CREATING ACCESSIBLE WEBSITES: DEVELOPING A FIRE SAFETY WEBSITE FOR TEENAGERS WHO ARE DEAF OR HARD OF HEARING

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Chapter 1: Introduction

"'There's constant tragedy with the deaf that is avoidable,' said DeLoye, who had become close friends with the Valencias through her husband, who is deaf. 'We've come such a long way just in this century. . . . But they were asleep, so the Sidekicks and the computers burned up. . . . It was up to the neighbors to call 911.'" (Reston 2007)

Ruby Pachecho and Alex Valencia were a friendly couple, both of whom were deaf, so they who wrote notes and taught some common signs to communicate with their neighbors.[1] They used vibrating alarm clocks and strobe lights attached to their doorbell to alert them when neighbors or friends came to visit. They had a TTY, which is what brought another deaf friend, Melissa Phoenix, to their house on December 4, 2007 (Bjelland 2007). But they did not have the one device that could have saved their lives that early morning: an audible smoke alarm connected to a strobe light and vibrating disc. Although advanced users of technology, many people who are deaf or hard of hearing either do not believe they need this technology or do not know the technology exists. Due to the hearing impairment, they are far more at risk for being hurt or killed in a fire, as most fatal fires occur when people are sleeping and less aware of their surroundings. The smoke alarm should wake people up, giving them enough time to escape the home, but

[1] Throughout this dissertation, I use the following guidelines for deciding when to capitalize "deaf": "Deaf" connotes Deaf culture (the shared use of American Sign Language and other cultural practices) or the Deaf community while "deaf" connotes a description of the person's hearing capacity. These are the conventions followed in journals focused on Deaf issues and the conventions outlined in *The Chicago Manual of Style*. I also recognize that the People-First Language Movement urges writers to use "people who are deaf" rather than "deaf people" because the movement asserts that deafness is only a characteristic of that individual. I will use both phrasings so that I follow the common conventions of Deaf scholarship.

customized smoke alarms with visual and tactile alerting mechanisms are costly and neither well understood or widely known.

Some fire service organizations have worked to fill this gap by applying for grant funding to distribute or install customized smoke alarms. Unfortunately, although their efforts are well intentioned, they have installed alarms with only an audible and visual alert, sacrificing the additional tactile alert in lieu of the more affordable alarm and of reaching more people in need of the alarms. But recent research suggests people who are deaf or hard of hearing may not awaken with the strobe alarm (Bruck and Thomas 2007, 9-10). The need for a new educational campaign is crucial to inform people that they have limited protection when they believe they have reduced or eliminated their risk altogether.

Furthermore, the fire at the Valencias' home shows a need for more education about fire prevention and strategies for escaping a fire. Shockingly according to the U.S. Fire Administration (USFA), "most [people who are deaf] have never designed or practiced an escape plan," and even worse, most have never heard of such an idea (1999, 13). The cause of the fire at the Valencias' home, a lit candle, is addressed in the common messages publicized about fire safety, so even limited exposure to these messages may have changed the Valencias' behavior and increased their chance of safety. The candle, sitting on top of a television, started a fire in the Valencias' main room, the room where the husband fell asleep but was awakened by the fire burning at his feet. He escaped but could not rescue or alert his wife and her friend who were sleeping in the bedroom (Bjelland 2007).

The Valencias' story is common but not well publicized, leaving many to assume that fire safety is not a pressing issue in the Deaf community. Perhaps this belief arises because the number of hearing and nonhearing people killed or injured in fires is relatively low compared with those killed or injured in car collisions or drowning accidents (Kung et al. 2008). Yet the words of the Valencias' neighbor reveal the truth of the situation, "There's constant tragedy with the deaf that is avoidable." Almost all the deaths or injuries caused by residential fires are avoidable, or preventable to some degree, if those living in the residence can access the proper equipment and education.

The USFA in 1999 recognized this truth and decided that people who are deaf or hard of hearing were an important population at risk and in need of fire safety education. According to the National Institute on Deafness and Other Communication Disorders (NIDCD), in the United States in 2008, approximately 28 million people are hard of hearing with 2 million of those people diagnosed as profoundly deaf. The USFA argues that this population has been left out of traditional methods of communicating about fire safety (1999, 12). The Deaf community is often seen by hearing people as an insular community that is distrustful of outsiders (Harmer 1999, 92-93; Mindess et al. 1999, 85-86), so fire safety professionals may find it difficult to begin new outreach or educational programs targeting this population.[2] Often, interpreters are not present during community

[2] Harmer, examining the history of deaf people and healthcare providers, argues that many members of the Deaf community choose to rely on each other rather than reaching outside of their community because hearing people have labeled the deaf as "disabled, impaired, and otherwise undesirable" (1999, 92). Mindess et al. explain the insider/outsider perspective as originally a dichotomy between deaf and hearing individuals, but now, with the proliferation of sign language, this dichotomy seems to have shifted to those who use ASL versus those who do not (85-86). Because the target audience is the best judge when designing educational programs and materials—meaning creators of those programs and materials need ways to engender the Deaf community's participation—the best way for a hearing person to reach into a Deaf community and to begin to gain trust is through working with people who are deaf and who have established ties to the Deaf community. Knowing some ASL is also beneficial.

meetings or health fairs where fire and life safety educators teach fire prevention, and when deaf people have attended such events or read materials developed by fire service organizations, they find the information incomprehensible, inapplicable, or completely irrelevant to their home situations. For example, typical fire safety messages rely on giving oral commands to family members during a home escape or following the commands of the firefighters, yet people who are deaf or hard of hearing cannot communicate in these ways, nor can they read each others' lips in dark or smoke-filled rooms or read the lips of a firefighter wearing a breathing apparatus (USFA 1999, 12-13). Most of the published materials focus on purchasing a smoke alarm at local retail stores without mentioning customized visual or tactile alarms and without recognizing that these stores do not sell customized alarms.

The USFA report (1999) has an appendix with fire prevention information for fire and life safety educators to use when teaching people who are deaf or hard of hearing. Yet, much of the language has no corresponding ASL sign and is too abstract and dense to understand when written in English, the second language of many people who are deaf.[3] Words like "hazardous," "refrain," "combustible," and "tempered glass" are confusing and too technical for adults who are deaf, much less for deaf teenagers and children, to understand and apply. USFA states that they hope as children are mainstreamed in schools that those who are deaf or hard of hearing will gain more information about fire safety, thus placing the burden of the problem on schools (USFA 1999, 13). Yet none of the fire safety curricula or programs targeting children includes

[3] According to Mitchell et al. (2006), declaring an accurate percentage of people who are deaf and who also use ASL is not possible at this time. No survey has asked specifically about the use of ASL, and many previous national surveys have coded using ASL as "speaking English." See the entire article for a historical discussion and review of literature of other factors impacting a lack of reliable statistics.

customized information for homes with people who are deaf or hard of hearing. Although the population was acknowledged "at risk" in 1999, no real efforts have been made to educate them.[4]

Current Efforts

Flash forward a few years to 2006. I have accepted a position as a technical writer on a grant program creating customized fire safety messages for people with disabilities. I am brought in after other writers have drafted most of the messages and worked with a team to create a DVD of the messages in ASL. The messages focus on testing and maintaining the Silent Call smoke alarm with a strobe light and vibrating disk, creating and practicing an escape plan, and preventing fires when cooking, smoking, and when using candles, electrical appliances, and fireplaces.[5] The content of the messages has been tested through focus groups, and individuals with different disabilities have reviewed each document during several stages of development. Part of my job is to edit and send to production these messages, but my main energy will focus on modifying a fire safety curriculum for children and teenagers with disabilities.

To accomplish this task, in late 2006, I joined a roundtable of teachers discussing how to customize educational materials for deaf students. The teachers emphasized how the concepts needed to remain as concrete as possible. They also said that their students had difficulties reading long texts and that many of their students tested well below their

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[4] I searched WorldCat, journals focused on deafness and deaf education, journals focused on adolescent education, Fire on the Web (a research portal maintained by the National Institute of Standards and Technology), Google.gov, the National Fire Protection Association website, and the Gallaudet-affiliated websites (Gallaudet UP and the Clerc Center) for programs, pilot studies, and/or any educational materials on fire safety for this population.

[5] The Silent Call detector used in this program was model 1008-4. For more information, see http://www.silentcall.com. The detector was installed with the Sidekick receiver and the vibrating disk.

grade level in vocabulary and reading comprehension. This finding corresponds to a prevalent theme in Deaf education research showing that children with hearing loss have delays in acquiring English (Vermeulen et al. 2007, Mayer 2007, Kyle and Harris 2006, Easterbrooks and Baker 2002). Most students who are deaf graduate from high school reading English at a fourth grade level (Vermeulen et al. 2007, Traxler 2000). The teachers emphasized that the technical vocabulary of the fire safety concepts would need to be rewritten in places; short written guides, like a teenage-version of the messages already in production, seemed questionable for reaching this audience.

Finally, one teacher said, “Put it on the web. If it’s on the web, they’ll get it.” His simple statement became the foundation of my research. I wondered what was already on the web, so after executing a quick search, I found ten or so websites targeting children (grades 4 and under), attempting to teach them through cartoon characters, coloring pages, and puzzles about smoke alarms and how to escape during a fire. But these websites suffered from the same problem as the multitude of published fire safety materials—no recognition that people who are deaf or hard of hearing have a different situation that requires customized equipment and messages. Even most of the websites targeting adults did not recognize how a disability may affect an individual’s ability to escape during a fire, may require different alerts through a customized smoke alarm, or may present additional fire hazards in daily life.

Another problem with the websites targeting children is that they offer mostly passive activities rather than reinforcing concepts through problem-solving or role playing scenarios. For example, USFA Kids, sponsored by the U.S. Fire Administration (USFA), offers three short tutorials for children to learn fire prevention strategies, what to

do in a fire, and how to maintain smoke alarms. After each tutorial, children take a multiple-choice quiz, asking them to recall what they learned on 2-3 screens' worth of information. However, five categories of the site are devoted to coloring pages, crossword puzzles, and matching games that do not actively engage children in understanding the concepts.

If cartoons and coloring pages are not enough to discourage teenagers from considering these sites as credible sources of information, the fact that many of the sites fail to follow even the most basic guidelines for web accessibility as outlined in 1999 by the Web Accessibility Initiative is sure to prevent teenagers who are deaf or hard of hearing from remaining on the websites (W3C Website, Guidelines 1.0). Most of these sites rely on the same jargon and long textual descriptions used in the fire prevention information in the appendix of the USFA report, which may suggest that the industry as a whole has lost sight of how to customize information for special populations. Clearly, the language was not tailored for children or teens with lower reading levels. In addition, many of these sites rely on Flash, a technology that makes captioning almost impossible, and other plug-ins that schools are likely to block. For example, Sparky the Fire Dog®, sponsored by the National Fire Protection Association (NFPA), requires a Shockwave plug-in before students can access the content, and the site's navigation is so confusing with catchy phrases for categories that many students may have difficulty knowing where to find basic facts about fire safety.

Finally, for deaf or hard of hearing teenagers to take these messages seriously, the websites need to provide more information about preventing fires and possibly situations that are more relevant to teenagers such as camping, cooking, and fire safety in public

buildings or venues. Some of this prevention information is available on websites targeting adults, such as the NFPA site, but the long paragraphs, lack of graphics, and heavy jargon make this information difficult to understand and unappealing. But, these were only my observations; they would remain unsubstantiated unless I had feedback from deaf or hard of hearing teenagers.

The Research Purpose, Questions, and Scope

This research project explores several research questions through three phases. The first and second phases explore whether the current fire safety sites are credible, useful, and satisfactory to teenagers who are deaf or hard of hearing. Specifically, the first phase focuses on defining the teenagers' questions or information needs related to fire safety. The second phase uses information from the first phase to evaluate whether the current sites are meeting the identified information needs? Are these sites accessible and usable? If the sites are not satisfactory, which my general observations suggest they are not, then the third phase involves creating and testing an accessible, information-rich website targeting teenagers who are deaf or hard of hearing.[6] This new website could provide information about escaping from a fire, preventing fires, and even careers in the fire service.

All three phases of the project integrate a number of diverse research areas with the aim of answering the following questions:

- What are the information needs of deaf teenagers concerning fire safety? What do they already know about smoke alarms and escape plans? What do they already

[6] From this point forward to make my argument as concise as possible, I will use "deaf students" or "students who are deaf" to represent both those who are deaf and those who are hard of hearing.

know about fire prevention strategies? What do they need to know about these subjects? What do they want to know about these subjects? (Research Phase 1)

- Do current fire safety websites meet the information needs of teenagers who are deaf? (Research Phases 1 and 2)
- Are current fire safety websites easy for deaf teenagers to navigate, and can they find information quickly? What type of navigation (text only, icon only, or text and icon combined) works well for this audience? (Research Phases 2 and 3)
- Is the information provided easy to understand and use for teenagers who are deaf? What fire safety vocabulary is appropriate for them? What techniques help them understand complex concepts? (Research Phases 2 and 3)
- Do current fire safety websites appeal aesthetically to deaf teenagers? Do they find the sites interesting and desire to use them? What aspects could be incorporated into a new fire safety website to reach this audience? (Research Phases 2 and 3)
- Is Instant Messaging software (IM) a viable alternative to using sign language interpreters when conducting usability tests of websites with deaf teenagers? Does IM collect the same amount, less, or more information than what is collected during communication via an interpreter? (Research Phase 3)

By responding to these questions, I hope to determine whether the Web Content Accessibility Guidelines 2.0 (WCAG 2.0) adequately represent the needs of deaf teenagers when considering how to make websites accessible to them. I also hope to confirm whether instant messaging software is an acceptable and perhaps better way to capture valuable feedback during usability tests of websites.

I chose to work with students at the Oklahoma School for the Deaf, a residential school, because this is where Deaf culture is most engrained. Many students choose to attend a residential school for the deaf to experience more Deaf culture and to be surrounded by other students using their same language. Some parents may encourage their children to go to the residential school if the children begin to show delays in mainstream classrooms because the classes at the residential schools are smaller. Also, the delivery of information is in multiple formats while remaining rooted in ASL as the primary method of communication. The residential school for the deaf, therefore, serves a dual purpose of providing students an environment to improve their reading comprehension and an environment where they can build strong ties to Deaf culture. Creating a website in collaboration with these students, a website they can understand and use, is a way not only to ensure the concepts and vocabulary are appropriate, but more importantly, a way to break into the Deaf community, ensuring more acceptance of the website and its content within the target audience.

My research site also limits my scope because I worked with students in grades 7-12 at only one residential school for the deaf rather than students in different residential schools for the deaf or those mainstreamed in public and private schools. This limited scope means the website created may not appeal as much to students outside residential schools. Some students may view the information as common knowledge and lose interest quickly. Hopefully, the additional categories of careers in fire safety and those customized to the activities of teenagers will provide relevant information, especially when compared to the other fire safety websites in existence right now.

To ensure the participants in my research would have their rights protected and to ensure my consent forms, testing instruments, and research methods were ethical, every aspect of my study was approved by the Institutional Review Board at Oklahoma State University. My study was classified as "Expedited Special Population," meaning four members of the board reviewed and approved the research application and materials before and during my contact with the student participants and their parents/guardians (see appendix A for the approval letter and consent forms).

Chapter Outline

This first chapter has shown how deaf teenagers are an important population at risk and one deserving of customized fire safety information. Using a website to deliver this information seems logical given that 93 percent of teenagers go online every day (Lenhart et al. 2007). Chapter two clarifies the gaps in current research and how my research will bring together diverse areas to ultimately provide an effective fire safety website for the target audience. The third chapter outlines my research methodology including a short questionnaire, students' evaluations combined with my content analysis of the current fire safety websites, and think-aloud interviews to evaluate a new fire safety website targeting teenagers who are deaf. Chapter four describes the results of the first two research phases, revealing problems with the current fire safety websites and showing the need for a new website. The fifth chapter discusses how I designed the new fire safety website and the results of the think-aloud interviews, evaluating the effectiveness of that site and of instant messaging software as a tool for conducting usability tests. Additionally, the fifth chapter describes the needed site revisions to make it more appropriate for the target audience. The final chapter provides overall

recommendations when designing and testing websites for teenagers who are deaf, and it outlines potential research areas in accessibility research and usability testing.

Chapter 2: Review of Literature

"A smoke alarm makes a very loud beeping noise to warn you that a fire has started. When you hear that loud noise, follow your home escape plan and get out fast." (USFA Kids)

"Web accessibility means that people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web." (WAI)

"Meeting the required accessibility standards does not, however, necessarily mean that a Web site is *usable* for people with disabilities." (Theofanos and Redish 2003)

Understanding where the current research stands is important for knowing what I should attempt to accomplish with my research. This project pulls together several diverse areas, areas with different goals, methodologies, and vocabulary. A working knowledge of fire safety concepts and concerns, along with how to design and test websites with people who are deaf, will enable me to show why this project is important and to clarify the language and goals for my research. Therefore, I will use this chapter to show the current research in the following areas:

- Fire safety statistics and educational outreach
- Web accessibility standards and studies
- Designing and testing websites with teenagers, including those who are deaf

Fire Safety and Targeted Groups: Who's at Risk?

In the United States in 2007, a person died in a fire approximately every two hours and 33 minutes, and every 30 minutes someone was injured (Karter 2008). Also in 2007, a home fire was reported every 76 seconds (Karter 2008). For teenagers aged

10-14, fire and burns were the third leading cause of deaths (CDC 2007).[7] The number of deaths caused by fire and smoke inhalation has been declining since the installation of residential smoke alarms was made affordable in the late 1970s; however, many of the 2,895 civilian deaths and 14,000 civilian injuries, in residential fires during 2007 alone, are preventable with a working smoke alarm, an escape plan, and basic knowledge of fire prevention strategies (Karter 2008).

According to the timeline in *Fire and Life Safety Educator* (1997), public fire education has a well established history beginning with Franklin Wentworth's "prevention bulletins" that he first sent to newspapers in 1907 with hopes that they would become longer articles (Powell 7).[8] By the 1920s, 23 states had mandated some type of fire safety education in public schools. The 1970s were significant to this branch of the fire service because of *America's Burning*, a report from the National Commission on Fire Prevention and Control urging more educational programs and issuing NFPA 1031® that included standards for a fire prevention education officer (Powell 7). During the last 30 years, NFPA has funded private and public educators and researchers, nonprofits, and state and local entities to develop and revise curricula to target various ages, especially young children and senior citizens.

Yet even with all the emphasis on customized curricula, one large group that has been overlooked with regard to fire safety is people with disabilities, who are far more likely to be injured or killed in residential fires than people without disabilities (Hall

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[7] The data were calculated using the CDC's WISQARS (Web-based Injury Statistics Query and Reporting System) at http://www.cdc.gov/ncipc/wisqars/. Unintentional Injury is the leading cause of death for those aged 1-44, but when exploring what causes of death make up this category, fire/burns are the third leading cause of deaths for those aged 10-14.

[8] Unfortunately, the 1997 edition of this textbook is the most current version of training materials for people studying to become Fire and Life Safety Educators in 2008.

2005). Exact statistics regarding how many people with disabilities are injured or killed by fire are masked because it is often difficult for the reporting agencies to determine some disabilities when victims are found; it is easier to track fire deaths by age and location. The National Fire Incident Reporting System (NFIRS), maintained by the USFA, does not track disability type because of the difficulties of accurately concluding a disability is present.[9] The fire may consume assistive technology (AT) devices often associated with disabilities, or victims may have attempted to escape without AT devices such as hearing aids or canes. Some disabilities, especially those of hearing loss, are not easily visible, so fire service organizations cannot accurately report them. Newspaper reports are the most reliable source of information showing how often people who are deaf or hard of hearing are injured or killed because of fire.

Even though hard statistical evidence is not readily available, the logic about people with disabilities having a higher risk of injury or death in a fire is easy to ascertain. People with mobility impairments and vision loss or blindness will have difficulty exiting, but they have a higher chance of evacuating because they are alerted to the fire by audible smoke alarms. People who are deaf cannot respond to audible alarms, which are designed to awaken people from sleeping when they are less aware of their surroundings and more susceptible to fatal fires. Those with hearing loss typically lose hearing in the higher frequencies first, with more profound loss developing later in the lower frequencies (known as *presbycusis*). The average smoke alarm operates at 3,100 Hz or more, meaning those with hearing loss are far less likely to hear the high-pitched

[9] NFIRS is the largest database of fire statistics with more than 21,000 fire departments reporting information every year. Although participation is voluntary, academic and industry journals use the statistics from this database to represent the most accurate information regarding fire incidents. For more information about this database, visit http://www.usfa.dhs.gov/fireservice/nfirs/about.shtm.

alarm sounding (Bruck and Thomas 2007). To combat this obvious problem, auditory alarms have been combined with a visual strobe light that emits a bright enough pulse of light to awaken people from sleep. These are more costly alarms, but they are cheaper than alarms equipped with both visual and tactile alert mechanisms. During the past 30 years, fire service organizations have used grant funding and other donations to purchase audible alarms with strobes and to install them for their community members who are deaf.

However, Bruck and Thomas (2007), working with 38 people who were hard of hearing (not profoundly deaf), showed that strobe lights alone awoke only 27 percent of participants while the standard 3,100 Hz alarm alone awoke 56 percent of participants (60-62). Their results are startling and mark a substantial shift in common assumptions held throughout the fire service and disability organizations.[10] Bruck and Thomas recommend that people who are deaf use a combination of a lower-pitched auditory alarm, strobe light, and vibrating disk or bed shaker (68-69). This dramatic shift in technical knowledge demands better education, specifically educational materials with enough room on the page or screen to explain the complex issue and to provide links to places where the more effective alarms can be accessed.

Most of the educational outreach in fire safety focuses on programs that teach fire safety to young children, emphasizing "stop, drop, and roll" and how to escape during a fire. The popular fire prevention week in October means fire and life safety educators are

[10] Fire service organizations have often purchased a smoke alarm made by Gentex that comes with a strobe light attached to the top of the smoke detector, thus combining the audible alert with a visual alert. This alarm retails for $150-170 while the Silent Call alarm that comes with a strobe light and vibrating disk/bed shaker retails for $300. Because the Gentex alarm is about half the cost of alarms with tactile and visual alerting mechanisms, the fire service and disability organizations purchase, demonstrate, and market these alarms for people who are deaf or hard of hearing.

in schools across the nation promoting smoke alarms and home escape plans. These messages are not often customized for older children and teenagers because it is assumed that they have adequate knowledge of fire prevention and evacuation strategies. If the education program has a website component, the websites are not accessible to children or teenagers who are deaf because they fail to provide captions and because many of them have far too much text and complex language for deaf teens who typically graduate from high school with much lower than 12th grade reading levels (Kyle and Harris 2006, Paul 2003), perhaps as low as a 4th grade reading level (Traxler 2000).[11] Teenagers who are deaf are a high-risk group in need of specific educational outreach to ensure they understand how to escape fires along with how to prevent them altogether.

In addition, campaigns targeting younger children may not meet the information needs of teenagers given that teenagers have far more independence and capacity for understanding exit strategies and fire prevention. According to Kanterman and D'Amore, "Fire safety education should continue through high school (probably the toughest audience of all) and college" (2001, 89). Most of the current campaigns are limited to cartoon characters explaining how to get out of the home when there is a fire; how to use a smoke alarm; and when to stop, drop, and roll. These basic messages are important, but they need to be customized for deaf teenagers. They could be augmented with fire prevention strategies about candle and cooking safety along with a few tips about creating exit strategies for public buildings, especially when visual alerts are not installed.

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[11] Interestingly, Fagan et al. (2007) found that children receiving cochlear implants when age 6 or younger had overcome their delays in reading comprehension and vocabulary development with reading comprehension scores "within the average range for hearing children" (469). But this progress depends on the child receiving the cochlear implant prior to age 6 (the earlier, the better) and actively wearing the device. Also, these devices remain controversial with the Deaf community.

These teenagers have unique needs, and they deserve a fire safety website that addresses those needs.

Web Accessibility Guidelines: Compliance and Testing

Not only have people who are deaf been left out of fire safety initiatives, but they have also been overlooked until recently in web accessibility. Web accessibility has become a higher priority, rather than an afterthought, in recent years as government agencies attempt to provide services and remain compliant with Section 508 of the Rehabilitation Act.[12] Although many corporate websites remain inaccessible (King et al. 2005, Loiacono 2004), lawsuits such as the *Department of Justice (DOJ) v. Sylvan Learning Centers* (DOJ 2007) and the *Federation of the Blind (FOB) v. Target Corporation* (Sliwa 2006) will motivate corporations to revise existing structures and design principles, integrating accessibility as a backbone. *DOJ v. Sylvan* argues that Sylvan should provide sign language interpreters and other assistive technology devices when working with students with disabilities at no additional charge to the student. In addition, the DOJ argues that online tests and other study guides need to be fully compliant for students with disabilities. *FOB v. Target* argues that people who are blind cannot purchase items on the Target website, items which are only provided on the website rather than in the physical stores. Because people who are blind have been denied access to this inventory, they argue that Target is in violation of Section 508.

