressed to me at Texas Woman's University, Communication Sciences & Disorders, P.O. Box 425737, Denton, TX 76204-5737.—*The Author*

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Appendix A

Search Engine Task Analysis

SEARCH ONE (*How long do alligators live in the wild, and how long in captivity?*)

- I. Please copy and paste the search queries used to locate the answer to the research question.
- II. Please copy and paste the links to Web sites you selected as possible options for the answers to the first question.
- III. Identify whether or not the site correctly answered the first question. When you find a site that correctly answers the question, you may stop looking for answers on this research task. Be sure to go to section IV.
- IV. Explain why you thought this site might be a correct match (i.e., title, description, address, etc.).

SEARCH TWO (*How many autobiographies has author Maya Angelou written?*)

- I. Please copy and paste the search queries used to locate the answer to the research question.
- II. Please copy and paste the links to Web sites you selected as possible options for the answers to the second question.
- III. Identify whether or not the site correctly answered the second question. When you find a site that correctly answers the question, you may stop looking for answers on this research task. Be sure to go to section IV.
- IV. Explain why you thought this site might be a correct match (i.e., title, description, address, etc.).