These lawsuits are important because they reveal the importance of accessible websites even when people with disabilities may not be the target audience of those

[12] For a thorough history of the legal issues with ADA and web accessibility, see chapters 16-17 in *Web Accessibility: Web Standards and Regulatory Compliance* (2006).

websites or services provided. Furthermore, the lawsuits show that although guidelines for accessibility were approved in 1999 and multiple guides were published showing programmers and web designers how to comply with the guidelines, many corporations and organizations still do not comply or do not understand how to comply.[13] Thus, drawing attention to web accessibility and clarifying the guidelines through usability tests with people of all disabilities should decrease this digital divide (RTC Rural 2006).

The Web Accessibility Initiative (WAI) was introduced as one of the five domains of the World Wide Web Consortium (W3C), a domain devoted to developing guidelines and tools for web accessibility by coordinating with individual researchers, disability organizations, governmental groups, and industry. The comprehensive guidelines became a W3C Recommendation on May 5, 1999, known as Web Content Accessibility Guidelines (WCAG) 1.0, and have now undergone a significant revision to incorporate new technologies in Java, Flash, and browsers (WCAG 2.0). WCAG 2.0 is set to be approved in February or March of 2008. The guidelines describe coding and formatting techniques and evaluation methods, along with links to helpful resources or additional standards, for implementing each guideline (Web Accessibility Initiative 2007).

WCAG 1.0 is clear when illustrating coding that enables users to navigate via keyboards or other assistive technology devices rather than mouse-only functions. The guidelines also address issues of captioning and text-only versions to enable screen

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[13] This claim is best articulated in several essays in *Advances in Universal Web Design and Evaluation* (2007). The most comprehensive guides published about web accessibility are as follows: *Web Accessibility for People with Disabilities* (2000), *Maximum Accessibility: Making Your Websites Usable for Everyone* (2002), *Building Accessible Websites* (2003), and *Web Accessibility: Web Standards and Regulatory Compliance* (2006).

readers to function properly and to enable people who are deaf to read video that is not signed. Yet features that truly make a website usable and accessible for people who are deaf have been limited to discussions of captioning and plain language without clear specifications for either captions or plain language, much less navigation and labeling systems. Many changes are proposed to correct some of this oversight in WCAG 2.0, such as translating spoken words or video into sign language; however, the web community is debating whether these changes are achievable.

Perhaps because WCAG 1.0 focuses so heavily on rendering websites properly through assistive technology, much of the research follows along these lines, testing websites with code checkers and with people using assistive technology or using keyboard-only access. Yet the primary demographic of people who do not use assistive technology devices when using computers is people who are deaf, meaning they have been overlooked. Some of this oversight exists because of an underlying assumption that the web is a visual medium, fully accessible to people who can see, meaning people who are deaf encounter no barriers when surfing.

For example since 2000, the *Journal of Visual Impairment and Blindness* has published seven studies of people with visual impairments or blindness using websites or testing new software applications to make websites more accessible. In comparison, the *Journal of Deaf Studies and Deaf Education* and the *American Annals of the Deaf* combined have published only three studies testing website accessibility with people who are deaf. In *Communications of the ACM*, seventeen studies are easily found testing websites with users who have vision impairment; this search does not include all the studies focused on how assistive technology interprets websites and studies that use only

code verification programs. Using the same search terms and substituting blind and vision impairment with deaf and hearing impairment, only two studies appear in *ACM*, further proving the underlying assumption that users who are deaf have no problems accessing websites although no empirical data supports or refutes this claim.[14]

One caveat articulated in research represents the underlying attitude about testing the guidelines with people with disabilities:

> While all of the checkpoints are applicable to evaluating various Web sites, only the indicators whose relevant dimensions could be objectively captured on-line were selected for this study. For example, while failing to use 'the clearest and simplest language appropriate for a site's content' (WCAG 1.0, Checkpoint 14.1) could be a major mistake of Web sites, this standard was not included since it was difficult for the coders to objectively decide if some text is 'clear and simple' (Huang 2002).

In other words, it is easier to run a website through an automatic code verification program or to detect whether an AT device can interface with the website rather than to test these websites with people with disabilities.[15] Even when actually testing the sites with people with disabilities, the researchers test only the guidelines that are easily

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[14] In the *Journal of Visual Impairment and Blindness*, see Sapp (2007), Gilson and Rongqiang (2007), Hackett and Parmanto (2006), Jones et al. (2005), Koenig (2003), Williamson et al. (2001), and Gerber and Kirchner (2001). In the *Journal of Deaf Studies and Deaf Education*, see Farjardo et al. (2008). In the *American Annals of the Deaf*, see Smith (2006), and Fels et al. (2006). In the *ACM* for studies with users with vision impairment, a total of 17 studies are published; see Vigo et al. (2007), Mahmud et al. (2007), Tan et al. (2007), Bingham et al. (2007), Takagi et al. (2007), Chandrashekar et al. (2006), Andronico et al. (2006), Borodin (2006), Mankoff et al. (2005), Damsma et al. (2005), Salampasis et al. (2005), Rotard et al. (2005), Aimeur et al. (2004), Seeman (2004), Yesilada et al. (2003), Hanson (2001), and Asakawa and Takagi (2000). In the *ACM* for studies with users with hearing impairments, see Kennaway (2007) and Saksiri et al. (2006).

[15] King et al. is one of the few articles to argue that "automated compliance reporting provides a very limited view of accessibility compliance status" and that human judgment is necessary to determine accurately whether the website is actually complying with the guideline (2005, 527).

quantifiable. For example, rather than creating a matrix to evaluate whether the "text is clear and simple," researchers will opt for testing the clearly measurable guidelines of captions being present or absent or of a screen reader reading the text in the correct order.

However, neither of the two guidelines targeting deaf users—using captioned text and using plain language—can be tested without the actual responses of comprehension from deaf users. A researcher can certainly verify whether a video has a caption, but whether the caption is at an appropriate size, speed, or placement involves the input of a deaf user. Ensuring that people who are deaf can understand the language captioned within the video and the language used throughout the site's content cannot be verified without the input of people who are deaf. Locating and recruiting people who are deaf for usability tests are difficult and costly in addition to the work involved with locating and paying sign language interpreters to facilitate communication during the test.

Only one article has addressed the concept of plain language when designing for users who are deaf, but even this article failed to create or test standards for what qualifies as plain language with those users. Boldyreff, Burd, Donkin, and Marshall (2001) emphasize the need for "plain English" when creating an accessible site for deaf users; they also emphasize how plain language will benefit users without disabilities because they can more easily find and understand the information presented (Boldyreff (Boldyreff et al. 2001). The specific features of plain language with implications for users who are deaf are creating controlled vocabulary and concise sentences and paragraphs, clearly emphasizing the main point visually and shifting it to the front of the sentence or information block. Unfortunately, Boldyreff et al. emphasize readability issues using readability formulas and a general insistence that plain language is helpful rather than

empirically testing specific characteristics of plain language with people who are deaf or rather than defining measurable benchmarks for implementing or evaluating a website's use of plain language.

These are important considerations that need to be tested and clarified in WCAG 2.0 rather than the W3C issuing vague statements about "use clear and simple language" if those in web accessibility fields want industry to adopt the new standards. The single guideline in WCAG 2.0 that addresses writing in a plain language style states, "When text requires reading ability more advanced than the lower secondary education level, supplemental content, or a version that does not require reading ability more advanced than the lower secondary education level, is available" (Guideline 3.1.5). Unfortunately, this guideline is assigned the lowest priority rating of the three ratings, receiving AAA (A is the highest, AA the middle, and AAA the lowest).

WCAG 2.0 does attempt to outline more quantifiable characteristics of plain language, listed as "advisory techniques." These techniques are stated as follows:

- Using sentences that contain no redundant words, that is, words that do not change the meaning of the sentence
- Using sentences that contain no more than two conjunctions
- Using sentences that are no longer than the typical accepted length for secondary education (Note: In English that is 25 words)
- Using sentences that do not contain complex words or phrases that could be replaced with more commonly used words without changing the meaning of the sentence (WCAG 2.0, Guideline 3.1.5)

Although these advisory techniques are more measurable than "use clear and simple language," the techniques may not actually produce more comprehensible content, especially for people who are deaf. Furthermore, WCAG 2.0 encourages web designers to run their web content through readability formulas—intended as predictors of reading levels—rather than encouraging them to test it with users. Scholarship has demonstrated that reading formulas based on sentence or syllable length, when used independently of other research methods, do not accurately determine whether the language and concepts are easy to understand (Connatser 2004, 1999; Giles and Still 2005; Schriver 2003; Redish 2000). Yet some studies rely only on the results of a readability formula when evaluating whether the material is appropriate for the target audience; these studies, like the studies using only software verification tools to analyze the coding language of websites, fail to test with actual people from the target audience.[16] What these researchers overlook is how the number of nominalizations, sentence clause order, paragraph cohesion, and other syntactical aspects of the paragraph and sentence contribute far more to comprehension than sentence length. It is unfortunate that WCAG 2.0 will continue to urge people to use such outdated and problematic methods of evaluation.

Designing Websites for Teenagers, Including Those who Are Deaf

Before investing in creating a website for teenagers, it is important to determine whether this method of communication might be effective in reaching them. Statistical trends show how the number of teenagers going online has increased each year. In 2007, 93 percent of teenagers (aged 12-17) used the internet, an increase from 86 percent in

[16] For examples of researchers evaluating materials by running text through readability formulas without human evaluation or testing, see Sabharwal and Badarudeen (2008), Sand-Jecklin (2007), and Hoffmann and McKenna (2006).

2004, and 11 million of them go online daily (Lenhart et al. 2007; Lenhart, Madden, and Hitlin 2005). In fact, IM has become so popular among teens "that the Pew Project [has] tagged them the 'Instant Message Generation'" with AOL IM as the most popular IM service (Montgomery 2007, 114). Many go online for social purposes, but more and more report going online to read about current events and to find health information (Lenhart et al. 2007).

These trends are also present in Deaf communities. Although the statistics for computer and internet use in Deaf communities are less precise, there is no doubt that people who are deaf are using computers and the internet routinely (Agboola and Lee 2000). In 2004, the most recent study of this issue, Zazove et al. interviewed 227 people in the Deaf community, and 63 percent of their participants responded that they used computers regularly. Zazove et al. also found that the younger participants were far more likely to use computers and the internet and to use them more frequently than older participants; this trend suggests their statistics of usage probably would have been significantly higher if their median age had been lower than 56 years. Also surprising, 40 percent used the internet to find health care information, and 38 percent searched for general information (Zazove et al. 2004, 380). Given the developments in email, instant messaging, and social network sites during the last four years, we can assume the majority of the Deaf community, especially teenagers, is online frequently.

When designing websites for teenagers, Nielsen and Loranger report that teenagers believe "adults are out of touch and don't understand their situations" (2006, 259). They want sites with stories they can understand and "relate to" and with more graphics illustrating the text (Nielsen and Loranger 2006, 259). In their 2005 study of

teenagers (aged 13-17), Loranger and Nielsen found that they have a lower tolerance for "boring" websites with lots of text or with small font sizes, but this study does not provide clear guidelines about vocabulary level, which is significant for labeling and navigation systems (Morville and Rosenfeld 2007). Also left out of this study is testing of more implicit navigation systems rather than the more obvious underlined, blue text signifying links or more graphical links. Most importantly, none of the 38 participants had a disability.

No studies have attempted to build a website with teenagers or people who are deaf. Only a few studies work with users who are under the age of 18 although approximately 17 of every 1,000 children under the age of 18 have hearing loss (NIDCD 2008) and although younger ages have grown up with the internet rather than coming to understand and use it as adults. Studies that have tested web issues with adults who are deaf have focused on information retrieval and navigation systems. Their results support the guidelines outlined when designing for people without disabilities.[17] For example, Fajardo et al. (2006) hypothesized that replacing textual information with graphics or icons would make navigating an online newspaper easier for adults who are deaf. However, after comparing the results of 21 deaf users and 24 hearing users, they determined that replacing textual links with graphics or icons causes longer search times as both deaf and hearing users finding fewer targets and becoming increasingly disoriented (459-460). They uphold the guidelines of providing mixed interfaces (combining text and graphics) or using text-only labels and interfaces rather than graphic-

[17] The most authoritative sources for web design guidelines to ensure the website meets the needs of its users are as follows: *Information Architecture for the World Wide Web* (2007, 3rd ed) by Morville and Rosenfeld, *Prioritizing Web Usability* (2006, update of *Designing Web Usability*, 2000) by Nielsen and Loranger, and *Principals of Web Design* (2008, 4th ed) by Sklar.

only interfaces. They do suggest that some of the longer searching time may have been due to a complex and deep interface with several links required to drill down to the target content, meaning more links and graphics for a user to hold in short-term memory (461).

Another important study tested a new type of navigational structure to see whether ASL or graphic-based links are easier for people who are deaf when browsing websites. Signlinks uses signed content and navigational structures so that deaf users of sign language do not have to switch between two languages—ASL and English—to navigate and understand web content. Fels et al. (2004) developed signlinks and tested the new navigational structure with nine deaf subjects (aged 18-30). Their findings suggest that this new navigation may work well for some websites; however, the subjects believed a "Visit Link" button below each video graphic would clearly indicate the difference between a video and a signlink—a link used only to access another video with extended content (Fels et al. 2004, 1114). Creating a navigation system that depends only on sign language may not translate well to those using ASL because it is not intuitive or similar to other media experiences such as video games, television, and popular websites like Youtube, MySpace, and Facebook. Text and graphic combinations are inevitable and expected even by ASL users, and those users may see the time invested to learning signlinks or all-signed websites as unnecessary or extravagant.

Only two studies work with teenagers who are deaf to test navigational structures and information retrieval. The most recent study worked with 30 deaf students and 31 hearing students to test two versions of a digital supermarket—one with text-only labels and one with graphic-only labels (Fajardo et al. 2008). Overall, the deaf students took, on average, 4-6 seconds longer to find targets when using both label systems compared with

the hearing students, and the deaf students were able to locate information via graphic-only labels 2 seconds faster than with text-only labels. However, the researches suggest "caution" when interpreting their results because "students are faster in getting to the target when nodes are represented by pictures, but they [can] become more disoriented using pictures as well" (Fajardo et al. 2008, 94). They explain that deaf students may employ more of an "'assess-all' decision strategy" rather than a targeted strategy that begins with articulating their information needs, conducting a search, and evaluating the results based on relevance while also modifying their main goal (Fajardo et al. 2008, 97). They also emphasize that the path distance between links and targeted content was short, so they hypothesize that the shallow navigation may have contributed to the faster speed when using graphical labels. Their mixed results when testing navigation and label systems with adults and teenagers who are deaf suggests this area needs further study.

The second study with teenagers who are deaf focuses on searching strategies and some limited navigation of the websites returned as search results. Smith (2006) replicated an earlier study with children and information retrieval on the internet, but for his study, Smith used 22 teenagers who are deaf (grades 9-12). He showed through think-aloud interviews how those 22 students created search terms, navigated through search engine results, and ultimately decided they had answered or they should abandon specific search tasks. The first search task involved a two-part answer, and no students answered both parts. For the second search task, only two students were able to locate the correct answer. Many students opted for partial responses or gave up the search completely. None of the students used advanced features when searching or tried a combination of terms with Boolean logic. On average, they examine 1-1.5 webpages to find the answer

to each task with a total of 12 minutes for the entire search activities—entering terms, waiting for results, choosing results, and scanning webpages for specific information (Smith 2006, 523-525).

Although Smith's study provides important data of how teenagers who are deaf retrieve information online, his expectations for the critical thinking skills of teenagers, more specifically teenagers who are deaf, may have been too high. For example, he expects students to provide two answers to his first research task: "How long do alligators live in the wild, and how long in captivity?" (529). This task involves two questions although he consistently refers to it as the "first question" throughout the worksheet where the students are to write in their answers. This wording could be confusing on its own, yet Smith also uses words that are not common to ASL; "wild" and "captivity" are concepts signed through multiple signs instead of one sign. He did sign the question to the students before asking them to search for information, but they may not have been able to remember that they were searching for two different answers. Many may have returned to the written question to verify search terms, hoping they could match exact words of the question with the information they found on the webpages, a coping strategy often employed by deaf students when reading complex information (Wauters et al. 2006, Schirmer et al. 2004).

Smith also articulates his surprise about how the students navigate, or fail to navigate, one of the websites returned as a result of their search. He chides the students on failing to click on the centered photograph of Maya Angelou, which is the only pathway into the main content of the website, when attempting to complete the second research task: "How many autobiographies has author Maya Angelou written?" (Smith

2006, 527, 529). However, there are no textual links nor buttons or other graphical devices offering additional ways to access the main content of the website. Many users overlook links when they are only accessible through graphics rather than through redundant text and graphics because the only signal provided that a link is present is the arrow changing to a pointing finger. (known as “mine-sweeping” in Nielsen and Loranger 2006, 184; Farkas and Farkas 2000, 342). The assumption that these students have poor critical thinking skills or that they “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” (Smith 2006, 527), blames the user rather than emphasizing the poor website design. Thus, some of Smith’s conclusions are questionable and need further verification through usability testing.

Testing websites with people who are deaf, especially teenagers, can be time consuming and costly. Researchers must locate participants for usability studies, and once located, parents or guardians of those underage participants must sign consent forms. Many companies and organizations already avoid usability testing claiming that the tests cost too much; this fear only grows when calculating costs for locating reliable interpreters and then paying them properly for their services. Instant messaging software may prove a new way to conduct usability testing with people who are deaf, especially given how popular instant messaging is with teenagers and people who are deaf. Sixty-eight percent of teenagers use instant messaging as a common way to communicate with their friends (Lenhart et al. 2007). Even though this percentage has dropped from 75 percent in 2004, it is assumed that the difference in self-reporting is because so many teenagers are messaging through social online networks and do not access a separate IM

service. Instant messaging is even more popular in Deaf communities. In 2002, a survey of 884 deaf and hard of hearing adults said that 75 percent of them used IM daily, and most included in the survey were aged 25-65 (Bowe 2002, 8). Given these data describing how two demographics use IM—teenagers without disabilities and adults who are deaf—it seems safe to assume that, in 2008, teenagers who are deaf use IM daily, meaning that IM may prove an extremely effective way to conduct usability tests of websites targeting them.

Conclusions

Drawing together these diverse areas of research elucidates several important considerations for my research. First, the research about fire safety shows that more education and outreach to people who are deaf is vital because they have been overlooked and underserved. The fire safety messages and materials are too complex and fail to offer any type of customized information that indicates people who are deaf have different needs when it comes to fire prevention and escaping during a fire. Furthermore, the assumptions held about visual smoke alarms may prove quite dangerous given the findings of the 2007 study, meaning it is urgent to update education materials for this population as quickly and thoroughly as possible.

Given how often teenagers go online, the fastest way to reach this at-risk population may be through a comprehensive website that can explain the technology shift, can provide robust information about fire prevention and escape, and can offer direct links to the most effective smoke alarms. This research survey has shown that none of the current fire safety websites target teenagers, much less those who are deaf although they may need to know more about fire prevention and strategies for escaping buildings

because audible smoke alarms cannot alert them. The current websites also fail to comply with web accessibility guidelines.

More importantly, creating a customized website with teenagers who are deaf can verify and perhaps clarify the limited data on appropriate navigation and labeling systems that people who are deaf find effective. Working with teenagers can also verify the findings of Nielsen and Loranger concerning the use of text and graphics and of additional interactive features, such as online quizzes or games. Designing a site in this way can provide, perhaps, more concrete and measurable benchmarks for what qualifies as plain language for this audience. Finally, my research can determine whether using instant messaging software is an effective way to conduct usability testing of websites with people who are deaf, thus potentially offering a win-win situation for both industry and people who are deaf; industry gains a cost-effective methodology while people who are deaf gain more voice in web design.

The next chapter will discuss my methodology in detail and explain why I chose to work with teenagers at the Oklahoma School for the Deaf to design the fire safety website.

Chapter 3: Methodology

"A site made by teens for teens would be more interesting, compared with what 'the adults think the teenagers are gonna want to look at'." (Livingstone 2007)

"…the usability experts will have to rely, more so than in the evaluation of a Web application, on their own subsequent estimation of the severity of the problems detected with the informational Web site." (van den Haak, de Jong, and Schellens 2007)

I based the methodology for this research on the belief that the intended target audience is the best authority when creating a website and testing its usability. To ensure teenagers who are deaf controlled the design and evaluation processes, I structured this research project into three phases:

1) Questionnaire that provided demographic information and measured internet usage and fire safety knowledge
2) Guided analysis of current fire safety sites
3) Think-aloud interview and evaluation of the new fire safety website

Each phase targeted different research questions. The first two phases gathered data to produce an effective fire safety website; the third phase verified some of the data gathered in the previous phases and tested the usability of the new website. Together, these phases provide a robust analysis of both current fire safety websites and ways to create a fire safety website that would meet the information needs and desires of teenagers who are deaf.

I worked with students from the Oklahoma School for the Deaf, which is a residential school established in 1908 in Sulphur, Oklahoma.[18] The school provides educational opportunities for children ages 2-21 and has several dorms for students who live outside the Sulphur community. During 2007-2008, according to an email from Assistant Principal Varner, 71.6 percent of students lived on campus, which reinforces, and may hasten, the students' socialization into Deaf culture. Because students may be attending OSD to participate in Deaf culture and because some of them may be attending OSD for specialized instruction, the school is an ideal research site for my study.

Before any contact with students, I received approval from Oklahoma State University's Institutional Review Board as four committee members examined each of my consent forms, a list of current fire safety websites, my testing instruments for each phase, and the overall justification of my methodology. To recruit participants, I created a packet of information for parents and students. The packet contained a short flyer describing the research activities and length of the process, a parental consent form with detailed information about the purpose of the project, the research activities, an estimated time frame for the process, and an emphasis that the student or parent could withdraw from the process at any time (see appendix A for the IRB approval letter and the approved consent forms). The student assent form was limited to a single page. Both forms were signed and returned to the OSD computer teacher or me. As described in these forms, students received no compensation for participating; however, they benefited from learning about fire safety and knowing how to react in a fire emergency.

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[18] Originally, students who were deaf attended classes at Fort Gibson, a military base in Oklahoma. In 1898, a school for the deaf was opened in Guthrie, Oklahoma, and after Oklahoma received statehood, OSD officially opened in Sulphur with three main buildings.

The first round of packets about the project was distributed in April 2007; however, not enough students and parents returned signed forms for the project to continue during the academic year of 2006-2007. To recruit more participants, I attended OSD's enrollment day in the fall when I distributed the second round of packets, answered questions, and described the project in more detail. Several students and parents learned about the project and agreed to participate. These parents and students spread the word to additional parents and students, so by the end of September 2007, I had collected 52 signed forms, enough to proceed with my research. Because OSD is a residential school where students typically go home only on certain weekends, the consent process was much longer than anticipated, an important factor for researchers to continue when working with this type of school.

For my research, 50 students completed Phases 1 and 2, the questionnaire and guided analysis of current fire safety websites. From this pool of students, I collaborated with the OSD assistant principal and the computer teacher to select 20 students for Phase 3, one-on-one interviews during which the students were asked to "think-aloud" and evaluate the new fire safety website. The rest of this chapter will describe how I selected the websites for testing, how I created and tested my research instruments, how I selected student participants, and how I conducted each research phase and then analyzed the data collected in those phases.

Before the Research—Selecting Websites for Testing

Before conducting Phase 1, I explored current fire safety websites to select a broad range of those websites for testing during Phase 2. Specifically, I used three main criteria for selecting sites:

- Sponsored by government, research, and nonprofit entities. Specifically, I considered sites sponsored by local, state, and federal governments (fire departments, state fire marshals, and other related organizations), sites sponsored by research entities within the fire service, and sites sponsored by nonprofit organizations focused on fire research or educational programs. I wanted to represent each of these types of website in my study. The majority of sites were sponsored or created by organizations in the United States and targeting U.S. audiences; however, I included two sites outside of the U.S. to compare website features, tone, and fire safety concepts.
- Containing a separate portal for children and/or teenagers, such as a "For Kids" section within a site targeting adults. I identified these sites through direct wording on the organization's main site or through the organization's press releases.
- Using graphics, vocabulary, or activities that seemed to target teenagers and/or children. For example, sites could be included if they used *kids*, *children*, *teen*, or *young person* as their main address. Other sites could be included if they provided coloring pages or other child/teen activities.

I used several keyword combinations and several search engines to locate potential websites. The search engines included Google, Yahoo, and MSN.[19] The keywords included combinations of *fire*, *fire safety*, *fire safe*, *children and fire*, *kid and fire*, *youth and fire*, *teenager and fire*, *adolescent and fire*, *burn*, *fire emergency*, *fire*

[19] I used these three search engines because they are the most widely used in the United States; the three engines combined facilitated over 90 percent of all searches conducted in 2007-2008. Google ranks the highest with over 60 percent of search "shares" (Burns 2008). http://searchenginewatch.com/showPage.html?page=3630718

education, *firefighting*, *learn about fire*, and *wildfire*. The following fire safety websites consistently appeared at the top of the search results:

- U.S. Fire Administration for Kids (USFA is under the Department of Homeland Security), http://www.usfa.dhs.gov/kids/flash.shtm
- Sparky the Fire Dog® (National Fire Protection Association), http://www.sparky.org/
- NYS Department of State: Fire Safety Kids' Room, http://www.dos.state.ny.us/kidsroom/firesafe/firesafe.html
- Kids Fire Safety Tips, http://www.kfst.net/
- Kids Safe, Fire (University of Oklahoma Police Department) http://www.ou.edu/oupd/kidsafe/fire.htm
- Children's Fire Safety, http://www.redhotdots.net/
- Get Fire Wise (United Kingdom), http://www.firekills.gov.uk/seniors/index.htm
- NOVA Online: On Fire, http://www.pbs.org/wgbh/nova/fire/onfire.html#
- Staying Alive: Kid Zone (Canada), http://www.stayingalive.ca/kids_zone.html
- Survive Alive (Allstate Insurance), http://www.survivealive.org/kids/index.cfm
- Danger Rangers (Educational Adventures) http://www.dangerrangers.com/KidsClub/games.cfm
- The Fire Avenger (Office of the Insurance and Fire Safety Commissioner in Georgia), http://167.193.82.12/
- Illinois Firesafe Kids, http://www.state.il.us/kids/fire/
- Smokey the Bear, http://www.smokeybear.com/

From these websites, I eliminated Danger Rangers because it was an entire site of video and audio, and a lack of captions made it useless to students who are deaf. I also eliminated Survive Alive by Allstate because it required visitors to create a login and password before they could explore the website. I did not want to force any students participating in this project to divulge personal information including email addresses to these websites, and after logging into Survive Alive, I realized it had mostly coloring activities and similar information to the other sites.

Additionally, I had prepared a guided worksheet for the Children's Fire Safety (Red Hot Dots) website and one for Kids Fire Safety Tips; however, the sites were not available on any of the three days before the testing; Kids Fire Safety Tips had a splash page indicating that the "tip" characters had retired, and I assumed Children's Fire Safety was no longer an active site because the site was unavailable. I removed both sites from the testing pool.

Finally, I chose not to test two sites, although they were age-appropriate, because their content was too narrow or too different from the main messages of home fire safety. I wanted to ensure the websites were similar in content and scope, so I could get an accurate representation of whether students understood the content and main messages. Smokey the Bear was focused on wildfires and their prevention rather than home fire safety, and NOVA Online: On Fire was focused on the chemistry of fires and causes of fire rather than fire prevention. Both websites were eliminated from testing but were included on the links section of the new fire safety website.

For my sample, I selected sites created by the leading education and research organizations in the fire service, those created by state and local agencies, those created

by fire departments or organizations founded by retired fire service personnel, and two created outside the United States, one in Canada and one in the United Kingdom. I limited my sample to websites with a specific section targeting children or teenagers; however, I tested one site targeting adults to determine whether the vocabulary and concepts were more appropriate for a teen audience than that presented on the sites targeting children. The following paragraphs describe why I selected each site for testing and what portions of the content were targeted for student evaluation.[20]

1) **U.S. Fire Administration for Kids**, created by the USFA under Homeland Security, is a widely disseminated website address among fire departments and fire and life safety educators because the USFA is the federal accrediting agency for fire departments and programs. The worksheet tasks include reading about smoke alarms and taking a comprehension quiz, playing the hazard house game, and reading and summarizing information about escape plans.
2) **Sparky the Fire Dog®**, created by the NFPA, is another widely disseminated website address among the fire service because the NFPA is the main clearinghouse of education and research in fire safety. The worksheet tasks include playing a fire drill game, reading information about an escape plan and smoke alarms, and understanding the technical descriptions of the fire engine's components.
3) **National Fire Protection Association** is the only site targeting adults that I tested for this research. I wanted to test one website written specifically for adults to compare results with sites targeting teenagers or children and to determine

[20] For more information about how I solicited student evaluation through guided worksheets, see the next section about testing instruments.

whether the vocabulary level and tone was more appropriate for teens than the concepts and tone presented on the websites targeting children. Specifically, the worksheet of tasks asks students to read about two topics, winter/holiday safety and fireworks, and to indicate what is new or interesting information to them and to list any confusing words or concepts related these topics.

4) **New York State Department of State: Fire Safety Kids' Room** was created by the Office of Fire Prevention and Control, part of the Secretary of State's office, in conjunction with the NY Department of Education and several fire departments in New York. It is a good example of the sites created by local fire departments and is also one of the few local fire department websites that has a section for children rather than only adult-appropriate information.[21] No specific age group is given as the target audience. The worksheet asks students to read and explain parts of creating an escape plan, to read and explain what arson dogs do, and to look at the graphics explaining how to test a door for heat before opening it; overall, the tasks target vocabulary level and comprehension of the graphics used in place of text.

5) **The Fire Avenger** was created by the Office of the Insurance and Fire Safety Commissioner of Georgia, an office responsible for appointing the State Fire Marshal, working with local fire departments during fire investigations, inspecting buildings for fire code compliance, and promoting fire safety

[21] I reviewed the websites created by local fire departments for the 25 most populated cities; typically these cities have more staff and funding for fire and life safety education, and all the sites I reviewed were created by departments rated ISO Class 1, a rating that includes the "type and extent of training provided to fire-company personnel, and the number of people who participate in the training" (Insurance Services Office, http://www.iso.com).

education. No specific age group is given as the target audience. The worksheet of tasks asks students to judge the overall tone of the website, to judge whether the site's activities are appropriate for teenagers, and to translate the technical jargon presented about smoke alarms into their own words.

6) **Illinois Firesafe Kids** was created in 1996 by the Illinois State Fire Marshal and the Division of Biomedical Communications within the Southern Illinois University School of Medicine. This site is one of the few developed with a communications group affiliated with a university, so I wanted to determine whether the content was more age-appropriate, assuming the university researchers performed more knowledge-gained assessments. No specific age group is given as the target audience, and the site is not included as one of the fire safety education links within the State Fire Marshal's website. The worksheet tasks include judging the overall tone of the website, summarizing information about fire hazards, such as an overloaded outlet, and describing what is new or interesting information about the fire equipment.

7) **Kids Safe, Fire** is a section of The Police Notebook website created in 1997 by the University of Oklahoma Police Department, one of the first police departments with a public safety portion of their website, to provide information about several safety issues. The site feels more like a collection of PowerPoint slides, so I selected it to determine whether its unique navigation style was appealing. No specific age group is given as the target audience for any of the various sections. The worksheet of tasks asks students to judge the overall tone of the website and whether the graphics are appropriate for teenagers and help them

understand the concepts. Specifically, the worksheet tests the students' comprehension of the information about crawling under smoke and how to help others escape a fire.

8) **Staying Alive: Kid Zone**, one of the two foreign country websites selected, is sponsored by a nonprofit organization founded in 1999 by a Winnipeg firefighter and fire and life safety educator. It targets kindergarten through 8th grade students. The site uses cartoon characters to present its messages. The worksheet tasks include judging the variety of games available and playing one of those games, reading and describing the science of how fires burn, and understanding and rephrasing the idiomatic or humorous language used in the "hot tip" section. I included this site to see whether it focused on the same fire safety concepts as those used in U.S. sites and to determine whether its tone and graphics would appeal to U.S. deaf teens.

9) **Get Fire Wise**, the other foreign country website selected, is sponsored by the UK Fire and Rescue Service. The site is part of a national fire safety campaign focused on educating people in every age group to reduce fire deaths and injuries. Flynn and Friends, part of Get Fire Wise, targets "seniors 8-14 years." The overall tone is much more sarcastic and serious than the other websites tested, and I wanted to determine whether U.S. deaf teens would find the graphics and tone more appealing than the U.S. sites targeting younger children. The worksheet tasks include playing and evaluating a game, taking a quiz about what starts fires, and reading and evaluating a story about Joe calling for help.

Testing Instruments

For each research phase, I designed several testing instruments, drawing from questions used on previous surveys and adding questions to reflect the nature of my research questions. All instruments were pilot tested and were reviewed by two professors, an ASL interpreter and an OSD administrator.

For Phase 1, I used a questionnaire that combined open- and closed-ended questions to measure information needs related to fire safety, to gather internet behavior and preferences, and to record demographic information for each participant (see appendix B for the questionnaire). Specifically, the first three questions focused on the students' knowledge of fire safety, asking them how they would stay safe from fire, what type of source they would use to learn more about fire safety, and what questions or topics they wanted to know more about as they related to fire safety or the fire service. The second part of the questionnaire, with seven questions, asked them how often they used the internet and instant messaging along with how they searched for information on the internet and what they would like to see on a fire safety website. Finally, the remaining eight questions asked them demographic information, such as their grade level, whether one of their parents was deaf or hard of hearing, whether they used sign language at home, and whether they used hearing aids or a cochlear implant. This demographic information allowed me to select a variety of participants for the think-aloud interviews in Phase 3.

The instruments for Phase 2 were guided worksheets with tasks and questions about a current fire safety website (see appendix C for the guided worksheets for each

website). I created these worksheets to target specific aspects of the different fire safety websites. Each worksheet provided the internet address for the specific website.

The first question asked the students to describe their first impression of the website and provided two spaces for them to write 1-3 aspects they considered "good" or "bad" about the website. The next 3-4 questions directed the students to click on specific links or complete specific tasks using the website. After completing the task, such as playing a game, reading a webpage, searching for an answer to a question, or looking at the graphics, the question would ask for a response to that aspect of the website. Some questions were designed to measure their fire safety knowledge before and after exploring the website while other questions measured the usability of certain aspects or recorded their preferences about tone, audience, and graphics. The last question, which was the same question on each worksheet, was a ranking system from 1-7 of the following six aspects of the website:

- Easy to find things
- Words are easy to understand
- Good number of pictures/graphics
- Good balance of pictures and words
- Good colors/color scheme
- Overall, I like this website

The worksheets were designed to stand alone, so each had similar instructions for how to complete the tasks and questions.

For Phase 3, I used a script with instructions to the participants and interview questions (see appendix D for the script and printed question sheet). The instructions

included the purpose of the interview and a reminder that they could end the interview at any time or refuse to answer any questions. The list of 16 written and oral questions ensured I used similar wording for each interview along with a similar order of questions. I did not list potential follow-up questions as part of the script; instead, I took notes about any follow-questions and the students' responses. The questions involved completing task scenarios, evaluating several aspects of the website, discussing what motivates teenagers to behave safely, and explaining how to escape during a fire. After asking the main questions, I gave each student a printed page with two additional sets of questions. The first set asked students how often they or a family member completed activities that could potentially cause fires. The second set asked students to rank the website from 1-7 for various aspects, such as whether they liked or could understand the graphics and words and whether they could find the information they wanted.

Phase 1: Questionnaire about Fire Safety and Internet Behavior

During Phase 1, I spent one day at OSD working with the OSD computer teacher, a Level 5 ASL interpreter, and 50 students in grades 7-12. The testing classroom consisted of 12 computers connected to the internet. Before the students arrived in the testing classroom, I reviewed the research activities and testing instruments with the computer teacher and interpreter who had been in contact with me about this project for several months. I reminded them to remain neutral and to pretend they were giving a test, meaning they should only sign the text as written rather than offering potential responses or answers to the question. We had five different classes of students, varying from 8-15 students, who participated in the research activities. Each class period lasted approximately 50 minutes.

Once the period began, I introduced the questionnaire and encouraged students to ask questions if they were confused or needed more information. I encouraged them to mark "no answer" or to skip any questions they did not wish to answer, and I reminded them that their participation in these activities in no way impacted their grades or class participation. I also reminded them that I was conducting this research to create an effective fire safety website that met their unique needs, but that I needed them to describe what they knew along with any questions or interests they had about fire safety or the fire service, and to detail any preferences they had about websites in general. During my introduction, the interpreter and the computer teacher provided the information in ASL, so students in different parts of the classroom could understand the instructions.

Then, the students began circling their answers and writing responses to the combination of open- and closed-ended questions. If they had individual questions, they raised their hands or asked the students sitting around them. I answered questions along with the interpreter and the computer teacher. Many of the younger students had questions, but most of the older students completed the questionnaire in fewer than 15 minutes.

For the closed-ended and demographic questions, I entered the data into Microsoft Excel® and used the program to calculate the mean, median, and mode to identify the central tendency of the data. To develop a coding scheme to categorize the open-ended questions, I read the students' responses on the questionnaire, reading the entire set of questionnaires twice before generating any common terms or keywords. I then looked for repetition of keywords or phrases (the unit of analysis) and began developing a list of key

themes along with synonyms for the words that represented each theme, grouping keywords and adding synonyms in an Excel spreadsheet (see appendix E for the coding sheet). I combined some themes and created more specificity for other themes to best represent all the responses. A second coder used these themes to sort the students' responses to the open-ended questions, and our coding overlap was 16 percent. Intercoder reliability was calculated at 0.88171 using Krippendorff's alpha.

Phase 2: Analysis of Current Fire Safety Websites

The second research phase began in each class period as the students finished the questionnaire. One by one, the students would exchange their completed questionnaire for a guided worksheet. To ensure they understood the ranking system at the end of each worksheet, they were told to choose lower numbers under the heading of *Disagree* if they thought the aspects were poor, confusing, or they didn't like them. They were told to choose higher numbers under the heading of *Agree* if they thought the aspects were good, easy to use, or they liked them.

Students could choose to work in pairs or on their own to complete the worksheets. They were encouraged that if they chose to work together that they should provide their individual opinions and responses about the website. In the first class, I started each student or pair of students with a different one of the nine worksheets (i.e., the first student began with worksheet/website 1, the second student began with worksheet/website 2, etc.). As a student completed a worksheet, he/she exchanged it for a new sheet. I continued distributing the worksheets in order, from 1-9, for each exchange. If a student indicated he/she had already completed the exchanged worksheet, then I moved it to a discard pile and selected the next worksheet/website from the ordered pile.

For the next student exchange, I began with the worksheet(s) in the discard pile to ensure the worksheets were distributed randomly to compensate for any residual knowledge the students might gain while looking at the different sites.[22] Once the discard pile ran out, I returned to distributing worksheets from the ordered pile. I continued this process for each student exchange until the end of the final class.

As with the questionnaire, the computer teacher, the interpreter, and I moved around the classroom to keep students on task and to answer questions if they did not understand what the worksheet was asking them to do. During this time, I also recorded the questions and verbal and signed responses of the students as they viewed different sites. This information allowed for a richer interpretation of their responses on the worksheets.

Before examining the guided worksheets, I analyzed the questionnaires from Phase 1, so I could perform a predictive content analysis for each of the current fire safety websites.[23] Using the questionnaire responses, I coded the nine fire safety websites to determine whether the websites met their information needs, included the interactivity they desired, and set an appropriate tone when addressing the students. The entire site

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[22] I attempted to control the students gaining residual knowledge of fire safety concepts as they completed worksheets by focusing each worksheet on different concepts and tasks. For example, the purpose of playing the House Hazard game on one website was to see whether students could understand the definitions and tips that displayed when they clicked or moved objects. Another worksheet would direct students to read sections about installing and maintaining smoke alarms while a third worksheet would ask students to evaluate the graphics in different sections of a site. However, some residual knowledge is sure to impact how the students defined certain terms or summarized concepts. Additionally, viewing several sites consecutively means that the students gained a better idea of what they really liked or disliked on the sites themselves, which could result in more variation in the Likert ratings on each worksheet. To compensate for these factors, I distributed the worksheets in a random order, with each student/pair of students beginning with a different worksheet, rather than giving the same worksheet to all the students at the beginning of each class period.

[23] I followed the method of content analysis explained in detail by Neuendorf's *The Content Analysis Guidebook* (2002) that incorporates the theoretical framework of Krippendorff (1980) and the model of five research domains outlined by Shoemaker and Reese (1996).

functioned as the unit of analysis. Specifically, I analyzed the sites according to the following aspects (see appendix F for the website coding sheet):

- Type of coding language(s) used and number and type of plug-ins required
- Methods for addressing the target audience (i.e. instances of "teenager/teen," "child," "youth," "young person," "kid," "student," "you," "people")
- Number and type of graphics
- Number and type of links, including broken links
- Type of main navigation and number of categories within main navigation
- Presence of captions for audio and video
- Use of fire safety jargon (e.g. "smoke detector," "egress," "hazard," "shelter," "PPE," "fire extinguisher," "EDITH")
- Use of a plain style of writing, meaning few instances of nominalizations, passive voice, abstract (instead of concrete) concepts, and lengthy introductory or subordinate clauses.

I also calculated the readability of each site using the SMOG (Simple Measure of Gobbledygook) formula, the formula often used for predicting the readability of health communication materials (Friedman and Hoffman-Goetz 2006, 356).[24] The SMOG formula involves the following four steps:

1) "Count 10 consecutive sentences near the beginning of the text to be assessed, 10 in the middle and 10 near the end. . . .

[24] The U.S. Department of Health and Human Services recommends using SMOG to predict the readability of educational materials (*Research-Based Web Design & Usability Guidelines* 2006), and the National Cancer Institute encourages people to use SMOG as part of its *Clear & Simple* guide for developing materials for low-literate readers (http://www.cancer.gov/). For additional research using SMOG to evaluate healthcare materials, see Vallance, Taylor, and Lavallee (2008); Friedman and Hoffman-Goetz (2006); Ley and Florio (1996); and Meade and Smith (1991).

2) In the 30 selected sentences count every word of three or more syllables. . . .
3) Estimate the square root of the number of polysyllabic words counted. . . .
4) Add 3 to the approximate square root. This gives the SMOG grade, which is the reading grade that a person must have reached if he is to understand fully the text assessed" (McLaughlin 1969, 369).[25]

Because websites are without linear text, I used 10 consecutive sentences from the homepage (or from the first navigation category if the homepage lacked a textual introduction), 10 consecutive sentences discussing fire prevention techniques, and 10 consecutive sentences discussing what to do during a fire emergency or 10 consecutive sentences explaining a specialized topic, such as arson dogs or fire engines. I selected these topics because each of the nine websites addresses them and because these are the website sections addressed in the students' guided worksheets. Combining the results from the SMOG formula with the analysis of different web aspects and with the students' evaluations allows me to interpret why students may have difficulty navigating or understanding each website.[26]

To validate my content analysis, including the readability data calculated with the SMOG formula, a second researcher independently coded the Illinois Firesafe Kids website, using the coding sheet. Because of confusion as to whether to classify a graphic

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[25] McLaughlin, since publishing this article, worked with a JAVA programmer to develop a SMOG calculator that more precisely analyzes a 30+ sentence passage and calculates a SMOG grade. This calculator is available at http://www.harrymclaughlin.com/SMOG.htm and is how I verified my results. The standard error for SMOG is +/- 1.5 grade level. I also have provided the Flesh-Kincaid grade level, which I calculated by analyzing the same 30-40 sentences in Microsoft Word 2003. The average number of words per sentence was the same for both formulas, so only one count is included.

[26] My content analysis of the websites was based on methods used by Bartell (2005) when evaluating airport websites for navigation issues, comprehensibility, and accessibility. The type of analysis I performed is known as "competitive benchmarking," in Morville and Rosenfeld's method of information architecture (2007) as the researcher evaluates comparable sites to "borrow" what works well on those sites and to avoid their pitfalls.

as an icon or logo, I combined that category because both graphics function to represent an entity, a function contrasted with a cartoon or photograph that may illustrate a concept or establish a tone for the overall message communicated. Also, the category named "coloring pages" was expanded to "activity pages" because two of the websites had seek-n-finds or crosswords that were technically not coloring pages. Overall, when comparing our coding results, I found the highest disagreement in classifying what qualified as jargon; however, after revising a list of keywords to search for on each site, the intercoder reliability calculated with Krippendorff's alpha was 0.9272. Appendix F is the final version of the coding sheet.

Phase 3: Think-Aloud Interviews

The third phase consisted of testing the new fire safety website through modified think-aloud interviews, based on the approach outlined in Dumas and Reddish (1993), but modified by Schirmer (2003) in her use of "gesture aloud" with students who are deaf. Schirmer and other scholars using the think-aloud interviews with people who are deaf encourage the test subjects to sign their thoughts as they work on a task; however, instead of prompting frequently, Schirmer recommends prompting at natural breaks given that subjects are translating English into ASL and vice-versa.[27] During my interviews, if students did not sign or facially express after clicking a link, I would ask them why they clicked that link or whether the content they found through the link was what they thought it would be. For students who clicked quickly (ten seconds or less on each page),

[27] This approach is verified by several researchers using the think-aloud methodology with children and teenagers who are deaf. For more information, see Branch (2000) and Roberts and Fels (2006). In 2007, van den Haak, de Jong, and Schellens compared the three most common methods of conducting think-aloud protocols and found them mostly interchangeable, and they concluded that the researcher should decide what is most appropriate and feasible given the subjects being tested.

thus completing the task in under a minute, I would ask them "talk-after" questions, using the methodology described in Branch (2000), to clarify why they chose their navigation path or whether they believed the information was easy to find.

With help from the OSD computer teacher, I selected twenty students who had participated in the earlier research phases. After reading the responses of the 7th grade students to the questionnaire and guided worksheets, I determined that their vocabulary and interest levels were appropriate for the current fire safety websites targeting children. Therefore, I chose to eliminate them from the think-aloud interviews of Phase 3.

I used the demographic information from the questionnaire to select a stratified representation of students. The students chosen were in grades 8-12 with a balance of male and female and with a balance of students who identified themselves as hard of hearing versus deaf. I also selected several students who wore hearing aids and the only student who used a cochlear implant. Finally, I selected a mix of students who marked that at least one of their parents was deaf and also a balance of those who selected that at least one person in their family used sign language versus those families who did not use sign language. I interviewed twenty students to evaluate their cognitive understanding of the information presented and their ability to navigate the website prototype.[28]

Each interview was recorded. For ten of the interviews, I communicated with the student via an ASL interpreter, the same interpreter who worked with this project during

[28] Again, to compensate for any residual knowledge gained while students participated in my study, I scheduled the research activities five months apart with Phases 1 and 2 in late October 2007 and Phase 3 in early April 2008.

Phases 1 and 2. For the other ten interviews, I communicated with the student via AOL Instant Messaging software.[29]

We met in a quiet, secluded room with three chairs grouped at the end of a table. During the interviews with the interpreter, the student who was deaf sat in front of a laptop computer, across from the interpreter, while I sat next to the student. For the interviews via IM, I sat next to the student, and we both had laptop computers in front of us. The student's laptop had a cordless mouse and a touchpad, two choices for manipulating the computer. Both computers had full internet access, so students could explore other fire safety websites linked to the new site. Before each student arrived, I opened Camtasia software to record the entire screen, including any mouse pointer movements and any browser activity, during the interview. I also opened the HTML file with the first question of the interview.

As each student arrived, I worked from a script and explained the purpose of the interview. I reassured the students that the website was the focus of this testing, not them, and that they could refuse to answer any questions during the interview. I emphasized that I wanted them to tell me what they were thinking as they clicked through the pages and tried to find the answers to the questions, and I gave them some examples to make sure they understood.[30]

During the interviews, I took notes to record the students' responses, and I also recorded branching questions that they asked, or that I asked, and notes about their facial

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[29] A 2002 survey by the National Association of the Deaf showed that 75 percent of people who are deaf (ages 25-55) used Instant Messaging every day, many keeping IM conversations going all day with several individuals. We can assume that IM is more popular today, especially with teenagers (Bowe 2002).

[30] Hoping that they would provide more honest responses, I did not tell them that I designed the website they were testing. Only one student asked me directly who designed the site, and I responded that I did not know. I told her I was only concerned with testing the site today.

reactions or ways of navigating to different pieces of information, such as using the back button, links within the paragraphs, or links on the navigation bar. I used a stopwatch to time the interview and to time the length of the individual task scenarios when I asked students to find a specific piece of information on the website. I recorded the overall length of the scenario and how long students remained on each page they accessed during the scenario.[31] To clarify answers or to encourage students to keep searching for information, I redirected some questions or asked, "Can you tell me more," or "Anything else."

Each interview began with the same two questions to test the students' fire safety knowledge before viewing the website. The first question asked students to choose the best smoke alarm for people who are deaf. It gave three answers with pictures of each alarm type and words describing the components pictured. The first response showed only a smoke detector. The second response showed the smoke detector with a strobe light. The third response showed a smoke detector, strobe light, and bed shaker.

The second question showed a picture of an escape map with arrows in two colors, one color for the first way out and the second color marking the second way out. The rooms were labeled with common names for the rooms, such as bedroom, kitchen, and living room. And a meeting place was marked "Meeting Place" and was symbolized by a tree some distance from the front door. The question asked students to name that diagram and to describe its purpose.

Then I told students to click the link, "Go to Website," and to click around some to get a feel for the website. I told them to click on things they thought were interesting or

[31] I paused the stopwatch if the students had several signed or typed questions, or if the interpreter was clarifying information. Thus, the times are general estimates for time on task.

things they wanted to know more about. I allowed them to surf the new site for approximately 3-5 minutes, asking them questions about where they were clicking and what they thought as they skimmed new pages or commented about graphics and information. To conclude this segment, I asked them their first impression of the website and what they thought was good and bad about the site.

During the main part of the interview, I asked students to complete the following four task scenarios, emphasizing they should look on the website to find the information:

1) You have to write a paper about fire. You want to know how many fires happen or how many people are hurt by fire. Where can you find that information?
2) You're graduating from school. Your friend said you can be a fire investigator. Who are they, or what do they do?
3) You're moving to your own place. The new place is empty—no furniture or anything inside. What will you buy or do to be fire safe?
4) You're going out with your friends to eat and to see a movie. What should you look for to keep you safe from fire when you go into these places?

I also asked them to answer yes or no to a series of items about whether each item would make them want to be more fire safe. The list of items included the following: ways to prevent fires, true stories about fire and people who got out of them, how to put fires out, how to escape from fire, number of fires each year, number of people hurt or burned by fire, photos of burned homes, and photos of people burned by fire. I asked if they could think of anything else that would motivate teenagers to be more fire safe. And then I asked which item was the most convincing to motivate teenagers to be more fire

safe. I asked them if they knew of anyone who had been in a fire or someone who had a close call and almost started a fire or was almost burned by fire.

I began concluding the interview with questions to gauge their overall response to the website. I asked them, “What do you wish was on this website if you could add something?” I also asked what they liked and disliked about the website and whether they would tell their friends about this website. The last three questions had corresponding graphics as part of the answer. The first question asked them to choose between three options of smoke alarms, choosing which alarm is best for people who are deaf. The second question showed a picture of an escape map without arrows. I asked them how many ways out should they draw. I told them they were in one of the rooms and asked them to identify the best way out. I then told them fire blocked one of the doors and asked them to identify a second way out.

Finally, I showed them the main navigation bar with pictures and one without pictures, asking them which bar they preferred. I closed the interview by asking if there was anything else they would like to tell me about the website. And then I gave them a sheet of paper with two questions. The first question asked how often the student or his/her family performed different activities that could cause home fires. The activities included lighting candles, shooting fireworks, cooking with the stove/oven, cooking with the microwave, going camping, and smoking cigarettes. Next to each activity were the options “1 time each week,” “1 time each month,” “1-2 times each year,” or “Never.”

The second and final question on the sheet of paper asked students to rate the website on a scale of 1-7, with 1 being Disagree and 7 being Agree, in the following categories:

- Easy to find things
- Words are easy to understand
- Pictures are easy to understand
- Good number of pictures/graphics
- Good balance of pictures and words
- Good colors
- Overall, I like this website

This question allowed comparison between the new website and the previous fire safety websites examined during Phase 2.

I concluded the interview by thanking the students for their help. After each student left the room, I stopped the recording devices and reset the computer to the opening question about the smoke alarm options. I also cleared the internet history on the student's computer so that the links would all appear unvisited, avoiding any potential bias from the previous students' navigation choices.

For the interviews conduced via instant messaging software, I logged both computers into the AOL Instant Messenger screen. The student's computer was logged in with the username FireSafeWeb to preserve each student's privacy. My computer was logged in with LacyLandrum, so the student could remember my name and feel more at ease with an unfamiliar person. Before the student entered the room, I logged in each computer. During the interview, the questions and responses were communicated via instant messaging. If students attempted to sign their responses rather than typing them, I signed for them to type and made notes about where this occurred during the IM chat. After the student left the room, I copied the IM transcript of the chat into Microsoft

Word®. Then I cleared the history of the chat so that each student saw only their personal chat with me rather than any of the responses of the previous students.

Summary

Overall, this chapter has outlined the procedures I used to select representative websites, to create and revise my testing instruments, to conduct the research phases, and to analyze the data collected during those phases. The first phase measured the students' information needs and website preferences for a website exploring fire safety. The second phase evaluated the current fire safety websites targeting children and teenagers. The third phase evaluated the fire safety website I designed according to what was uncovered during the first two research phases. The next chapter will discuss the results of the first two research phases, data I needed to analyze to understand how to build an effective fire safety website for deaf teenagers.

Chapter 4: Assessing Information Needs and Analyzing Current Fire Safety Websites

"UCD [User-centered Design] is an evolutionary process whereby the final product is 'shaped' over time. It requires designers to take the attitude that the optimum design is acquired through a process of trial and error, discovery and refinement. Assumptions about how to proceed remain assumptions and are not cast in concrete until evaluated with the end user. The end user's performance and preferences are the final arbiters of design decisions." (Rubin 1994, 17)

"The way you get *appropriate* design ideas (and not just ideas for cool designs that nobody can use) is to watch users and see what they like, what they find easy, and where they stumble. The way to get good design ideas is quite often to follow usability engineering methodology and steep yourself in user reactions and data." (Nielsen 2000, 12)

The reasons many websites fail are related to usability and to meeting the information needs of the target audience. Morville and Rosenfeld (2007) outline a comprehensive method for measuring the audience's information needs, categorizing information, and structuring the information within the new website so that users can find, understand, and use the information presented. Understanding what deaf teenagers know about fire safety is vital to evaluating current fire safety websites and to ensuring the information presented on the new site is relevant and useful. This chapter describes the results from my first two phases of research, phases that worked together to discern what the Oklahoma School for the Deaf (OSD) students understood or wanted to know more about fire safety, what they thought about current fire safety websites, and whether they found those websites usable and interesting. Table 4.1 summarizes the demographics of the OSD students who participated in Phases 1 and 2; these demographics were collected on my questionnaire during Phase 1.

Table 4.1: Number of OSD students in each category who completed phases 1 and 2

	7th grade	8th grade	9th grade	10th grade	11th grade	12th grade	Total
Gender							
Male	4	4	5	2	5	3	23
Female	4	2	5	5	8	3	27
Race							
African American	1	0	1	1	4	0	7
American Indian	1	1	0	0	1	1	4
Caucasian	6	5	9	5	7	5	37
Hispanic	0	0	0	1	1	0	2
Identification							
Deaf	3	4	4	2	10	3	26
Hard of Hearing	5	2	6	5	3	3	24
Use of AT							
Cochlear implant	0	1	0	1	0	0	2
Hearing aid(s)	6	3	5	2	6	2	24
None	2	2	5	4	7	4	24
Family info							
At least one parent is deaf	2	3	1	0	1	1	8
At least one family member uses ASL	4	4	5	4	6	3	26
Total	8	6	10	7	13	6	50

According to my questionnaire responses, of the 50 students, 24 wore hearing aids, but only two wore cochlear implants, totaling 52 percent who used some type of assistive technology daily to augment their hearing.[32] Fifty-two percent of the students

[32] Interestingly, one 11th grader marked that she had a cochlear implant but wrote a note saying she never wore it. I have counted her in the no AT category because she does not use the AT regularly. Also of note, two 9th graders added a category to the questionnaire, marking that they wore their hearing aids

identified themselves as Deaf with the remaining students identifying themselves as hard of hearing. Only 16 percent had at least one parent who is deaf, but over half of the families of all the participating students used sign language (52 percent). For the students who identified themselves as Deaf, 65 percent of their families used sign language. For those who identified themselves as hard of hearing, only 37.5 percent of their families used sign language. Measuring whether at least one family member uses sign language is important because studies have shown that deaf children born to hearing mothers experience more delays in first-language acquisition than deaf children born to deaf mothers (Watkin et al. 2007; Loots and Devise 2003; Easterbrooks and Baker 2001, 82-84); typically, delays in first-language acquisition contribute to problems with reading comprehension and vocabulary development (Paul 2003; Marschark, Lang, and Albertini 2002; Lederberg and Everhart 2000).[33] Overall, the students selected for my study reflect the diversity of OSD, and an overwhelming majority participated in this research (see table 4.2).

"sometimes." I counted them in the Hearing Aid category because they said "sometimes" rather than writing "never" like the other student.

[33] The vast majority (90 percent or more) of deaf children are born to hearing parents (Goldin-Meadow and Mayberry 2001, Moores 2000). Most of these parents never considered the possibility of having a deaf child, so they immediately begin "sorting through medical, communication, and educational options," feeling "overwhelmed," and having no idea how to begin communicating with their child (Easterbrooks and Baker 2001, 84). Emmorey (2002) posits that most of these families will create "home-sign gesture systems," but that "home sign is not a language. . . , [and] there is little evidence for hierarchical phrase structure, symbols that expressly encode abstract semantic relations (e.g., "if," "but"), or a system of inflections to convey semantic relationships" (209). Thus, a child using home sign will not gain exposure to a language until kindergarten unless he/she is identified and approved for an early intervention program.

Table 4.2: Comparison of OSD students and research participants

	Number of students at OSD	Number of research participants	Percentage participating (%)
Male	33	22	66.7
Female	47	28	59.6
7th grade	13	8	61.5
8th grade	12	6	50
9th grade	14	10	71.4
10th grade	14	7	50
11th grade	20	13	65
12th grade	7	6	85.7
African American	7	7	100
American Indian	11	4	36.4
Asian	0	0	0
Caucasian	55	37	67.3
Hispanic	7	2	28.6
Total	80	50	

Results of Phase 1: Questionnaire

Phase 1 consisted of 50 students responding to a questionnaire about their fire safety knowledge, interests, and internet behavior (see appendix B for the questionnaire). The results of the questionnaire provide a data foundation that addresses the following research questions:

- What are the information needs of deaf teenagers concerning fire safety?
- What do they already know about smoke alarms and escape plans?
- What do they already know about fire prevention strategies?
- What do they need to know about these subjects?
- What do they want to know about these subjects?

MEASURING FIRE SAFETY INFORMATION NEEDS

The first part of the questionnaire focused on fire safety knowledge and interests. The first question attempted to determine what source teenagers would use or consider reliable to learn more about fire safety. The question asked, "If you had a question about fire safety, what would you do? Circle 1 answer." From the list of six options, 40 percent of students chose "firefighter" and 26 percent chose "parent." Only 14 percent chose "internet"; however, given the difficulty that many teenagers who are deaf face when communicating with firefighters, it is likely that they would use one of the other options even though ideally they would like to ask the expert.[34]

The second question targeted the students' current fire safety knowledge because a website explaining only the basics will quickly lose their interest. I used an open-ended question, asking them to "list 3 things you know about fire or how to stay safe from fire," hoping to gain not only an understanding of their current knowledge, but also a list of words they use to describe that knowledge. The question had 138 responses from the 50 students, and although the question asked for three responses, several students provided more than three while others provided fewer responses; only two students left the question blank. The 138 responses were coded into five main themes:

1) Behavior/actions taken in a fire situation, such as escape methods, contacting 911, going outside, warning others, or stop, drop, and roll (97 responses).

[34] Each October, the Sulphur Fire Department sends 3-4 firefighters and a fire truck to OSD for Fire Prevention Month. The firefighters discuss their protective gear and firefighting equipment, their profession, and general fire safety (e.g. installed and working smoke alarms with a strobe light). Yet the firefighters meet only with students in grades 1-3, meaning they assume that older students understand this basic information. They do not offer more detailed presentations for older students, which may be why the students listed such a large and varied number of responses in this first part of the questionnaire.

2) Tools/equipment that alerts people to the presence of fire or that suppresses fire, such as a smoke alarm, an extinguisher, a fire blanket, and fire sprinklers (10 responses).
3) Behavior/actions that prevent fire, such as never leaving candles burning, not playing with fire or fuel sources, checking if items smell weird, and not putting paper towels by the stove (19 responses)
4) Characteristics of fire, such as how it spreads or how it is dangerous (2 responses)
5) Confusing/indecipherable responses, such as "I will teeth out," "School out," "Fire," and "1 dog in the house. The house is fire." (8 responses)[35]

The third question asked students to list any questions they have about fire safety or firefighting or topics in these areas about which they would like to know more. Seven students left this question blank, one responded that he did not know, and one replied that he already knew about fire safety because his father had taught him. The remaining 41 responses totaled a much lower number of responses than those provided for the previous question, but many of the responses were broad rather than more specific questions or topics. For example, several students responded that they wanted to know more about firefighting or more about preventing fires at their homes rather than focusing on a specific duty of firefighters or ways to prevent kitchen fires or candles fires. The 41 responses were coded into the following four themes:

1) Behavior/actions taken in a fire situation (7 responses)

[35] Where indicated with quotation marks, I have chosen to use direct quotations from the students' responses on the questionnaires. I have refrained from correcting grammar or spelling and from using [*sic*] notation given that this notation may cause confusion given the number of notations that would need to appear throughout the students' responses.

2) Behavior and equipment unique to how a deaf person would be alerted to the presence of fire or would communicate in a fire situation, such as how deaf people can use or buy special alarms and how they can contact firefighters (8 responses)
3) Behavior and equipment appropriate for everyone—not customized for deaf people—that alerts people to the presence of fire or helps them suppress fire, such as strategies for preventing fire when cooking and how extinguishers, alarms, and sprinklers work (9 responses)
4) Characteristics of fire (9 responses)
5) Aspects of a career in fire service, such as whether people who are deaf can be firefighters, how detectives determine what started a fire, and how the fire service handles false alarms (8 responses)

Taken together, these three questions provided a rich resource of what these students believe they know about fire safety and what topics they want to understand more deeply. Many students provided accurate information about what they would do in a fire emergency or how to stay safe from fire. But 12 of the responses were troubling and revealed how this group may have been overlooked in educational initiatives; furthermore, none of these responses were from the same student, meaning that 12 of the 50 students participating had serious misconceptions of fire safety.[36] Consider the following responses that reveal misconceptions or dangerous reactions during fire situations:

[36] Also of note, these 12 students were from every grade level, indicating that this information is not included in a health and safety class or other classes completed in higher grade levels.

- Misunderstandings of the fire suppression technique, Stop, Drop, and Roll, which means that they may believe this technique is part of the correct response to a smoke alarm signal or that they must be outside to perform this technique (2 responses): “If you have fire on you, u have go outside lay and roll” and “Crawl or rolled on the floor and get out of house”
- Misunderstanding about when to suppress fire with water versus baking soda, perhaps believing they can be used interchangeably. Using water on a grease fire in a pan will cause the fire to flare up and spread (2 responses): “Fire can be put out w/ baking soda or water etc.” and “Water away the pan”
- Incorrect belief that specific equipment will help them or keep them safe when this equipment may spread the fire and will not protect them from smoke inhalation (2 responses): “Use ax” and “You can use ‘fire blanket’ to protect urself from fire”
- Incorrect belief that the fire department will arrive with a net to help them escape from a window (3 responses). This belief could mean that they would wait until the fire department arrived before attempting to escape out a window, meaning that they will most likely be injured or killed in the fire while they wait. Furthermore, this misconception occurs because of common portrayals of fire rescue in popular culture: “Out window jump down net ride,” “Jump on net,” “Net out”
- Wrong behavior that, if followed, would kill them through smoke inhalation or becoming trapped by flames (3 responses): “Scream and cry,” “Jump in toilent,” and “To hide safe”

UNDERSTANDING INTERNET BEHAVIOR AND PREFERENCES

The next portion of the questionnaire focused on internet behavior and preferences. In response to the question, "How often do you use the internet to email or look at websites," 54 percent chose "many times a day" while 12 percent chose "once a day." Female students used the internet more frequently than male students; 82 percent of female students said they use the internet at least once or many times a day compared to only 50 percent of male students who do so. There was no trend by grade level for students using the internet (see table 4.3). Overall, 88 percent of the students are going online at least once a week, showing that the majority of these teenagers are actively using the internet; therefore, educational and informational websites are a useful medium for reaching this audience.

Table 4.3: Use of internet compared by grade level

	Many times a day (%)	One time a day (%)	One time every 3-5 days (%)	One time a week (%)	Total using internet at least once a week (%)	Total number responding to question
7th grade	12.5	50	0	37.5	100	8
8th grade	50	0	16.67	0	66.67	6
9th grade	80	0	10	0	90	10
10th grade	71.43	0	14.29	14.29	100	7
11th grade	53.85	7.69	7.69	15.38	84.62	13
12th grade	66.67	16.67	0	0	83.33	6

Note: One student selected no response; five said they use the internet only one time every 2-3 weeks.

The responses to "How often do you Instant Message (IM)," were similar to the internet usage question with 48 percent responding "many times a day." Sixteen percent responded "once a day," and overall, 84 percent used IM at least once a week, reflecting a larger percentage than the teenagers surveyed in the latest Pew Internet report (Lenhart

et al. 2007).[37] As with internet usage, female students used IM more frequently than male students; 79 percent of female students said they use IM at least once a day compared with only 50 percent of male students who do so. On average, students in higher grade levels reported using IM more frequently than younger students (see table 4.4). Nevertheless, the responses show that these teenagers are familiar with IM, so this familiarity may make IM a well-accepted tool for conducting usability tests with deaf teenagers.

Table 4.4: Use of instant message (IM) compared by grade level

	Many times a day (%)	One time a day (%)	One time every 3-5 days (%)	One time a week (%)	Total using IM at least once a week (%)	Total number responding to question
7th grade	12.5	50	0	12.5	75	8
8th grade	50	0	0	0	50	6
9th grade	40	10	20	20	90	10
10th grade	71.43	0	14.29	0	85.71	7
11th grade	69.23	15.38	0	7.69	92.31	13
12th grade	50	16.67	16.67	0	83.33	6

Note: Six students selected no response; two said they use IM only one time every 2-3 weeks.

The next open-ended question asked students to list their three favorite websites and to list why they liked each website. Almost all the students listed three websites, providing a total of 131 responses, but few listed any characteristics of those sites or reasons why they liked the sites. The most frequently referenced websites were Yahoo (25 responses), followed by Youtube (17 responses) and MySpace (16 responses). Reasons why students liked Yahoo included the following responses: “find stuff easy,”

[37] This Pew Internet report (2007) indicates that 28 percent of teens use IM daily, but the percentage of those using IM daily jumps to 42 percent for those who also use social network sites. Teens still prefer using a cell phone or landline to contact each other; however, IM is ranked third for teens using social networking sites (responses = 493) and ranked fourth for all teens (responses = 935) (Lenhart et al. 2007).

"IM, because it is fast," "easy, fast, email," and "they have everything." Reasons why they liked YouTube included: "has some funny things on it," "cuz I been enjoy to watch anything I like," "teach me new things," and "I like picture." Reasons why they liked MySpace included: "it cool," "I've some friend in there," "see my email," and "same as facebook lot of friends." See appendix G for a comprehensive list of the websites and why they liked those sites.

The next question gave students a research task scenario and asked them which search engine they would choose from a list of five options with a sixth option of Other:_____. Overwhelmingly, students chose Yahoo (48 percent) and Google (34 percent). All the other responses together received only 18 percent with two students selecting "Other" and writing in "Skype" and "Videophone," which are software or technologies that enable video phone calls; only one student selected "No answer."

To continue the line of thinking about searching online, the next question asked students to list words they would type in the search box to find a "good website about fire safety." The question directed students to write the first three words or set of words that came to mind, and the format of the questionnaire included three numbers with space between each for the students to use to write in their answers. The students provided 106 responses with many of those responses as sets of words rather than single words. Only one responded, "dunno," and eight students left the question blank. I coded the 106 responses according to the following six themes:

- Variations of the words fire safety/safe (38 responses): "learn fire safety," "how to be safety around fire," "fire safety tips," "fire safe," "what use for fire safety," "fire safety information," and "research fire safety"

- Words related to preventing fire or how to react if a fire (20 responses): “how to stop fire from starting,” “how you stay away from fire,” “how to put out fire,” “fight fire,” “what to do about fire,” “how protect from fire,” and “fire sigenal”
- Words related to emergency responders or fire service equipment (15 responses): “call firefighter,” “fireman,” “fireman web,” “firefighter safety,” “how firefighters works good,” “police deparment,” “emeracy,” and “fire truck”
- Words focused on fire itself with no mention of preventing or staying safe from fire (11 responses): “wildfire,” “what about fire,” “how fire get caunght on,” “how fire is hot,” and “rules for fire”
- Variations of the words safety/safe with no mention of fire (8 responses): “safety out,” “safe house,” and “build safety”
- Wrong words/intent or confusing combination of search terms (14 responses): “games,” “toys,” “search,” “website,” “very entertaining,” and “if hot want words”

The final two questions, both multiple-choice questions, focused on website features and how websites targeting teenagers should address them. Concerning features, students were given a list of nine options plus the option of “Other” where they could write in a feature. The question asked students if they were making a website about fire safety for teenagers, which of the following nine options they would include. They could circle as many options as they wanted. Out of 122 responses, the option with the most responses (20) was “Facts about fires, firefighting, fire safety.” The next two highly-ranked options earned the same number of responses, 18 each, and they were “games” and “ASL video.” “Captioned video” was just below those two options with 17

responses. “Stories” and “Photos” were next in the rankings with 12 and 11 responses respectively. Although the question prompted students to circle as many options as they wanted and the wording was signed to the students, over half of the students, 56 percent, selected only one option.

For the last question, students were asked how a website for them should “name” them, and they were instructed to choose one option from the six provided. The students overwhelmingly chose “teenager” with 54 percent. In fact, more students chose “no answer” (16 percent) rather than any of the remaining five options, which received a combined response of 26 percent. The next option with the most responses was “young person” with 12 percent. “Kid” and “youth” received no responses at all, meaning that the websites using these words to address teenagers could be viewed as patronizing or out of touch with this age group.

Results of Phase 2: Analysis of Current Fire Safety Websites

Phase 2 was comprised of two separate approaches to analyze the current fire safety websites to determine their usability and how well they met the needs of this teenage population. First, the students evaluated targeted aspects of the sites through guided worksheets. As with the questionnaire, the younger students, who have lower grade-levels of reading, completed fewer worksheets than the older students. Some students started worksheets, but could not complete them because the class period ended; these worksheets are not included in this discussion. On average, each student completed two worksheets. Of the nine websites explored, each site received approximately nine evaluations, with the least-visited site (Illinois Firesafe Kids) receiving only six evaluations and the most-visited site (Staying Alive) receiving eleven evaluations.

Because the NFPA website targets adults, I purposely distributed those worksheets only 11th and 12th graders, assuming that the vocabulary was too difficult for the younger students. Only three of the nine sites were evaluated by 7th graders, and I realized when analyzing the data that the younger students, particularly the 7th graders, had a more positive evaluation of the sites as a whole than the students in other grades. In an effort to be as transparent as possible with the data, I show two sets of medians and means for the three sites evaluated by 7th graders—one set that includes the 7th graders' scores and one set without those scores.

To create a broader perspective of these websites, for the second approach of Phase 2, I performed a content analysis on each site, coding specific elements of the sites (see appendix F for the coding sheet) and analyzing whether the sites met the students' information needs as indicated by their responses to the questionnaire from Phase 1. I also used the SMOG formula to predict the readability of the site. The purpose of these combined activities in Phase 2 was to gather data that addressed the following research questions:

- Do current fire safety websites meet the information needs of teenagers who are deaf? (Adding to data collected in Phase 1)
- Are current fire safety websites easy for deaf teenagers to navigate, and can they find information quickly? What type of navigation (text only, icon only, or text and icon combined) works well for this audience? (Research Phases 2 and 3)
- Is the information found easy to understand and use for teenagers who are deaf? What fire safety vocabulary is appropriate for them? What techniques help them understand complex concepts? (Research Phases 2 and 3)

- Do current fire safety websites appeal aesthetically to deaf teenagers? Do they find the sites interesting and desire to use them? What aspects could be incorporated into a new fire safety website to reach this audience? (Research Phases 2 and 3)

The following sections focus on one site at a time and follow the same organizational pattern: a brief overview of the site with a screenshot of the site's homepage, the results of my content analysis (discussing site coding languages, navigation, content and style, and graphic design), and the students' responses on the guided worksheets. To distinguish the students' evaluations from my own evaluations and predictions of the students' experience, I use "deaf teen" in my analysis and reserve "student" for the students' responses. Furthermore, although several of the sites I tested fail to comply with accessibility guidelines, I have limited my discussion of these failures, focusing instead on problems that would impact deaf teens rather than all the potential problems for teenagers who may use AT devices or text-only browsers.

SPARKY THE FIRE DOG

Sparky the Fire Dog® (http://www.sparky.org) is sponsored by the NFPA. The homepage has eight categories with lots of color, graphics, and moving parts (see figure 4.1). Sparky stands in the middle of the page welcoming visitors to a metaphorical theme park of fire safety with each category in different fonts and colors as if signs throughout a theme park. The site has 69 separate pages and almost 200 links within those pages, making this a much larger site than most of the other fire safety sites I tested. The coding language behind the homepage is mostly HTML and CSS with two lines of Javascript. The code also reveals a table structure holding the sliced images and appropriate alt-text

descriptions of Sparky and the site's categories, which means the homepage is compliant with the accessibility guidelines regarding its code. Problems arise on the site's internal pages that are mostly Javascript; however, these are not problems that would impact deaf teens unless they relied on screenreaders.

Figure 4.1: The homepage of Sparky the Fire Dog®

The navigation, including the names of the eight categories comprising the primary navigation, is problematic because some of the categories are more explicit than others. For example, "Sparky's Arcade Games" conveys its meaning clearly as it includes games about fire safety; however, "News Flash" and "Hot Diggity Dalmatians" are more confusing, making it difficult for a deaf teen to anticipate what information "News Flash" will provide versus the information related to fire safety under "Hot Diggity Dalmatians."

The lack of clear categories with meaningful names leaves deaf teens guessing where to click to find information and makes it more difficult for them to remember where certain pieces of information are located within the different categories.

Further complicating matters, when one of the main categories is selected, the page changes, displaying the main content on the right side of the page and a navigation menu on the left side. Yet this navigation menu disappears for two of the categories, “Fun with Fire Trucks” and “Hot Diggity Dalmations.” Instead of a predictable pattern, with the navigation menu always on the left side of the page, the user is forced to learn new navigation methods based on implicit, graphic-based links instead of the textual links of the navigation menu used in the other sections of the site (see figure 4.2). A final problem with the navigation of this site is that within “Fun with Fire Trucks” and “Hot Diggity Dalmations,” the graphic links to return to the main site are broken, meaning the user has to click the browser’s back button 10-12 times or retype the website’s address to return to the homepage that lists all the categories.

Figure 4.2: Internal pages showing different navigation schemes

Concerning content, Sparky the Fire Dog® relies heavily on games to explain fire safety concepts, and the majority of its pages describe fire trucks and Dalmatians rather than how to prevent fires or what to do during a fire emergency. Although the students indicated on the questionnaire that they liked playing games on websites, six of the eight games available require a Shockwave plug-in, which may not be installed on computers because of its large size and security problems.[38] Of the two remaining games that worked, one depended on sound. Sparky Says: Search for Fire Safety presents students with a jumbled scene of random objects in a garage and outside; as students locate and click on different objects—such as firefighter equipment, a tree for a meeting place, and an escape map—they hear a description of the object's purpose. But the rules for playing the game and the object descriptions are only in aural form; there are no textual descriptions of these sounds, meaning teenagers who are deaf cannot play this game or access the important descriptions of fire safety objects to learn why they are locating a boot, a tree, or a map. Without the descriptions, these are regular objects that seem unrelated to fire safety.

Although the site provides only eight pages about how to prevent fires, these pages are full of practical information and mostly consistent in style, tone, and

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[38] Even if the games work properly, meaning the computer has the proper plug-in, each game takes 1-2 minutes to load and has multiple problems with the game's controls and graphical interface; the long loading time and problems with the controls and interfaces most likely will frustrate teenagers who will move to other sections of the website or leave it altogether. All the games open in windows that are too small to show all the game pieces and words, and worse, these windows are not resizeable. For example, Tales from the Great Escape involves moving objects to fill the blanks of a long story, but the user cannot resize the small screen to see all the available objects or the entire story to know where to fill in the blanks with those objects. Another game, The Fire Drill Challenge, should teach users how to escape during a fire by moving a piece left/right/up/down away from smoke and fire. However, the rules flash too quickly and disappear from the screen before deaf teenagers can read them. To move the piece, the teen cannot drag it with the mouse. Instead, the teen has to click the control over and over as the piece shifts only millimeters with each click. The end result is a teen abandoning the game because the controls are too frustrating to manipulate. Finally, the remaining games present instructions and key aspects of the game only in aural form, leaving deaf teens unable to play the games.

vocabulary level. The SMOG readability score is 8.77 grade-level (Flesh-Kincaid = 7.8), averaging 16.7 words per sentence, which means this site has longer sentences than any of the other sites targeting children.[39] The text is easy to read, though, because the main point of each paragraph is in the first sentence and often is emphasized with red or bold font type. These paragraphs are also free of fire safety jargon, using instead more familiar terms—such as "smoke alarm," "escape ladder," and "cooking area." The sections of the website using fire safety jargon attempt to clarify those specific terms through examples, analogies, or sentence definitions. For example, an "aerial ladder" is a "metal ladder that can extend like a telescope up in the air about 100 feet (10 stories)." The sentence explaining "combustible liquids" provides examples of "nail polish, hair spray, gasoline." But deaf teens may give up reading the long sentences and paragraphs as soon as they encounter a difficult term such as "combustible liquid," so they may miss any additional information that would clarify the concepts or fire safety jargon.

Fortunately, many of these content pages break up the text and illustrate the concepts with graphics. Providing 273 graphics, Sparky the Fire Dog® is visually appealing, offering a wide array of cartoons (187), photographs (56), logos (18), and even different graphics (2) for bulleted lists. Several of these graphics are implicit links that users only realize if they rollover pieces of the graphics, and some links on the image maps represent such small pieces that many users may miss that active piece of the image map, thereby missing the information associated with that piece, such as the definition of a part on a fire engine. But the majority of the graphics clarify concepts, such as a diagram of an escape map next to the paragraph of instructions describing how to create

[39] The NFPA site targeting adults has only slightly longer sentence that average 17 words per sentence.

such a map. Furthermore, the photographs depicting a family drawing an escape map and acting safely when cooking or setting up a space heater show exactly what to do and may even convey enough information that a deaf teen would not need to read the words to understand the main points.

Eight students evaluated the site using the guided worksheet. Most students wrote several aspects that they thought were "good" as they briefly clicked through the site. Four students commented that the pictures and depth of information as good attributes. Two praised the colors with one student replying, "It is full of different kind of colors on it which make it even more cool." Concerning the "bad" aspects, several students commented that the words were confusing, such as "some long words that you can't understand." They also felt like the type size was too small and the colored text made it difficult to read. Several also said they did not like the background color, and two students mentioned that the tone seemed more for younger children.[40]

After the students described their initial impressions, the worksheet guided them to click on a specific part of the website to learn about the parts of the fire engine. Specifically, I wanted to test whether they could find this information, given that they have to notice the cursor changing as they rollover active links within the graphic, and whether they could understand the technical vocabulary presented in this section. The worksheet task asked them to read about the "apparatus cab" and to describe it in their

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[40] During all the site evaluations, no students criticized the lack of captions for sound elements. Most had no idea sound was present on several of the sites, and in the instances when sound facilitates understanding, such as the directions to a game or additional fire safety information only in aural form, the students did not realize that they were missing key pieces of information. Instead, they would muddle through playing the game until they could understand it, or they would give up playing the game and move to another section of the website. Concerning the additional information available only in aural form, the students never realized they were missing that information; they would read the brief tips and try to understand the concept based on the tips alone, which could explain some of their difficulty finding information on these websites or understanding key concepts.

own words. All eight students found this part of the truck, meaning they would rollover the graphic until they saw the alt tag popup or the cursor change to a pointer, and then they would click the link.

As for understanding the information once they found the hidden descriptions, two students replied that the apparatus cab was the individual who drives the fire truck; three copied verbatim a sentence from the description, explaining that this truck needed two steering wheels and two drivers. One student said she "understand it more clear," and one replied that he thought the cab would be helpful but that he wanted to know "how deaf out house." Only one student answered the question correctly by replying "where the firefighters sit to drive." Therefore, these students had problems understanding the vocabulary presented, an issue forecasted in my analysis.

The next task asked students to play a specific game and describe their opinion of the game; however, students could not play the game because their computers did not have the proper Shockwave plug-in. Not one of the games operated without this plug-in, confirming previous research that cautions designers from using scripts within the main content if that script requires plug-ins or special graphics or sound components to render properly (Mueller 330-332; WCAG 1.0, Guideline 1.4).[41] If the computers in the OSD computer lab, typically computers with the most current software and browsers, are not supporting this coding, then any sites wishing to reach teenage audiences may want to

[41] I am purposely citing WCAG 1.0 rather than WCAG 2.0 because programmers are debating whether to regulate plug-ins within the new accessibility guidelines. One side of programmers believes regulating plug-ins helps programmers know which plug-ins will work properly with AT devices and text-only browsers; however, the other side believes regulating plug-ins will force the guidelines out of date as soon as browsers, software applications, and programming languages advance or as new ones are introduced into the market. My point is to use coding attributes that are proven to render properly with AT devices and text-only browsers. For a thoughtful discussion of accessible scripting attributes, see chapter 13 in John Mueller's *Accessibility for Everyone* (2003).

ensure they have HTML coding to back up Shockwave or Flash sections, especially as some teens may access the internet only from school or public library computers.

The last task asked students to read through specific safety tips and to list the number of any tips that presented new information to them. The tips page is quite lengthy, but the four main tips are numbered and use a red font to emphasize the main point, and then returning to a regular, black font for discussion of each tip. The four tips are as follows: 1. Create two ways out from each room, 2. Install smoke alarms outside every sleeping area, 3. Decide on a meeting place, and 4. Practice your escape plan with your family. One student replied she did not know she needed two ways out of each room. Two students described how they did not know where to put smoke alarms or how smoke alarms worked. One student said she did not know what a meeting place was and that she did not think her family had one. Finally, another student replied that she did not know if her family had an escape plan because they never practiced it. Given these responses to the basic fire prevention information, any site targeting teenagers should include this information rather than assuming it is familiar, well understood, or often practiced.

The final question for each website asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students' agreement with the statement and 1 representing disagreement. Table 4.5 shows the scores for each aspect. The students ranked highly the graphics of the site (median = 7), in fact, giving this site the highest score of all the sites for graphics. The lowest ranking attribute was that the words were easy to understand (median = 5). This score echoes how the students had trouble summarizing the definition or meaning of the apparatus cab. Overall, the students

scored the website above average for most of the aspects, but they scored the site slightly lower than others for their response to "overall, I like this site." This lower score could reflect how several students liked the graphics, but felt like the words were too difficult to understand and that the site, as a whole, targeted younger audiences.

Table 4.5: Scores for Sparky the Fire Dog® website

Website aspects (# of students evaluating = 8)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	6	5.5
Words are easy to understand	5	4.9
Good number of pictures/graphics	7	6.3
Good balance of pictures and words	6	5.9
Good colors/color scheme	6	5.8
Overall, I like this website	5.5	5.6

NATIONAL FIRE PROTECTION ASSOCIATION

The NFPA website (http://www.nfpa.org) is updated regularly with the most current fire and safety information and with current reports and materials for teaching fire safety to different age groups. Although the website targets adults, I included it as one of the sites students could evaluate because I wanted to see if the tone, vocabulary, and concepts were more appealing than the sites targeting younger children. The site has many categories, listing six main areas across the top navigation, but providing multiple in-text and sidebar links to specific information or products (see the homepage in figure 4.3).

Figure 4.3: The homepage of NFPA

As the clearinghouse and main research source for the fire service, NFPA is deep and robust, consisting of hundreds of reports, fact sheets and press releases. The average page contains a search box and three navigation menus with the main menu divided into six categories; in addition to these menus, each page contains 20-30 text-based links within the main content and organized through sidebars. The layout is consistent throughout the site with the main menus remaining stable and the side menus changing to reflect the contents of each of the six categories. The main navigation menu remaining at the top of each page and the more specialized topics listed in the menu on the left side of the page make switching topics and finding information easy. Because NFPA is such a large site, I analyzed in detail only the pages that the students evaluated.

This site's focus on research means it is rich with fire prevention messages along with statistics about the numbers of fires and how many people are hurt or injured by fire. Each of the 27 fact sheets describes prevention strategies and statistics while also using stories about ordinary people, related research reports, and links to laws, fire codes, public service announcement (PSA) videos, slideshows, charts, and podcasts. Of the sites I tested, NFPA is the most comprehensive in its approach to topics and delivery of information through different media. The pages are dense with text, but the site designers have organized the text for skimming with descriptive headings, bolded and set apart from the paragraphs, and with in-text links and bulleted lists of key points. Yet even these organizational aspects may not make the text digestible for deaf teens because of the technical terms, such as "civilian deaths and injuries," and convoluted phrases, such as "those made with flame-resistant, flame-retardant or non-combustible materials" and "NFPA's zero-tolerance policy on amateur use of fireworks." These phrases combined with the site's SMOG readability score of grade 12.61 (Flesh-Kincaid = 12) and average of 17.8 words per sentence may quickly scare deaf teens from even exploring the site for more readable information.

The pages I asked the students to evaluate contain similar graphics, so I will focus my analysis on the fireworks page that provides more links and types of media. This page has nine photographs, two charts, one logo, and two cartoons spread throughout three screens full of text separated into bulleted lists and links. Most of the graphics are small squares, averaging half an inch. The two cartoons lead to public service announcements (PSAs) posted on YouTube in video that is not captioned, but that communicates the main idea through the graphics shown and text written at the end of each PSA. However,

the five audio files describing injury statistics, true stories, and safety tips on the fireworks page are also not captioned, rendering them useless to people who are deaf. Also, this information is not represented in textual form on the main fireworks page or as part of other linked reports or fact sheets, thereby seriously limiting the information accessible to deaf teens. But teens may still think this site is worth surfing because of the information they can gain from looking at the videos, photographs, and charts.

Because this site targets adults, I gave worksheets only to students in grades 11-12. Seven students evaluated the site. Of the seven students, every one wrote as part of the good aspects of this website that it provided lots of information or specific information about interesting topics. One student said he liked the "professional look" of the site, and another wrote that she liked how it provided a list of what to put in an "emergency supplied kit." One student liked the "history" and facts the site provided, and another student said he thought the site was "a little tough to read" but that he liked things that were challenging for him. Every student responded along these lines of the website being difficult to read with "hard words" or a "boring look." They also commented that the site needed "better graphics," "more color," and something "more cool." They also indicated they needed a larger font or perhaps more space between lines because they described the site as "hard to read" and found themselves getting lost within the long sentences or trying to find the links they wanted.

The first task asked students to type "seasonal safety" into the search box and to then click on a specific link from the results list.[42] The directions also asked students to

[42] Giving them words to enter into the search box and the name of the link to select from the list of results was the easiest way to ensure every student landed on the same page. The web address for the targeted page was lengthy and complex, so this pathway to the information was easier for the worksheet task.

read a portion of the target page and to list something interesting or surprising to them. Five of the seven students wrote the number of fires started by a specific holiday feature, such as a Christmas tree or fireworks. And all responded how surprised they were by the large number of people hurt or killed in these types of fires. One said he was also surprised that a Christmas tree with lights on it could ever cause a fire, and that he would make sure to unplug the lights each night.

The second task asked them to look at some of the topics available on the website and to write down which topics they thought teenagers needed to understand or learn more about to remain safe. Six of the seven students wrote fireworks as one of the topics because they believed teenagers played with fireworks or that they did not really understand how dangerous fireworks could be. Four wrote grilling as an important topic, and one explained why he thought this topic was important because of how often he cooked on the grill at his parents' house. Finally, one student wrote winter safety because he was still amazed how many people got hurt or killed in fires started by space heaters and candles during Christmas.

The final task asked students to read about fireworks, describing what they liked or did not like about the page and listing which words they thought were confusing. Three said the page was "boring" and "too long." One said she liked the single picture on the page but that she wanted a lot more pictures that were bigger and that had captions. Another student commented that the page described a lot of results about fireworks but that he wanted to know more about how to prevent fires when using fireworks. As for specific words that the students found confusing, one student wrote "2005 fireworks injuries by type of fireworks," then she explained that she did not know what all those

words meant when they were together but that she understood them separately. Another student wrote “relative,” “lacerations,” and “contusions.” And several students responded “many words” are confusing or “weird.”

The final question for each website asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students’ agreement with the statement and 1 representing disagreement. Table 4.6 shows the scores for each aspect. Ironically, the highest ranking aspect was that students liked the website overall. However, only the color scheme ranked above average (median = 6). As indicated by previous qualitative responses to tasks and questions, the students ranked “words are easy to understand” the lowest of all the aspects (median = 4), indicating that the vocabulary and sentence levels were too difficult for this teenage population. Other aspects receiving low scores were the easy of finding things on the site and the balance of pictures and words. Although the overall score has a median of 6, the lower scored aspects indicate that students may have had more problems than their overall score reflects.

Table 4.6: Scores for NFPA website

Website aspects (# of students evaluating = 7)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	4	4.4
Words are easy to understand	4	3.7
Good number of pictures/graphics	5	4.4
Good balance of pictures and words	4	4.3
Good colors/color scheme	6	5.3
Overall, I like this website	6	5.4

USFA KIDS

USFA Kids (http://www.usfa.dhs.gov/kids/flash.shtm) targets children ages 10 and under and is an outreach of the United States Fire Administration. The website

operates with two versions: one version is all Flash, including the navigation and content panes, and the other version is all HTML.[43] Both versions are identical in layout and in the main categories that make up the navigation menus. The site has two main sections with several categories in each section (see the homepage in figure 4.4). The first section, "Learn About," has three categories focusing on prevention strategies and how to escape during a fire emergency. The second section, "Fun and Games," offers six activities varying from coloring and matching to interactive seek-and-find games and quizzes.

Figure 4.4: The homepage of USFA Kids

[43] Because OSD had Flash animation disabled, as it requires large bandwidth, the students viewed the HTML version of the website. The main difference between the two versions is that the HTML version has the activity pages as PDF files rather than interactive Flash screens. If the site had been coded only in Flash, without the HTML version, it would have been completely unusable without the Flash plug-in, which is why WCAG 1.0 and 2.0 warn designers not to code entire sites or key parts of sites in Flash unless there is an HTML back-up. The designers of USFA Kids, unlike designers of some of the other sites I tested, have followed the guidelines regarding coding with scripting language or plug-ins properly.

With 73 separate Flash pages, USFA Kids is one of the larger sites in this analysis; however, the site is approximately 20 pages smaller in the HTML version because the coloring pages and games are in single PDF files rather than individually coded pages. As part of its navigation structure, the site has 112 total links and relies heavily on text-labeled buttons with 85 links via buttons labeled “next,” “back,” and “print” rather than links within paragraphs or as part of sidebars. Using buttons with such labels promotes sequential reading of the pages within a single category, but the navigation menu listing all the categories remains consistent on the left side of the page if a deaf teen wanted to skip to a different topic. The only navigation problem that may develop is when completing a quiz; if the deaf teen fails to click the correct response, the outcome page presents the same message, “That is incorrect. Please try again . . .” The teen cannot proceed through the quiz until selecting the correct answer, which could result in several teens abandoning the quiz in frustration, and thus, failing to learn the correct answers.

The concepts described in the tutorials and incorporated into the games and activity pages focus on maintaining a smoke alarm, creating and practicing an escape plan, and acting in certain ways to prevent fires from starting. Yet most of the information may seem like common sense or even demeaning to a teenage audience because the messages tell the “kid” to remind an “adult” to do many activities that teenagers can accomplish on their own (plugging electronics into outlets and turning on heaters) while also warning them to “never touch matches, lighters, or candles.” Some of the activities, too, may be only appropriate for younger audiences given that they are mostly coloring pages and matching card games. But the advanced crossword puzzle

might be useful to deaf teenagers to help them learn fire safety vocabulary, and “Hazard House” provides quick reminders about how to correct the hazards shown in the cartoon room.

USFA Kids is one of the best sites I analyzed concerning its writing style and vocabulary level. Its SMOG readability score is a 6.84 grade-level (Flesh-Kincaid = 4.8), averaging 11.8 words per sentence. The site refers to its audience as “kids” and uses contractions and simple words to describe the behavior of fire and fire prevention strategies. For example, a passage describing fire and smoke includes, “Fires are scary and very dangerous. They are loud and hot, and the smoke makes it very dark.” The definition of smoke alarms is that they “are tools that can tell if there is smoke in the air”; this definition is complemented by a cartoon graphic and comparison of a smoke alarm’s appearance to a dinner plate on the ceiling. The pattern of using definitions, graphics, and analogies to common objects to explain the more complex objects and concepts repeats throughout the site.

The site’s 142 graphics are all cartoons and cartoon buttons, and the main character on the homepage is a child with a pet turtle, which may signal to deaf teenagers that this site is more appropriate for younger ages. These homepage graphics are also oversized, similar to the oversized buttons and handles found on toys. The rest of the graphics seem less age-specific as they focus on objects rather than people. The bright orange and green color scheme for the background and main navigation also may appeal to deaf teenagers, and the font type resembles those found in graphic novels and teen comic books. As a whole, with all these factors, if the teens are willing to forgive some aspects, they may find this site easy to use and understand.

Ten students evaluated USFA Kids, giving it mixed reviews. Seven students wrote that they liked the colors and pictures as part of their initial impression of the site. They thought the site had good information and that "it got what you need" and provided "very good teaching to kids." However, one student wrote "stupid design" in the bad column, and five wrote that they were not "kids" and that they believed this website was not intended for them. One student said she thought it worked well for younger students, but that she did not want to do the coloring pages or many of the other activities provided. One student commented that he thought the site needed "biger writing" or font type, especially in the description sections about fire safety.

The first task asked students to read about smoke alarms and to take the quiz at the end of the smoke alarm section. Specifically, students were asked to explain how to clean smoke alarms and to write down the score from their quiz. Only three students responded to how to clean the smoke alarm, and of those responses, one student gave a correct method for cleaning the alarm. Most wrote a score from their quiz with five students scoring 100 percent, two scoring 95 percent, and two scoring 85 percent. These high scores reflect the students' basic understanding of how smoke alarms operate, how to clean them, and how to test and respond to them.

The second task asked students to play the "Hazard House" game, reading the tips as they played, and explaining how they should handle candles. Five students provided correct responses, including "never play with candles," "never lit em," "put out candles," and "never light close to curtain." Three students provided their quiz score from this game as 100 percent, and three students left the question blank. So the results of this task are mixed although one student offered his positive response to playing the game, "it cool

game," instead of explaining what to do with candles or giving his quiz score. Overall, the correct responses for handling candles and high quiz scores lead me to assume that students could play the game successfully and could remember and articulate correct information after playing the game.

The third task asked students to read about escaping from fire and to define in their own words *escape plan*. Only five students provided a response to this question. Of those, four gave correct responses, such as "something to prepare in case if there are fire," "a way to git out the house the fastest," and "way out home." But one student gave the troubling response of "bust a giant hole in the wall," which given his correct and detailed responses to the other sections, means he did not understand what he was reading and may attempt a behavior that will endanger him rather than escaping from fire.

The final question, like the worksheets for the other sites, asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students' agreement with the statement and 1 representing disagreement. Table 4.7 shows the scores for each aspect. Although I implemented a methodology to ensure the worksheets were distributed to students randomly, three 7th graders worked together as a team. Additionally, two 7th graders completed more than one worksheet, and by random chance, reviewed USFA Kids. Therefore, USFA Kids is the only site with multiple 7th graders evaluating it, and the difference in the scores is clear when the 7th graders' scores are removed from the total. To show the full meaning of this data, I have included the medians and means with the 7th graders' scores and without those scores. Although the tone of the website was not one of the aspects students were asked to rank, perhaps the lower scores reflect the initial impression that older students thought this website was for

"kids" and that they did not believe themselves to be "kids." The lowest ranking attribute was related to the number of pictures (median = 4), which could either indicate a dislike of the main graphics used (cartoons of a boy in overalls and a turtle), or a dislike of how often these same graphics repeat throughout the pages. The overall score, especially the score without the 7th graders' evaluations, is the lowest for all the sites tested, revealing that the first impression gained of a site through the graphics and navigation categories may be tough to overcome if students believe the site is intended for a younger audience.

Table 4.7: Scores for USFA Kids website

Website aspects (# of students evaluating = 10 # of 7th graders evaluating = 5)	Likert scores on scale of 1-7			
	Median with 7th graders	Median without 7th graders	Mean with 7th graders	Mean without 7th graders
Easy to find things	7	5	5.8	4.8
Words are easy to understand	7	5	6	5
Good number of pictures/graphics	6	4	5.2	4.4
Good balance of pictures and words	6.5	5	5.8	5.2
Good colors/color scheme	6.5	5	5.6	5.4
Overall, I like this website	6.5	4	5.6	5

STAYING ALIVE

Staying Alive (http://www.stayingalive.ca/kids_zone.html) is a website created and maintained by a Canadian nonprofit group, of the same name, committed to educating students in kindergarten through eighth grade about fire safety. Founded by a firefighter and fire and life safety education, Staying Alive combines classroom presentations, awareness campaigns, and the website to deliver educational programs throughout the year. The homepage presents fifteen categories with pictures and textual labels designating each category (see figure 4.5). The site opens in Flash but also

provides an HTML link with directions to click that link if “you cannot see the icons above.” Both versions of the site present the same layout and options, but the Flash version introduces small movements within some homepage icons. For example, the candle icon displays as a lit candle in the HTML version, but in the Flash version, the candle icon is first unlit, then lit, and finally extinguished by a candle snuffer. Because these movements are small additions that do not fundamentally change the information conveyed, Staying Alive correctly follows the accessibility guidelines of providing a comparable substitution for the Flash in HTML.

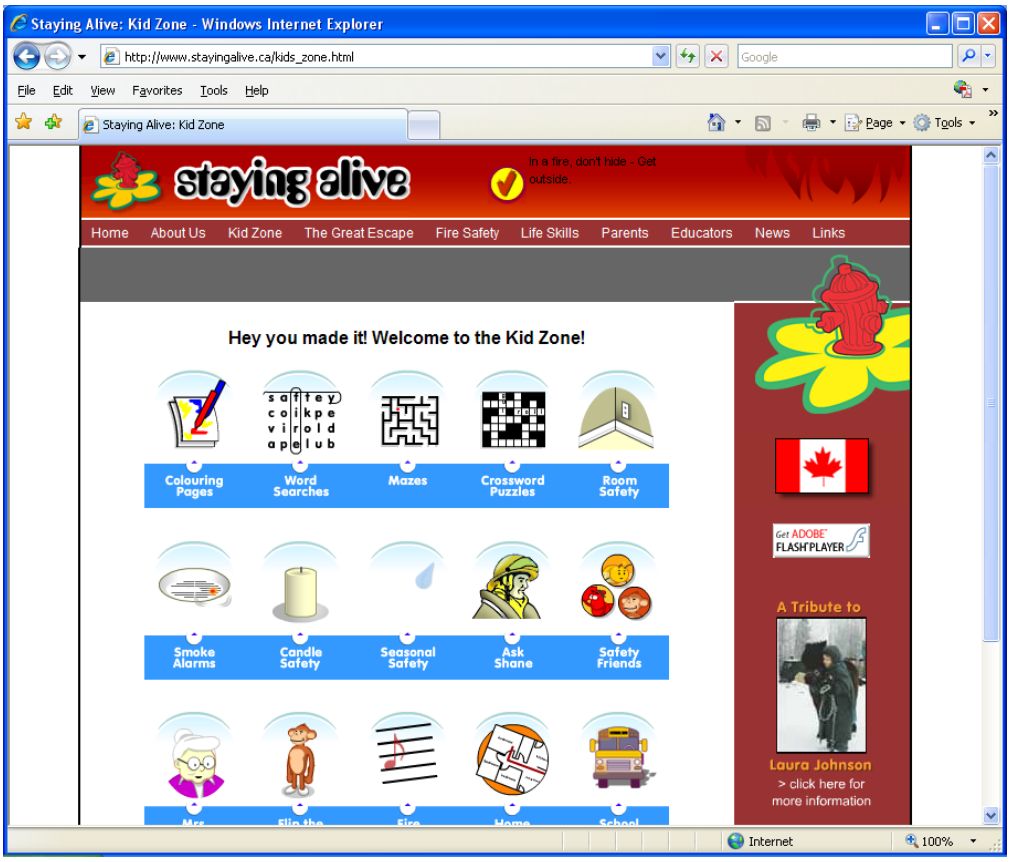

Figure 4.5: The homepage of Staying Alive, Flash version

Staying Alive has a consistent design that groups the fifteen topics into six main categories and that offers easy ways to navigate between categories. Some categories are

explicit, such as “candle safety,” “smoke alarms,” and “fire safety songs”; others are labeled implicitly with catchy phrases, such as “Mrs. Aboutfire,” “Flip the Fire Monkey,” and “Ask Shane” so that a deaf teen would have to click on that category before understanding what it means and what information it contains. The top banner and left navigation menu remain stable throughout each internal page, and a bottom banner with a link to a sitemap and contact information offers another easy way to quickly access the site’s information structure. The right sidebar maintains a consistent look, but its content changes periodically to include different seasonal safety links or “hot tips” and song links.

At first, the change as the fifteen topics collapse into six main categories is awkward, but a secondary navigation menu displays, at the top of the page under the main banner, and has an icon and textual label for each of its topics (see figure 4.6). This pattern repeats, allowing teens to become familiar and understand where they are within the site and how to navigate to other topics within those six categories with ease. None of the 250 links throughout the 31 pages is broken, further enabling site navigation.

Figure 4.6: Internal pages with primary and secondary navigation

Unlike USFA Kids and Sparky the Fire Dog®, Staying Alive provides more than just information about fire prevention strategies, firefighter equipment, and smoke alarms. The site also describes seasonal safety tips, the daily activities of firefighters, and the characteristics of fire, such as how fire spreads and how hot it can become. These topics are discussed in content-heavy pages that are separated with short headings, bulleted lists, and a few cartoon graphics. Like other sites, the games section seems more tailored to younger audiences because of its coloring pages and rather simple mazes and word searches; these passive activities may reinforce fire safety vocabulary, but they fail to engage the teenager in problem-solving or testing a deeper understanding of the fire safety concepts.

With a readability score of 7.99 grade-level (Flesh-Kincaid = 6.3), Staying Alive explains fire safety jargon and concepts in detail, enabling the user to learn vital information; the site also averages 13.1 words per sentence. For example, instead of rattling through a list of firefighter equipment or clothing, this site describes the purpose of the equipment and uses helpful forecasting sentences to ease the user into the more technical descriptions. When describing the types of smoke alarms, the site offers the following, “There are two types of smoke alarms on the market, ionization and photoelectric. An ionization smoke alarm detects a flaming fire faster, a photoelectric will detect a smoldering fire quicker.” These descriptions help the user to understand the purpose of each alarm and see how they react to different fires. When describing the firefighter’s clothing, the site explains, “Our steel-toed boots protect our feet. Our turn-out pants protect our legs, and have knee pads so that we can crawl under the hot, smokey [*sic*] air.” These descriptions also move logically down the body, adding a piece at a time and relating the piece of clothing to the firefighter’s tasks. Unfortunately, several fuller descriptions about fire safety concepts are only available in audio files without captions, meaning teenagers who are deaf cannot access this information.

Overall, the site uses 197 cartoon graphics and 21 photographs for a total of 239 graphics, making it visually stimulating. The cartoons set a fun tone for the site, and using characters to represent three of the main categories may help deaf teenagers remember where to click for information about different topics because they can associate an older lady as a science teacher describing the characteristics of fire; they can also associate a firefighter answering questions about his daily activities. However, the remaining 16 characters do not seem to signal an obvious connection to the information

they represent. What does a monkey or a lobster have to do with fire safety? What does a hockey goalie or a ski instructor have to do with fire safety? Approximately half of the graphics throughout the whole site show an object or illustrate a fire safety concept (like an escape plan), but the other graphics seem to clutter the pages or may cause confusion about how they relate to the text that surrounds them.

To complement my analysis, eleven students evaluated Staying Alive. Several liked the icons for each category and that the site had a "simple toolbar," making it easy to distinguish categories. Two students responded that they liked the "good facts" or information available to "protect and help people." Three responded positively to the different games offered although one said the links to the games were broken. Six students responded that they believed the site was for younger students, commenting that the site "looks like its for kids age 5," "It's interesting but its look like it's for little kids," and "I thought it was more for kids who were younger than me than for kids my age." Perhaps this type of tone explains why several students found the layout too simple or the content lacking depth of information. One student replied that the site seemed "too cartoonist" and that it needed to have "real people tell their true stories." Another student said the site did not really "catch her attention," and a third student did not like the advertisements—or what she perceived as advertisements—but were graphic and textual links to other safety campaigns and videos along the right side of each page.

The first task asked students to read the page associated with "Mrs. Aboutfire," which explains some of the basic characteristics of fire. Specifically, students were to describe what fire needs to keep burning and what happens if one of the elements is removed. Six students responded correctly as they provided the three elements necessary

to keep fire burning and as they said the fire would burn out if one of the elements was removed. Three students could not identify this correct response of the fire extinguishing itself, but they did list other characteristics of fire found on this page, such as the temperature at which it can burn or how quickly a small fire grows into a large fire. Perhaps they provided these responses because they were described in the first three bullets; whereas, the correct information was provided in the sixth bullet. One student gave an incorrect answer, stating that the fire would explode if one of the elements was removed, and the final student said he could not find the correct information.

The second task asked students to click on “Games & Activities” and to explain whether the games looked interesting or if they would like to play any of them. Two students replied that they believed the games were for younger kids, and they cited the coloring pages as evidence; they said they would not play any of the games. Another student said she would play the maze or word search but that the coloring pages were “too baby-ish to me.” Five students said they would try the maze even with some of the other games seeming appropriate for younger audiences. Four students said the crossword and word searches were more interesting for them. Only two students said they would try all the games, including the coloring pages, because they believed the games would help them understand more about fire and how to stay safe.

The final task asked students to read part of the section under “Flip the Fire Monkey” and to summarize this information. Nine students responded correctly, describing parts of an escape plan and how to include the whole family in the planning. Of these students, two copied the information verbatim, stating “Gather your clan, make a fire plan,” instead of explaining the information in their own words. One student

described information in two of the other tips, and one student wrote “don’t know,” indicating that she either did not understand the catchy phrasing or could not find the information.

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students’ agreement with the statement and 1 representing disagreement. Table 4.8 shows the scores for each aspect. All the sections ranked highly, and the ease of finding things and the vocabulary received the highest score of all the sites tested. The combination of icons and textual links probably attributed to the high score for the ease of finding things, and the fact that most of the students answered the questions correctly for the worksheet tasks reveals that they could understand the vocabulary and concepts. But the balance of pictures and words ranked much lower (median = 4). This lower score could be because several icons did not load properly in the HTML version of the website. The initial impression of the site having more relevant content and activities for a younger audience may also attribute to the lower score for the balance of graphics and text with few graphics illustrating the information on each page, but appealing to a younger audience may explain why the students found the information easy to find and the words easy to understand.

Table 4.8: Scores for Staying Alive website

Website aspects (# of students evaluating = 11)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	7	6.2
Words are easy to understand	7	6.2
Good number of pictures/graphics	6	4.9
Good balance of pictures and words	4	4.5
Good colors/color scheme	6	5.1
Overall, I like this website	6	5.2

ILLINOIS FIRESAFE KIDS

Illinois Firesafe Kids (http://www.state.il.us/kids/fire/) was originally created by the Division of Biomedical Communications—part of the Southern Illinois University School of Medicine—and has been maintained by the Illinois State Fire Marshal. The site's homepage consists of a short introduction and six main categories, each illustrated by a photograph or cartoon (see figure 4.7). The site was designed with FrontPage Express (a free version of the full FrontPage), a software program that offers few coding options and that does not support Cascading Style Sheets (CSS). Because of the software's limitations, I was not surprised to see multiple violations of the accessibility guidelines outlined in WCAG 1.0, such as missing alt descriptions for images, but none of the violations will impact deaf teenagers unless they use screenreaders.

Figure 4.7: The homepage of Illinois Firesafe Kids

Unfortunately, the site does not use a consistent design or branding scheme throughout the pages, and it lacks a navigation menu. Instead, to navigate among categories, deaf teens must scroll to the bottom of the page and click one of the textual links for each category; however, two additional categories external to this site are listed among these links, which causes confusion when trying to stay within the site, and these categories are written for adults with more complex sentence constructions and a much higher vocabulary level. As a further complication to mapping this site cognitively, these main categories are not always listed at the bottom of each page, making it difficult to remember exactly which categories are supposed to be "for kids." According to the homepage's organization, six categories comprise the "for kids" website. Four of these categories are named explicitly to describe their contents, such as "Firefighter," "Cool Stuff for Teachers and Students," and "Fire Engines." Two of the categories use more catchy language, such as "Going to the Dogs" and "House of Hazards," language that may require a deaf teen to guess at what information that category contains.

Illinois Firesafe Kids uses both "child" and "kid" throughout the site to address its audience. Although writing for this target audience, the site has a SMOG readability score of 8.86 grade-level (Flesh-Kincaid = 7.9), an average of 9.3 words per sentence, and it relies heavily on fire safety jargon, especially in "Hazard House" that explains fire prevention strategies, "Fire Engines" that describes equipment on and parts of the fire engine, and "Going to the Dogs" that profiles five arson dogs. For example, the "Hazard House" instructs users to avoid "seasoned wood," "heat sources," and "exposed wiring," but these terms are not textually explained or graphically illustrated. The "Firefighter" category provides close-up photos of firefighting equipment and clothing, using terms

like “protective clothing” along with a description of its purpose, clearly explaining from what the clothing protects the firefighter. However, this same clarity of description and simplification of jargon is not used in “Fire Engines.” Of the 26 labeled fire engine parts and equipment, the site provides only two descriptions next to the technical names, which would be easier to understand and remember if the site explained when or why that part/equipment is used. Of the two descriptions available, deaf teens may struggle to understand the “electric inverter” that “changes DC voltage to AC voltage.” Finally, too much jargon laces sentences in the category describing arson dogs. Several of the dog handlers are described as “certified accelerant detection canine handler,” and the dogs “search for accelerants used by arsonists who start fires intentionally.”

The site is comprised of 48 pages, most of which contain simply close-up photographs of firefighting equipment and fire engine parts. Out of 53 graphics, the vast majority are photographs (35) with only 11 cartoons, four logos, two bullet/borders, and one button used frequently as the navigation method for returning from the specific photos to the broader categories. The cartoons depict characters that seem more the ages of older teenagers and adults, but those depicting objects and activities within the “Hazard House” use good detail for a deaf teen to see the object, visually connect it with the vocabulary terms used, and then, perhaps, relate these objects to the rooms in their own home. This connection would help deaf teens survey their homes for potential fire hazards. Although the photographs of the fire engines and firefighter show exactly what the equipment looks like, hotspots in the image maps, where teens can click to find the name of that equipment, are extremely small (averaging 18-20 pixels), thus difficult to find.

To determine what deaf teens think about this site, six students evaluated the site, emphasizing that they believed the site was more appropriate for younger audiences. Specifically, one student described the site as “lame” and “cheesy” and said, “It didn’t have any facts about what to do” to prevent fires or to escape from them. A younger student, though, appreciated the site “because it explain clear” with words he could understand and with a navigation system that was easy to use. Three students liked the pictures and colors as their first impression of the site, but another student thought the page was too small and the font was hard to read.

The first task asked students to explore the “House of Hazards” section and to describe an “overloaded outlet” in their own words. Only three students effectively described this concept; one wrote that he did not know; another drew an extension cord without anything plugged into the cord; one said it was a “bad thing;” and the final student wrote that touching electrical things with a wet hand was bad. Clearly, the students did not know how to locate the objects, moving the mouse pointer across each object until the arrow changed to a pointing finger, or the students did not know to click on the object once they found the hazard, thus enabling them to read about that hazard. To clarify how to play the “House of Hazards,” the site designers should include brief instructions below each house graphic, so that teens know how to search for objects with their mouse and know to click on the objects for more information once they realize they have found a hotspot. Another problem could be that even if the students could locate the object and click on it, they did not understand the description of each hazard because the descriptions rely on technical jargon.

The second task asked students to explore the "Firefighter" section and to explain if they would like to know more about firefighters or the equipment they use. Four students said they would like to know more details about the firefighting equipment. One student said he thought clicking on the picture to learn about the equipment was easy to use. Another thought the descriptions were easy to understand. Overall, this section seemed to be effective with the students although they would like to have more details and equipment options to explore.

The final question asked students if they thought this website would be good for teenagers and to justify their opinion. Three of the younger students thought this was a good site because it allowed students to "learn about some they don't even know about and it will be good for them to know about" and because it used pictures to help explain the "tough words." But the older students felt the site was better for "kids" or younger students because it was too "boring" for them and did not answer some of their questions about fire safety.

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students' agreement with the statement and 1 representing disagreement. Table 4.9 shows the scores for each aspect. All the sections ranked above average with the words being easy to understand ranking the highest (median = 6.5), a score which surprised me. Combined with the readability score, the mention of "tough words" on the site, and the incorrect or incomplete answers on the first task, this score seems too high. Ironically, the next highest aspect was the overall feeling that the students liked the website although they scored the other aspects lower. Like previous sites, the lower scores related to graphics and color scheme may be attributed to

their initial impression of the site having more relevant content and activities for a younger audience. The idea of this site appealing to younger audiences may also explain why the students found the information easy to find.

Table 4.9: Scores for Illinois Firesafe Kids website

Website aspects (# of students evaluating = 6)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	5	5
Words are easy to understand	6.5	6.3
Good number of pictures/graphics	5	4.8
Good balance of pictures and words	4.5	4.8
Good colors/color scheme	4.5	4.7
Overall, I like this website	6.5	5.8

THE FIRE AVENGER

Like Illinois Firesafe Kids, The Fire Avenger website (http://167.193.82.12/) is also a state-sponsored website, but this site is maintained by the Insurance and Fire Safety Commissioner for Georgia. Also like the previous site, The Fire Avenger uses a simple homepage with only four categories, each represented by a cartoon graphic (see figure 4.8). Also like Illinois Firesafe Kids, this site was created with an old version of FrontPage, relying on HTML and a table structure to hold all the graphic and textual elements. Several violations of WCAG 1.0 are throughout the code, but none of these violations impact how deaf teens interact with the site.

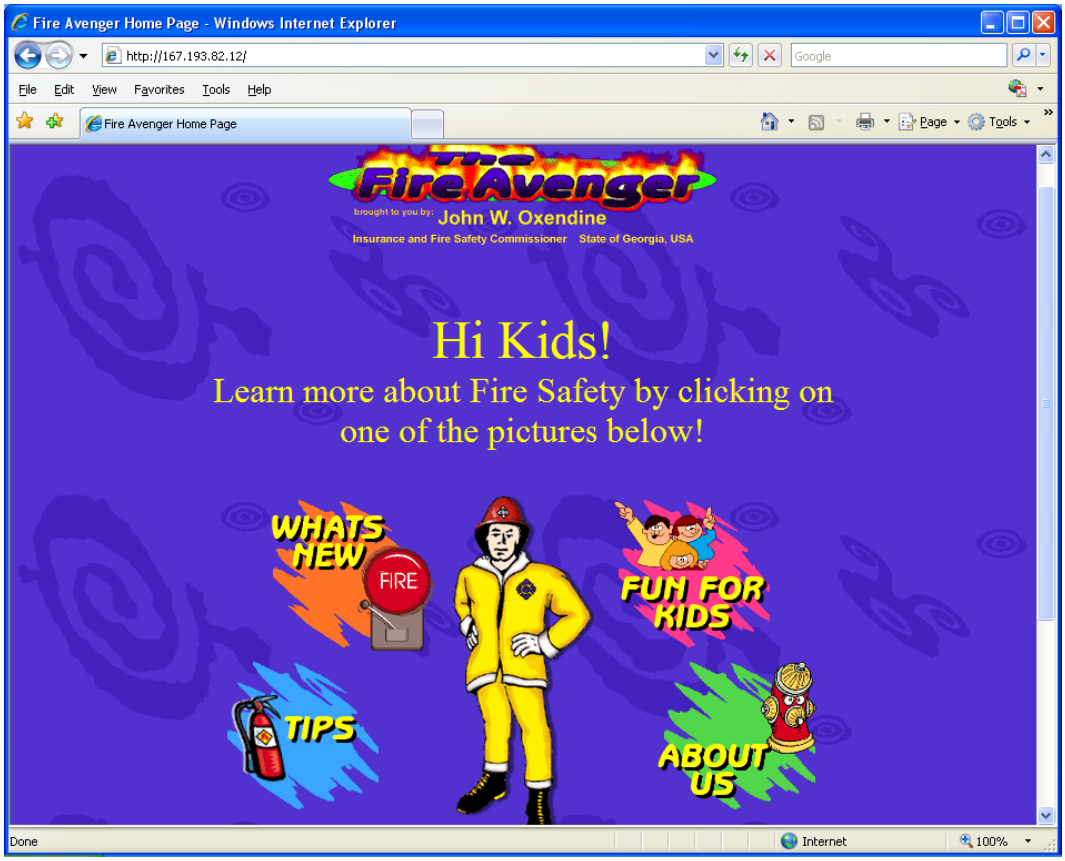

Figure 4.8: The homepage of The Fire Avenger

The site fails to provide a consistent layout or navigation method for each page even though the site is quite small with only 24 pages and 28 links. Sometimes at the bottom of the page, three links appear—Contact Us, Home, and Site Map. But these links are not consistent, and the Contact Us link actually leads to the About Us page, meaning one page has two names, which could confuse a deaf teen who anticipates finding contact information but instead finds a lengthy narrative about the commissioner's office. Additional complications arise as the browser's back button becomes the only way to return to the homepage on two internal pages. The site's primary navigation uses implicit links requiring the click of a graphic to move to the next page rather than the more standard navigation menu. The main categories are fairly self-explanatory with "Tips,"

"Fun for Kids," "About Us," and "Whats [*sic*] New"—the least specific category that leads to a link with the fire safety tips and a link to a quiz.

In addition to the problematic navigation structure and category naming, The Fire Avenger fails to communicate clearly fire prevention strategies and escape methods. The site uses abstract sentences, such as "Smoke detectors warn of danger," without immediately clarifying "danger" or what to do when the smoke alarm sounds. Instead, the deaf teen must scan up or down the page for such descriptive information, mixed among bulleted points about other safety behavior or fire concepts. The site often instructs children to create an escape plan with their families, but the directions for how to create such a plan or what the families should discuss are not included, leaving many to assume that one way out is sufficient. Another semantic problem is when the site authors decorate the word "cool" with snowflake graphics, implying a cold temperature, but in this context, cool describes a likeable or popular person. The graphic would not cause dangerous behavior, but the cognitive dissonance further complicates the already complex discussion of fire safety, especially for teenagers who are deaf because they will pay more attention to the snowflake graphic and interpret the sentence's meaning according to that graphic.

The writing style and level of vocabulary are mostly consistent throughout the site's 24 pages, but the "About Us" section uses a much higher vocabulary level, providing information for parents and teachers and describing the purpose and duties of the Insurance and Fire Safety Commission office. This page is full of phrases unfamiliar to the target audience, such as "regulates explosives and hazardous materials" and "compliance with state fire codes." Fortunately, the remaining pages, of which eight are

coloring pages, use mostly simple sentence structures, limited fire safety jargon, and a more appropriate level of vocabulary for the target audience. Overall, the site scored 10.5 grade-level with the SMOG formula (Flesh-Kincaid = 7.9), averaging 12.5 words per sentence. Besides the jargon found in "About Us," the only terms throughout the site that could be difficult for deaf teens to understand are "designated meeting place" and "smoke detector."

Although the coloring pages are not relevant for a teenage audience, I analyzed them for how they presented fire safety tips with an accompanying illustration. Several of the pages work well to present a single concept with a picture that illustrates the concept. Yet some of the illustrations created more confusion and potentially illustrated dangerous behavior. For example, the coloring page telling kids to practice their escape plan with their parents shows the kid on top of the roof, smiling, as he may jump off the roof or go down the ladder while the firefighter has his hands on his hips and his back to the kid on the roof. The same problem exists in the coloring page telling kids that if they find matches they should tell an adult where they are. But the illustration shows a small girl giving the matches to the adult rather than telling the adult or showing the adult the matches' location, meaning that the child handles the matches, perhaps for an indefinite time. Yet the coloring pages are the only graphics attempting to illustrate complex fire safety concepts.

The rest of the site's graphics are used to establish the site's tone and to represent its main categories, and the site designer has chosen cartoons for these functions, attempting to make the site look colorful and fun. For a young child, the graphics seem appropriate, but they may be too silly for a teenage audience. The purple background

with a subtle pattern resembles backgrounds available on MySpace, a site praised for its design according to the questionnaire responses. So the students may respond positively to the overall color scheme and graphics if they can look past the textual references to "toys" and "coloring pages."

Nine students evaluated this website, and again as with previous sites, they found the website to be more appropriate for younger audiences, especially as the site emphasized the coloring pages. As part of their first impressions, several students responded that the pictures or "cartoons" were a good aspect of the site. One student liked the menu structure, and another student responded that the tips were good. However, five students emphasized that the website was too "babyish," "lame," and "cheesy," looking "like its for little kids." One student also pointed out that the website's address (http://167.193.82.12) was "goofy," perhaps because she was confused by all the numbers in the address rather than the more standard practice of words in website addresses.

For the first task, students read a page about how to be prepared at night if a fire started and were asked to describe a smoke detector. The page uses the words "smoke detector" but does not define the term or its purpose. Instead, the page emphasizes where to place the "smoke detectors" throughout the house. I wanted to determine whether students were familiar with the term or whether they needed the definition before knowing where to place the devices. Five students correctly responded to the question, explaining that a smoke detector "is an alarm that warns people," "an alarm that goes off when there's fire," or "beeps" to tell people when "it detects smoke." The other four

students copied the text from the page, stating that “if your house has more than one level, be sure there is a smoke detector on every level.”

The second task asked students to evaluate the graphics explaining the stop, drop, and roll technique. Again, the evaluations were mixed. Five students evaluated the graphics favorably, commenting that they demonstrated the technique well or that they “were cool” or “very cool.” One student did not understand the question and wrote “clothes.” The remaining three students gave the graphics low scores, but they justified these scores with important considerations for site designers. For example, one student emphasized that the graphics needed to move more slowly and that the cartoon figure should not be smiling while he performed the technique. Another student emphasized that the technique looked silly because there was no actual fire. The final student responded only that the “pictures are lame,” but according to her additional responses on the page, she believed the entire site was “too childish” for teenagers.

The third task involved looking at the coloring pages under the activities section and explaining whether they believed the website was “good for teenagers.” Six students responded that these activities were inappropriate because “teens are too old to color” and the pictures “are childish” or “for kids.” The remaining three students thought the pictures were good because they “show how to do that” and they “help the child to understand.” Overall, I expected this negative response toward the coloring pages, but new websites could use the color pages as examples of graphics they could adapt to explain more complex concepts.

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students’ agreement with the statement and 1

representing disagreement. Table 4.10 shows the scores for each aspect, and as with USFA Kids and NY OFPC, the medians and means for The Fire Avenger are different when the 7th graders' scores are removed. Two scores decrease and one score increases when the 7th graders' scores are removed. Overall, the scores are mixed with the site's color scheme scoring the highest (median = 6), a score that is expected given the rich purple background and the bright colors of the other homepage icons. The two aspects that scored lower were (1) the number of graphics and (2) the ease of finding things (median = 4). These findings correspond to the students' responses that some of the graphics seemed more appropriate for younger audiences and that some of the students could not find the definition of a smoke detector. Compared to the other sites tested, The Fire Avenger received lower scores across the board although it did not have the lowest score for "overall, I like this website."

Table 4.10: Scores for The Fire Avenger website

Website aspects (# of students evaluating = 9 # of 7th graders evaluating = 1)	Likert scores on scale of 1-7			
	Median with 7th graders	Median without 7th graders	Mean with 7th graders	Mean without 7th graders
Easy to find things	4	4	4.6	4.3
Words are easy to understand	6	5.5	5	4.9
Good number of pictures/graphics	4	4	4.6	4.6
Good balance of pictures and words	5	5.5	4.9	4.9
Good colors/color scheme	6	6	5.4	5.4
Overall, I like this website	6	5.5	5.1	4.9

GET FIRE WISE

The Get Fire Wise website (http://www.firekills.gov.uk/seniors/index.htm) is maintained by the United Kingdom Fire Service.[44] The site is organized into three major categories with *manga* characters representing each category (see the homepage in figure 4.9).[45] Unlike several of the other sites I tested, this site follows all the accessibility guidelines for the main content portions, using HTML with CSS to create a light and clean code that will require very little connection speed or computer processing speed to render the website. Although the quizzes are coded in Flash, they are also available in HTML; however, six of the eight games require a Flash or Shockwave plug-in, limiting how many of those activities may be available to deaf teenagers who lack those plug-ins on their computer.

[44] Unfortunately, at the end of May 2008, the UK consolidated many governmental sites, and this site targeting teenagers along with a site targeting younger children were disabled. The fire service does not believe that they will be using these sites or produce new sites targeting youth audiences in the near future (Email from Fire Gateway Support, June 11, 2008). To access versions of these websites, use the Internet Archive found at http:// www.archive.org.

[45] Both from Japanese culture and growing in popularity with teenage audiences, "*manga* are printed comics found in graphic-novel format, whereas *anime* are animated cartoons" (Schwartz and Rubinstein-Avila 2006, 41).

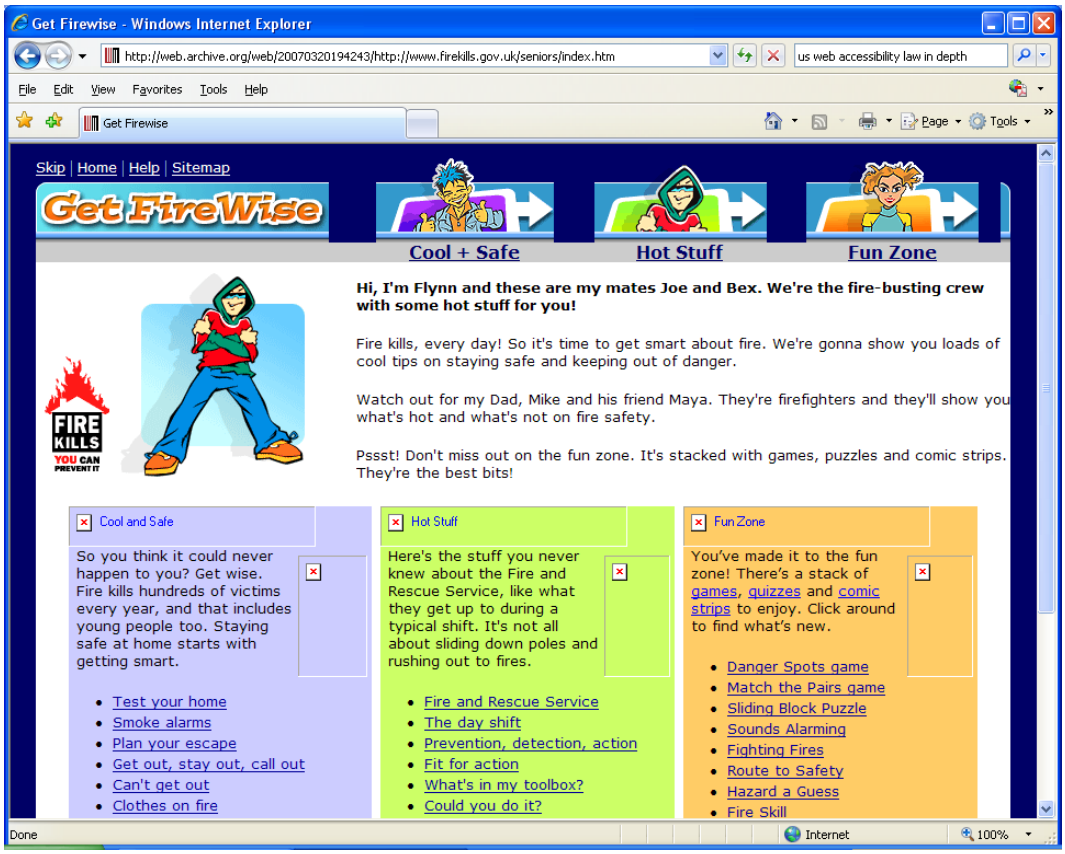

Figure 4.9: The homepage of Get Fire Wise[46]

With 93 pages and 246 links, Get Fire Wise is the largest of the current fire safety websites I tested, and the only site targeting a young teen audience, specifying its audience "for seniors 8-14 years." Along with a site map and a help page for people using assistive technology, the site relies mostly on explicit textual links (88 percent of the links) and a consistent layout and color scheme to visually unify the information and to ensure deaf teenagers remain aware of their location within the site. The primary navigation menu offers quick links to the three main categories while the pages within

[46] Because this screenshot is pulled from the web archive, six of the graphics are missing as shown by the red x. On the original site, the "Cool + Safe," "Hot Stuff," and "Fun Zone" headings in the middle of the page were in a cartoon font similar to the website's title. The graphics next to the section paragraphs were full-size shots of the main three characters pictured at the top of the homepage.

each category are offered as links in the left sidebar. Even with such a large number of links and navigation menus, not one link is broken, so the site works smoothly and as expected rather than causing frustration.[47]

Get Fire Wise also offers a wide range of information, activities, and media. The character named Flynn explains the category named "Cool + Safe" that presents information about fire prevention, what to do during fire emergencies, and the consequences of arson. The character Joe explains the category named "Hot Stuff" that describes the daily activities of the fire service, the equipment in the station and used during fires, and how to become a firefighter; of the sites in my study, this site has the most comprehensive information about the fire service, in general, along with examples of daily fire service activities that may help a deaf teenager understand and even consider working in the fire service. The third character, Bex, introduces the category named "Fun Zone," which contains eight games, six quizzes, and four comic strips illustrating how to prevent fire, how to act during a fire emergency, and what firefighters do during their average "dayshift." This site is also the only one in my study that explains why teenagers should not "prank" phone call the fire department.

The writing style of this site is more informal and chatty than any of the other websites I analyzed. For example, the site uses contractions and phrases like "we're gonna show you loads of cool tips" and "we're the fire-busting crew with some hot stuff for you." These phrases reflect the language of teens rather than the more formal fire safety jargon of the experts. The "firebustin' facts" spread throughout the site are short

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[47] In general, the larger the scope of the website, the more opportunities for broken links and inconsistent tone and navigation elements as webmasters change or multiple people work together on a coding team to create and maintain the larger sites.

sentences, emphasized in bold font, that summarize the main points of each page, and this technique may be appreciated by teenagers who are deaf as they desire the key points rather than lots of description. With its informal writing style, the site scored 7.02 grade-level for readability with the SMOG formula (Flesh-Kincaid = 5.7), averaging 11.2 words per sentence. The only aspect of this site that may cause comprehension problems for teenagers who are deaf is its use of British English and 999 for emergencies rather than 911, but the students' evaluations may offer some insight.

The site uses mostly cartoon graphics, but these cartoons are in the Japanese *manga* style, a style that appeals to teenage audiences (Schwartz and Rubinstein-Avila 2006, 41-42). On almost every page, the site presents a different cartoon for a total of 85 cartoons, and the four comic strips use vivid colors and *manga* characters to explain the more complex fire prevention concepts and the daily lives of firefighters. The comic strips also limit the text to 1-2 sentences per frame and use a detailed cartoon to illustrate the sentences; this visual presentation of information with limited text may work well to educate deaf teenagers with lower levels of reading comprehension. Unfortunately, though, the use of cartoons to illustrate the concepts is not repeated for two-thirds of the site where the concepts are more complex and discussed in detail.

Nine students evaluated Get Fire Wise.[48] I expected this site to score well with the students; however, some felt like this site had too many games and concepts targeting younger students rather than those in high school. Five students commented favorably about the graphics, listing "cool pictures" or "cool page." Two students responded that

[48] Five additional students began evaluating this website, but they only completed the first question asking for their initial impression of the site. Because they did not complete any tasks, nor rate the specific aspects of the website, I chose to eliminate these responses and instead opted to use only the nine complete evaluations.

they liked this website more than fire safety websites they had viewed because it seemed more appropriate for their age group. They liked how it taught subjects that interested them. But two students stated that there were too many topics or links on the homepage; they were confused and had difficulty finding the links described in the worksheet tasks. Two other students, both 12th graders, felt the website was for younger audiences; one commented that the games were too "kidish," and the other student said the site targeted ages 10-14.[49]

The first task asked students to read one of the website's pages about fire prevention and to take the associated quiz. The question asked students to explain whether they liked the quiz. Four students replied that they liked or "loved" the quiz, but five students either found the quiz confusing or boring. Specifically, one student said the answers to the question were too obvious from the given choices or that the questions asked only for common sense answers. Two students found the quiz confusing, saying that they did not have enough information or that they could not determine the correct answers from what they had read.

The second task involved reading one of the stories that illustrated how to respond in a fire emergency. The question asked students their opinion of the story and to explain whether they could understand it. Almost all the students (eight of the nine) responded positively to the story, describing how it helped them understand the "facts of what to do" or "taught kids" well. One student said he liked the story but felt like it was a little

[49] I am not sure why this student chose the age range of 10-14, but he was correct in assuming these ages. According to the first page of the FireKills homepage, under the Kids Area, this "seniors" site, named "Flynn and Friends," is for 8-14 year olds while the "juniors" site, named "Frances the Firefly," is for 3-7 year olds (www.firekills.gov.uk/kids/01.htm).

condescending. Only one student completely disliked the story, commenting that it was "boring."

The final task asked students to play and evaluate one of the interactive games—a game that did not require a plug-in—describing whether they found the game easy or difficult. The game presents a room with fire hazards, which players click on to correct while the clock counts down from two minutes. When the player clicks on a hazard, a window pops out describing why that object is a fire hazard and reminding players how to prevent the hazard. Three of the younger students found the game difficult because they could not find all the fire hazards in the room. One said he found the game moderately difficult, but he thought it was "fun." Five students said the game was easy, but that they liked it because it showed the hazard and then showed the correct picture after the object was selected. Of these students, one said he thought the game was easy, but he could not find one of the hazards and was disappointed that the game did not explain which hazard he missed when the game time expired.

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students' agreement with the statement and 1 representing disagreement. Table 4.11 shows the scores for each aspect. Every aspect of Get Fire Wise scored above average. Ironically, this site scored highly for the words being easy to understand (mean = 7) even though the site is written in British English, using several terms differently from American English, such as 999 instead of 911. But the readability score was one of the lower scores compared with the other sites, predicting that students should be able to understand the vocabulary presented. The lowest rated aspect was the balance of pictures and words, which could reflect how some

of the students desired more textual explanations of the fire hazards—so they could understand why an object was dangerous—when answering the quiz questions and when playing the "Danger Spots" game. Considering all the scores, though, Get Fire Wise scored well above average in every aspect and was one of the most effective and most liked sites when compared with the other sites tested.

Table 4.11: Scores for Get Fire Wise website

Website aspects (# of students evaluating = 9)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	6	5.2
Words are easy to understand	7	6
Good number of pictures/graphics	6	5.4
Good balance of pictures and words	6	5.1
Good colors/color scheme	6	5.2
Overall, I like this website	6	5.2

FIRE SAFETY—OFFICE OF FIRE PREVENTION & CONTROL IN NEW YORK

The fire safety website sponsored by the Office of Fire Prevention & Control (OFPC), housed within the Department of State office for the state of New York, opens with an uncluttered page with 10 main categories (http://www.dos.state.ny.us/ kidsroom/firesafe/firesafe.html). The homepage centers on Hershey the Arson Dog who explains his job and the history of Fire Prevention Week before moving on to specific fire prevention topics regarding how to escape during a fire and how to cook safely (see figure 4.10). The code supporting the site is all HTML that will render properly, except for the navigation menu, which is an image map that lacks alt tags for the individual pieces of the map; this flaw means that teenagers using screenreaders may not be able to

access the individual links within the menu. But for the majority of deaf teenagers, the site's content and features will render properly on their computers.

Figure 4.10: The homepage of the fire safety site by the OFPC in NY

This site provides two ways to navigate through the information: a main menu on the left side of each page or graphics of paw prints at the bottom on the left and right sides of each page. The navigation menu, which lists the categories between the rungs of its ladder, would seem to allow deaf teenagers to quickly switch between them, but the categories change unpredictably as the teen clicks through the pages, switching positions and colors within the ladder rungs, without a logical pattern or a clear connection to the active page. These categories are explicitly labeled, though, such as "Arson Dogs,"

“Puzzles,” “Fire Trucks,” “Action Photos,” and “Fire Lessons,” making it easier for deaf teenagers to anticipate what information each category contains. The second navigation method is via the paw prints, a method explained on the homepage, but without these instructions on every internal page or textual labels on the paw prints like “back” and “next,” the prints may be confusing or ignored. But if the prints are understood, they may compensate for the confusing navigation menu because they move the teen through the categories consecutively

The vocabulary used to describe the fire safety concepts works well throughout most of the site, which scores a 7.67 grade-level with the SMOG readability formula (Flesh-Kincaid = 5.5)and averages 12.9 words per sentence. At first glance, I thought jargon such as “Operation EDITH” and “trained accelerant detection canines” would be problematic for the teenagers evaluating the site, but if deaf teenagers continue to read past this jargon, they will find sentences and graphics attempting to explain it. Considering how this pattern of information repeats throughout the site’s 42 pages, it seems to offer quality information with an appropriate tone. The sections that may be less clear are the descriptions in the “Arson” category and the tips in the fire prevention section that are rewritten in a plain style rather than as bulky phrases with unnecessary nominalizations, such as “Do not ever start a fire in a fireplace without the participation and supervision of an adult or parent.”

A combination of cartoons, diagrams, and photographs within a consistent layout and color scheme complement the textual descriptions throughout the site. The vast majority of the graphics are cartoons (111) that show safe behaviors, such as how to crawl low under smoke or how to feel a door to test if it is hot while others show different

types of fire trucks. The photographs depict firefighters extinguishing a home fire and firefighters working with their arson dogs. The detail and variation in graphics may make this site more appealing to teenagers while also helping them understand how to react during a fire and what fighting a fire entails. The graphics that may not be as appealing are those that seem more like standard clipart or those that are more cute than informative.

To complement my analysis, seven students completed evaluations of the OFPC's fire safety website.[50] Every one of the students said they liked the pictures on the website, especially the photographs of the arson dogs. They also liked learning about arson dogs because the other websites did not provide this type of information. However, two students commented that they "don't understand words" or "can't read words" although they believed the information was "good" and that it "help kid." One student wrote that she did not "like it," meaning she did not like the site, and she gave low scores to the graphics, colors, and balance of graphics and text.

The first task asked students to click through one of the fire lessons about how to escape during a fire. The question asked students to explain how to "test the door." Four students answered this question with a version of avoiding the door if it is hot and proceeding to the window; however, only one of these students actually mentioned feeling the door with "the back of your hand," the most appropriate answer to the question. The other three students provided incomplete or incorrect answers. For example, one student wrote, "Feeling it with the back of your head," and another said

[50] Two students' worksheets were not included because the students completed only the initial impression of the website and the first task. They did not complete the other two tasks or the final rating of different aspects.

only, “Door knob,” with no elaboration. The final student responded, “Close door,” which is a confusing answer because she could mean to keep the door closed, a correct behavior if the door is hot, but an extremely problematic and potentially life threatening behavior if she does not test the door or search for a second way out.

The second task focused on reading about arson dogs and explaining what they do. Every student gave a correct answer for this question, and most of them used their own words to explain how the dogs “smell fire start,” “find where the fires started,” or “find where the fire started and what material is used.” Only one student used the exact wording of the website to say, “With our partners and handlers, we investigate questionable fires across the state,” instead of providing an answer in her own words as prompted by the question.

The third task asked students to read another fire lesson, one called “Operation EDITH.” The question asked students whether their family had “an EDITH plan,” using the exact wording of the website, and to give the location of their “meeting place.” Five students answered both questions correctly, explaining how they get out of their house and go to various locations outside. They wrote the “mailbox” and the “driveway” as meeting places. Another student answered the first part of the question with “to make to ways out the house,” meaning she understood an EDITH plan to be the specific ways to get out of the house during a fire. The final student gave a vague answer, replying “emergency.”

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students’ agreement with the statement and 1 representing disagreement. Table 4.12 shows the scores for each aspect, including the

scores with and without the 7th grader's evaluation. Interestingly, several of the medians increase when the 7th grader's evaluation is removed, which is not the trend seen with the other websites when the 7th graders' scores are removed. The highest aspect was the site's color scheme (median = 7), which is reflected in the students' favorable comments about the pictures on the site and the presence of both photographs and cartoons. Surprisingly, although almost all the students answered all three of the task questions correctly, the lowest ranked aspect was "easy to find things" (median = 6), but this score is still high compared with other sites. Overall, the students gave the site a high ranking.

Table 4.12: Scores for the fire safety website by OFPC in New York

Website aspects (# of students evaluating = 7 # of 7th graders evaluating = 1)	Likert scores on scale of 1-7			
	Median with 7th graders	Median without 7th graders	Mean with 7th graders	Mean without 7th graders
Easy to find things	5	6	5.3	5.5
Words are easy to understand	7	6.5	6.1	6
Good number of pictures/graphics	6	6.5	5.1	5.7
Good balance of pictures and words	6	6.5	5.1	5.5
Good colors/color scheme	7	7	5.3	6
Overall, I like this website	6	6.5	5.4	5.7

FIRE SAFETY—THE UNIVERSITY OF OKLAHOMA POLICE DEPARTMENT

The fire safety website created and maintained by the University of Oklahoma's Police Department (http://www.ou.edu/oupd/kidsafe/fire.htm) is really a set of slides more than the standard website with a navigation menu on each page. Instead, this website opens with a table listing 27 safety topics for kids (see figure 4.11); only four topics are related to fire safety, so I limited my analysis to these topics.

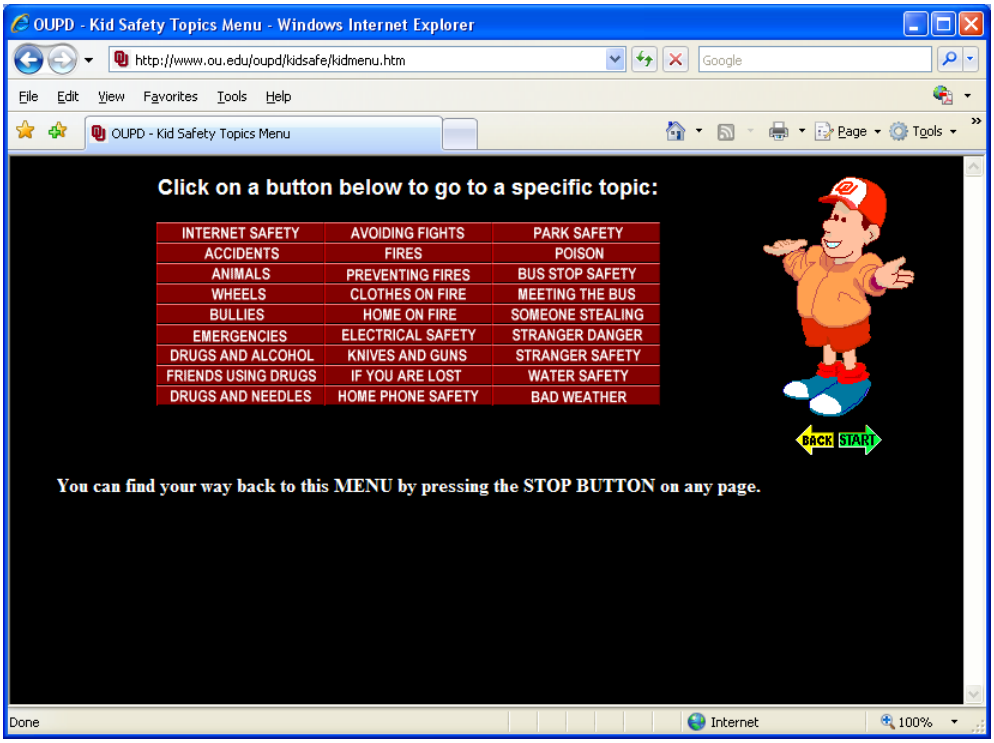

Figure 4.11: The homepage of the fire safety site by the OU Police Dept.

To navigate through the topics, deaf teenagers click on individual topics that look like buttons and that are organized in a table. The homepage explains this navigation method, which may be less intuitive than the standard menus found on other sites. Once within one of these topics, however, the site may be confusing because it lacks the most common structures of websites, the top banner and some type of navigation menu. These internal pages force teens to progress through the topics sequentially by clicking the arrow graphics labeled “Next” and “Back.” Because these labels mimic the browser buttons frequently used when navigating sites, teens may appreciate this simple method and find it less overwhelming than choosing from a menu of topics. Or they may be frustrated by their lack of controlling the order of information and begin wishing for the standard menu. Finally, the “Stop” link, which is the only way to return to the homepage,

may be confusing because the graphic stop sign connotes driving rather than fire safety; a link named “home” seems more helpful.

The site’s content explains how to escape during a fire and call 911; how to perform stop, drop, and roll; and how to practice basic fire prevention by cooking only when adults are present and by staying away from matches and gasoline. Each of the four topics opens with a cartoon graphic and a question at the top of the page (see figure 4.12). The next page opens with a new cartoon graphic, a heading, and several bullet points of information, supposedly related to the initial question. This pattern is consistent for each topic. But with only nine pages and 5-6 tips per page, the site does not offer much detail or any activities or other media for learning new information, especially compared to the other sites I analyzed. Some deaf teens may be bored by the lack of information and either abandon the site quickly or feel no reason to return to the site or recommend it to their friends.

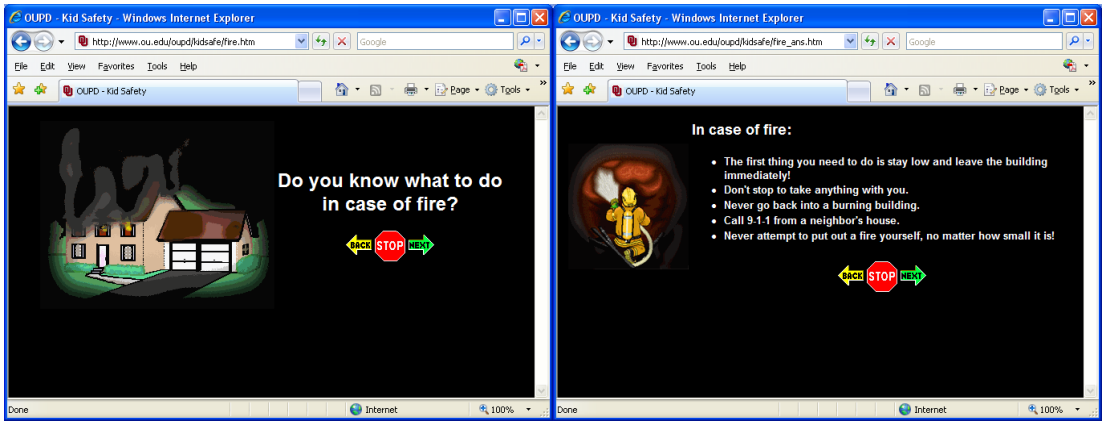

Figure 4.12: Internal pages mimicking a slide presentation

Although this site presents a limited amount of information with one of the lower SMOG readability scores at 6.59 grade-level (Flesh-Kincaid = 4.7) and an average of 10.9 words per sentence—aspects that should make the information easier to

understand—the items in the bulleted lists are sometimes unrelated to each other. Some items also seem irrelevant to the initial question introducing the topic. For example, in the middle of the list answering, “What do I do if I wake up and my house is on fire,” is the bulleted item, “Household members with disabilities may need special help.” This information follows the bulleted statement discussing how kids should practice their fire escape plan, and it precedes the bulleted command for kids to “alert others in the house.” The shift in style from imperative to declarative statements and the shift from prevention strategies and ancillary information to progressive actions taken in a fire emergency may be confusing. Furthermore, the shifts may prevent deaf teenagers from remembering the correct order of activities related to prevention versus action during an emergency situation.

Visually, given how different this site is from standard websites, the black background and cartoons with moving parts may be appealing. But these graphics only serve to set the tone for the website as they depict firefighters and burning houses. Only two of the 13 graphics attempt to illustrate a concept from bulleted list adjacent to each graphic. The first of these graphics shows an “escape route” with a labeled meeting place. But the other graphic illustrating a concept does not seem as clear. Trying to show how to stop, drop, and roll, the graphic depicts a person who seems to be taking a nap with a blanket covering his torso while a flame burns on his knee. A red arrow points downward, trying to signal that this person is rolling forward. Perhaps a better illustration of stop, drop, and roll would use three different graphics to signal each action rather than combining them into one graphic.

Because this website's navigation and presentation of information is completely different from the other fire safety websites, giving limited information and few options, I began this worksheet encouraging students to proceed through the slides by clicking the next arrow instead of asking their initial impression of the website. Eight students evaluated this website. The first question asked students to click the next arrow and to read the five bullets of information about what to do in case of fire. Then the question asked, "Why should you stay low in a fire?" I asked this question because the first bullet point said to "stay low" and leave immediately, but it did not explain why people should stay low. Half of the students answered this question correctly, showing that they have some previous knowledge of how to exit during a fire and how to stay low to avoid the smoke. Two students responded with the language in the last half of the first bulleted point, stating, "Leave immediately." One student said to stay low "because fire rises," perhaps confusing or combining fire and smoke into the same deadly force. The final student also understood the main concept but did not know exactly what would harm him as he replied, "It will hurt you."

The next task asked students to read the points under the topic, "How can you practice fire safety," and to explain whether they thought this information was appropriate for teenagers. They were asked whether any of the information was new to them. Three students said this was not new information and that they believed it was "too easy" or that they learned this in first grade. Two students responded that they believed the information was good for teenagers. The first student said she thought it was good because "most teenagers think it's fun to play with matches;" the other student said it was good because the information presented "good facts." One student described the picture

with the main question, revealing that the student did not click the next arrow the second time, so he possibly did not understand the navigation system. Two students left this question blank also perhaps because they did not understand the navigation system.

The next task asked students to proceed through the topic about the technique stop, drop, and roll, and to evaluate the pictures they had seen so far. A second question asked the students to explain whether they believed the pictures helped them understand the words on the website. Three students responded positively to the pictures, calling them “cool but kinda weird” and saying that they “fit along with the theme of the website.” Two students, though, responded negatively saying the pictures were “silly” and “stupid.” The remaining three students described the stop, drop, and roll technique rather than giving their opinion of the pictures. Responding to the second part of this question, half of the students believed the pictures helped them understand the words and technique while the other half of the students said the pictures only “kinda” or “not really” helped them understand. One said showing the man in the different stages of stop, drop, and roll would be better than an arrow pointing over the man while he is outstretched.

The final task asked students to return to the main menu of the 27 different topics and to click on “Home on Fire,” a topic that explains what to do if you awaken and your house is on fire. The question asked students what they should do to help others in the house. Seven students gave positive responses about specific ways they could help others escape from a fire, such as discussing and practicing an escape plan, “bang on doors” as you exit the house, “yelling fire and running out,” and calling 911. Only one student gave

an incomplete answer by only describing the picture without providing a way to help others.

The final question asked students to rank different aspects of the website on a Likert scale from 1-7, with 7 representing students' agreement with the statement and 1 representing disagreement. Table 4.13 shows the scores for each aspect. All the aspects ranked above average. Given the simple navigation system with only three options, one of the highest ranked aspects was that things were easy to find on this website. Two aspects, (1) words are easy to understand and (2) good balance of pictures and words, tied for the lowest ranking (median = 6), but even these scores were above other sites tested These rankings are complemented by the students' responses to the questions as some complained the pictures did not help them understand the concepts although they liked the number of pictures provided on the site. Overall, the students seemed to appreciate the simplicity of this site as a whole, indicating that designs mimicking the style of slide presentations—one graphic and a few bullet points—may work well because they limit the scope of information.

Table 4.13: Scores for the fire safety website of the OU Police Department

Website aspects (# of students evaluating = 8)	Likert scores on scale of 1-7	
	Median	Mean
Easy to find things	6.5	5.5
Words are easy to understand	6	5.1
Good number of pictures/graphics	6.5	5.3
Good balance of pictures and words	6	5.1
Good colors/color scheme	6.5	5.4
Overall, I like this website	7	5.3

Conclusions from Phases 1 and 2

The students' responses in the questionnaires and their evaluations of the websites were an important complement to my analysis of the nine fire safety websites. Site features that I believed they would enjoy and find easy to use proved to be silly or boring to them. However, the students rarely ranked sites on the lower side of the scale with 1-3. The vast majority of them took the task of ranking the websites seriously but they limited their scores to 4-7. Only 15 out of 75 completed worksheets had straight scores of 7 for all the aspects. Table 4.14 (located on the following page) summarizes the scores for all nine websites. The scores and the open-ended responses provided important trends in what the students understood, what information they needed, what they liked, and what features they found usable.

CODING LANGUAGE

Confirming what I suspected, several of the sites did not operate properly because their code required Flash or Shockwave plug-ins or called to Javascript actions that required too much memory or additional plug-ins. Anything coded with these attributes must have an HTML version to meet the accessibility guidelines and to render properly without requiring a deaf teenager to download additional plug-ins. The sites that performed best on the OSD computers were those with their main content and navigation coded in HTML and Cascading Style Sheets that enabled the student to enlarge the text size if they desired.[51]

[51] Two students adjusted the text size by accessing the browser's Tools menu.

Table 4.14: Summary of median scores for all nine fire safety websites

	Easy to find things	Words are easy to understand	Good number of pictures/ graphics	Good balance of pictures and words	Good colors/ color scheme	Overall, I like this website	Number of 8th-12th graders evaluating
Sparky the Fire Dog	6	5	7	6	6	5.5	8
National Fire Protection Association	4	4	5	4	6	6	7
USFA Kids	5	5	4	5	5	4	5
Staying Alive	7	7	6	4	6	6	11
Illinois Firesafe Kids	5	6.5	5	4.5	4.5	6.5	6
The Fire Avenger	4	5.5	4	5.5	6	5.5	8
Get Fire Wise	6	7	6	6	6	6	9
NY Office of Fire Prevention & Control	6	6.5	6.5	6.5	7	6.5	6
OU Police Dept	6.5	6	6.5	6	6.5	7	8

CONTENT AND STYLE

Combining the worksheet responses with my analysis of the current websites, I identified several topics that need to be included to meet the students' information needs, which were identified through the questionnaire. First, none of the current websites discusses specialized smoke alarms that use visual and tactile alert mechanisms, the very devices that could save the lives of teenagers who are deaf.[52] This lack of information means that deaf teenagers will remain unaware that customized alarms even exist, much less understand how they work, how they should be used, or where to purchase them. Furthermore, the current sites fail to offer any customized fire safety information for teenagers or children who are deaf, information that would better equip deaf teenagers with how their deafness may impact their safety before, during, and after a fire emergency. This information was explicitly and implicitly requested in the students' responses to the questionnaire. The responses also revealed an interest in how deafness impacts people working for the fire service and in more information about careers in fire service, another area that is ignored by current fire safety sites.

The current sites offer reliable and relevant information about fire prevention and how to respond during fire emergencies although several sites use fire safety jargon to describe these concepts. The sites that best explain the concepts of fire prevention and how to react in a fire emergency are USFA Kids and Get Fire Wise because they illustrate the concepts with graphics that the teens relate to and because they present the information through tips, stories, quizzes, and games. Almost all the sites explain Stop,

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[52] The lack of information on these websites about specialized smoke alarms confirms what USFA previously argued about the "dearth of information about how to obtain them [the alarms] and the prohibitive cost of such alarms (1999, 3).

Drop, and Roll, a technique that was misunderstood by three students responding to the questionnaire. The sites also explain how to create an escape plan, how to avoid starting fires, and how to escape with detailed examples and specific actions rather than with catchy phrases or the more general idea to just avoid fire altogether, again correcting misunderstandings and providing more detailed information as requested by the students on the questionnaire. Because so many students responded that they wanted more information about careers in fire service, I analyzed how the sites presented the daily activities of firefighters. Get Fire Wise is a good model for explaining these daily activities and for exploring other jobs in the fire service rather than the more restrictive information about arson dogs provided by sites like Sparky the Fire Dog® and the site sponsored by the New York OFPC.

The writing style appropriate for teenagers who are deaf is the most difficult to evaluate in this study. Given the students' rankings, two of the nine sites—Get Fire Wise, and Staying Alive—scored highly for "words are easy to understand" (median = 7). My analysis suggests that USFA Kids works well with shorter sentences and less use of long clauses or nominalizations. Only three sites, USFA Kids, Fire Safety by OU Police Department, and Get Fire Wise had lower scores according to the readability formulas, but even then, only two of these three sites had scores that were reasonable for deaf teenagers (see table 4.15 for a summary of the readability scores for all nine sites).

Table 4.15: Summary of the readability scores for all nine websites

	SMOG	Flesh-Kincaid	Average # words per sentence
Sparky the Fire Dog	8.77	7.8	16.7
National Fire Protection Association	12.61	12	17.8
USFA Kids	6.84	4.8	11.8
Staying Alive	7.99	6.3	13.1
Illinois Firesafe Kids	8.86	7.9	9.3
The Fire Avenger	10.5	7.9	12.5
Get Fire Wise	7.02	5.7	11.2
NY Office of Fire Prevention & Control	7.67	5.5	12.9
OU Police Dept	6.59	4.7	10.9

Yet the readability scores were only predictors, and each of the sites that scored well with the students clearly explained fire safety concepts and jargon with short descriptions and illustrative graphics, perhaps a better way to anticipate how well teenagers will comprehend the concepts presented. The site that scored the lowest for readability was the NFPA site targeting adults because it had so much jargon and so few graphics. Overall, writing concisely, using short sentences with subject-verb-object patterns, ensuring that keywords have ASL equivalents, and replacing longer descriptions with graphics may appeal to this audience given their lower vocabulary levels for reading English.[53]

[53] The research presented in my literature review about the vocabulary levels of students who are deaf were confirmed by the open-ended responses to the questionnaire and the guided worksheets. Multiple misspellings, inverted word order, lack of subject verb agreement, and confusion over basic fire safety

NAVIGATION AND GRAPHIC DESIGN

The design, encompassing both the navigation elements and the graphics and fonts, of the current sites worked well for half the sites. Those with consistent branding banners and use and placement of navigation menus, sites like Staying Alive and Get Fire Wise, ranked higher for aspects of making information easy to find and for overall likeability (refer to table 4.14 for summary scores). Yet sites like the New York OFPC and Sparky the Fire Dog®—offering lots of graphics or using implicit links within image maps as the main navigation elements—may rank lower for how easy it is to find information within the site because "teens don't want business sites or government sites that are made to look as if they were created by teenagers when they were not" (Nielsen & Loranger, 2006, xxiii). The overall low score for USFA Kids shows how important the first impression of the site is for this audience given that the site used a consistent navigation, but that the cartoon elements and large buttons labeled "coloring pages" immediately disinterested the teens from even exploring the site.

The rankings from the guided worksheets indicated that these teenagers, like adults, want consistent primary navigation, so they know where to click to explore more information. Also, given the students' preference for sites like Yahoo, combining icons and text for navigation elements may speed their ability to find the information they seek. The secondary navigation or subsites may have subtle changes in appearance and overall layout; however, the changes must be easy to intuit and must maintain some connection

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concepts were evident in every grade level although these markers tended to decrease in the responses from students in higher grade levels.

to the larger website so that the site's information looks like it comes from an authoritative source.

This audience prefers an enormous number of graphics, especially photographs as indicated by their questionnaire responses, to both illustrate and spread out the textual information. Sparky the Fire Dog® scored the highest of all the sites for its number of graphics, so this site works as a good model for how to integrate graphics. However, several of the students commented that many of the cartoon graphics on all the sites seemed to target a younger, more "kid," audience. Presenting sites with more photographs or with a balance of photographs and cartoons may create a tone more appropriate for this teenage audience. Video also ranked highly in the questionnaire responses, but none of the sites used captioned video or text substitutions for audio files.

Overall, combining the students' evaluations of the current sites with my analysis has shown trends that clarify the aspects that are effective; using these aspects while adding content that specifically meets the information needs students expressed in the questionnaire will create a solid foundation for the new fire safety site. This chapter has presented the results of Phases 1 and 2, providing the basic guidelines for what works and what fails on the current fire safety websites. These guidelines function as a starting point for the design plan of a new fire safety website, one specifically targeting teenagers who are deaf. The next chapter describes how I designed the new site along with the results of the students' evaluation of that site through the think-aloud interviews of the final research phase.

Chapter 5: Designing and Testing a New Fire Safety Website

"One of the things that becomes obvious as soon as you do any usability testing—whether you're testing Web sites, software, or household appliances—is the extent to which people use things all the time without understanding how they work, or with completely wrong-headed ideas about how they work. . . . Instead, we forge ahead and muddle through, making up our own vaguely plausible stories about what we're doing and why it works. . . . if people manage to muddle through so much, does it really matter whether they 'get it'? The answer is that it matters a great deal because while muddling through may work sometimes, it tends to be inefficient and error prone." (Krug 2005)

After analyzing the data from Phases 1 and 2, the results of which were explained in Chapter 4, I began designing the new fire safety website. This chapter will discuss Phase 3 of my research, which included my design plan, the problems resolved while designing, and the results of the think-aloud interviews with the students as they evaluated the new site. At the end of the chapter is a discussion of using Instant Messaging software for half of the think-aloud interviews to determine whether IM is a feasible alternative to sign language interpreters during usability tests. Throughout this chapter, I concentrate on the results of Phase 3 of my research as they relate to the following questions, and I verify some of the data presented in Chapter 4 from the earlier research phases:

- Are current fire safety websites easy for deaf teenagers to navigate, and can they find information quickly? What type of navigation (text only, icon only, or text and icon combined) works well for them? (Research Phases 2 and 3)

- Is the information found easy to understand and use for teenagers who are deaf? What fire safety vocabulary is appropriate for them? What techniques help them understand complex concepts? (Research Phases 2 and 3)
- Do current fire safety websites appeal aesthetically to teenagers who are deaf? Do they find the sites interesting and desire to use them? What aspects could be incorporated into a new fire safety website to reach this audience? (Research Phases 2 and 3)
- Is instant messaging software a viable alternative to using sign language interpreters when conducting usability tests of websites with deaf teenagers? Does IM collect the same amount, less, or more information than what is collected during communication via an interpreter? (Research Phase 3)

Design Plan for the New Fire Safety Website

My design plan consisted of the decisions I made before and while coding the new website based on the results of the first two research phases. Phase 1 elucidated the unique information needs related to fire safety and broader topics related to the fire service, such as careers and organizations. Phase 1 combined with Phase 2 showed what worked successfully on current fire safety websites and what aspects needed revision or elimination. These findings provided a framework for my design plan for the new fire safety site.[54]

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[54] Specific guidelines for web design will continue to evolve as computer, software, and browser technologies themselves evolve; however, guidelines for basic design elements—such as navigation types and placement, color schemes, font sizes and types, linking and labeling, graphic file sizes, and searching features—have remained relatively stable. See the following as the best resources: Morville and Rosenfeld's *Information Architecture* (2007, 3rd ed), Krug's *Don't Make Me Think* (2005, 2nd ed), and Nielsen and Loranger's *Prioritizing Web Usability* (2006). For a good explanation of CSS and XHTML, see Cederholm's *Bulletproof Web Design* (2008, 2nd ed).

CODING LANGUAGE

The foundation of the new site incorporates the W3C guidelines for creating fully accessible websites for people with disabilities. Although the majority of users in my target audience are able to access the internet without assistive technology devices, such as screen readers, screen enlargement software, or keyboard-based sequences, no site targeting users with a single disability should design to eliminate users with other disabilities. Also, many people with disabilities actually have multiple disabilities. Given these considerations, I chose to use only HTML and Cascading Style Sheets (CSS) for coding languages. This choice meant the interactive applications on the new site would be limited because most interactive elements are possible only through Flash, Shockwave, and Javascript coding languages.

Originally, I considered coding some elements—such as a slideshow, quiz, or short video—with Flash, but the language itself restricted internet spiders from crawling the text, meaning that none of the text would appear as keywords in search results and that the text could not run through a screen reader application. Also, the updates and plug-ins for Flash and Shockwave require larger segments of computer processor memory, and the OSD computers had none of the updates installed, which blocked several components of the current sites or made those components inoperable. However, recent developments in Flash technology and search engines now enable the first levels of code to be crawled by spiders and processed by screen readers; developers hope to make all the code levels accessible by the beginning of 2009.[55] With this in mind, I may

[55] Google and Adobe announced their collaboration to rework an algorithm that searches the SWF files created by Flash. These announcements first appeared on Google's blog (http://googleblog.blogspot.com, entry on June 30, 2008) and then through an Adobe press release (http://www.adobe.com, entry on July 1,

add some Flash components to complement the existing HTML as long as the main information and navigation elements remain coded in HTML, which will render properly with AT devices.

CONTENT AND STYLE

To create appropriate content, I started with the main fire safety messages distributed through NFPA, the messages that focus on strategies to prevent fire. Yet instead of using all the messages, I selected the categories relevant to the students' questionnaire responses. For example, because several students said their friends "play" with fireworks and because the injury rate is high for teenagers handling fireworks, I included a section on fireworks safety. Several students responded with questions or topics related to cooking safety, so I included that topic but organized the information with microwave safety as first on the page followed by stove and oven safety given that teenagers cook more with the microwave than the stove or oven and given how many snacks and foods enjoyed by teenagers can be cooked in the microwave (*The U.S. Teens Market* 2002).

I also considered how often teenagers go to public spaces to hang out, spaces like movie theaters, shopping malls, coffee shops, and concert venues, and I thought about how a teenager who is deaf could be alerted to fire in those public spaces. Realizing that many of these places lack visual alert systems, especially if they are older buildings, and that people are most likely to use only the way they entered the space to exit that space during an emergency (Perez 2007), I created a section on "public buildings" to offer tips

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2008). For detailed guidelines about making Flash accessible, see WebAIM at http://www.webaim.org/techniques/flash/.

on what teenagers who are deaf should look for and how they should plan when they enter these spaces. None of the sites tested in Phase 2 included this information. Because these tips are unusual information—more than the basic tips for preventing fire at home—I hope teenagers will read the information more closely so that it becomes second nature.

Another important part of the site includes information about specialized smoke alarms for people with hearing impairments, creating home escape plans, and understanding what to do during a fire emergency. Because of the recent research indicating that many people may not awaken with only the audible alert and the strobe light (Bruck and Thomas 2007), I wanted the site to clearly explain why people who are deaf need the higher-priced alarm with the visual and tactile alerting mechanisms. This page also includes a link to a site where people can purchase the alarms, which are not available in home improvement retail stores where most people purchase smoke alarms. Although state and city programs vary widely as to whether they provide funding for these alarms, I included reminders for people to check with their local fire department and with their state service providers, including the School for the Deaf, the Department of Human Services, and the Department of Rehabilitation. If the service provider has a smoke alarm program, I reminded people to verify that the alarm had both alerting mechanisms before agreeing to participate in the program.

Based on the numerous responses and questions from the students about how people who are deaf can work in the fire service, I included information about fire service careers, and I focused on careers in which people who are deaf would face less prejudice and find attainable. I also contacted several people who identify themselves as deaf who

also work in the fire service and included links to their blogs and news articles about them. This section of the website could be expanded to include descriptions of many fire service careers with additional links to stories about people who are deaf serving in these positions.

Finally, I added links to true stories and informational websites to give the new site credibility and to enable teenagers using the site to continue exploring information on fire safety or fire service careers. The American Burn Association has found that using true stories and photographs of "fire-related incidents involving people in this age group" work well to persuade teenagers to change their behavior (ABA, "Leaving Home"), and the students responded in the questionnaire that they wanted facts, stories, and photos on a website about fire safety. To locate relevant items, I combed news sites to find stories about teenagers and fires and stories about people who are deaf and fires. I selected stories to serve two purposes: 1) to illustrate the consequences of ignoring the safety strategies or 2) to show how following the safety strategies lead to a positive outcome by avoiding fire altogether or escaping it successfully. Then I linked to related websites with historical information, fire safety games and quizzes, fire service organizations, research in fire technology, and career information, assuming that these links would encourage teenagers to return to the site to explore for more information.

To ensure this content made sense to the target audience, I looked up keywords in *The Gallaudet Dictionary of American Sign Language* (2006) and consulted with OSD staff and an ASL interpreter. I used synonyms or removed keywords that did not have ASL equivalents (see appendix H). For example, the NFPA messages about cooking with microwaves begin by instructing people to "read the manufacturer's instructions before

using a microwave oven" But I omitted this message for three reasons: (1) *manufacturer's instructions* itself is a confusing term, (2) those instructions are seldom written in plain language, and (3) I believed a teenage audience would not find those instructions relevant or helpful. The NFPA message continues with "Open microwaved food slowly, away from the face. Hot steam escaping from a container or the food itself can cause burns." I revised the order and wording of these messages, using instead the following, "Food gets hot in the microwave. Get out food with potholders. Take off lids slowly, so you don't get burned." I emphasized the main point of the message with the "food gets hot" as the first words, and limited the details of the message. For each message, I revised sentences so that they followed a subject-verb-object pattern, and if they used any introductory clauses, those clauses were limited to three words or less. Another cooking tip from the NFPA messages illustrates how I applied these techniques. The message states, "Keep anything that can catch fire—oven mitts, wooden utensils, food packaging, towels or curtains—away from your stovetop." My revision states, "Give stove space. Move away things that can burn. No papertowels, potholders, or towels," a revision that keeps the subjects and verbs close together and that uses more concrete verbs.

After these revisions, I calculated the SMOG readability score, which was lower than the current fire safety sites, with Deaf Fire Safe scoring 5.45 (Flesh-Kincaid = 5.0) and averaging 8.1 words per sentence.[56] Overall, I used plain language guidelines, leading each paragraph with the most important information, focusing each sentence on a

[56] USFA had the best readability score with a SMOG score of 6.84, slightly higher than Deaf Fire Safe's SMOG score of 5.45, and with a Flesh-Kincaid score of 4.8, slightly lower than Deaf Fire Safe's score of 5.0.

single topic, minimizing any nominalizations or bulky clauses, and avoiding passive voice altogether.[57] Because this site is for teenagers, I used "teens" in the site's subtitle, "you" in over 95 percent of the main content, and "teenager" or "teen" for all other addresses to the audience.[58]

NAVIGATION

The navigation menu and links within paragraphs work together to allow teenagers multiple ways to access some of the same information within the site and to help them cognitively map the location of specific pieces of information. I began my navigation choices by creating a text and icon menu similar to the primary navigation used on Yahoo and MySpace, which were the most popular sites from the questionnaire responses (see figure 5.1). Most of the icons I created depicted the topic with a concrete illustration, such as a burned and black house for the category "After a Fire" and a round alarm for "Smoke Alarms." The more abstract hand holding the globe represents "Links," but the globe is a common icon for connecting the world through internet links. I assumed it conveyed the category better than chain links or other icons that sometimes represent links. This combination of text and icon has been shown most easy to use and understand for people who are deaf as the icon helps to visually clarify the text label (Fajardo et al. 2006).[59]

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[57] For detailed guidelines about writing in plain language, see the United States government site at http://www.plainlanguage.gov/, or WebAIM's documentation guidelines at http://webaim.org/teitac/wiki/Documentation~Plain_Language.php. Recently this style was adopted by the Oklahoma Department of Human Services, the office serving people who are deaf, with definitions and guidelines at http://www.okdhs.org/library/webmgmt/procguide/docs/planguage.htm.

[58] "Teenager" was the most preferred term of address (54 percent) according to the results of my questionnaire (see chapter 4).

[59] The think-aloud interview will test whether the students prefer a navigation menu with only textual labels or with an icon and the textual label, the format used by MySpace and Yahoo.

Figure 5.1: Yahoo navigation menu and Deaf Fire Safe navigation menu

Two additional graphic elements helped to define navigation elements from the rest of the text. First, I used a different color for links and underlined clickable text to distinguish it from nonclickable text; the underline, although viewed by some designers as unnecessary, is the only signal to colorblind users that a link is present. I also used thumbnail graphics next to links to news stories or other websites to signal they are links to external websites and to break up the textual chunks within each page, another common feature used on MySpace and the games and news sites the students indicated they visited according to the questionnaire. Finally, I avoided using empty phrases—such as “click here,” “click for more,” “more,” or “next”—and relied on descriptive link labels—such as “Learn more about these alarms” and “Reports about fireworks”—that help users anticipate what information will result once they click the link.

GRAPHIC DESIGN AND COLOR SCHEME

Choosing a color scheme and appropriate graphics to convey the complex concepts and to set a compelling tone was the most difficult aspect of designing the new website. I selected dark reds and full color for the icons and most of the graphics throughout the site because reds, yellows, and oranges are most associated with fire. The banner collage of graphics combines images of deafness, assistive technology, sign language, fire flames, and smoke alarms (see figure 5.2), and the collage affect mimics the designs prevalent in MySpace, a site mentioned frequently as part of the questionnaire responses. I chose black text on a white background for the main textual chunks because this color combination has the highest contrast, a contrast recommended in WCAG 2.0 (W3C Website, Guidelines 1.4.6-8).

Figure 5.2: The banner of Deaf Fire Safe

Although fire and life safety educators debate about whether to show photographs depicting burn survivors or structural damage caused by fire, I chose to include both types of photographs. The American Burn Association has found that stark photographs depicting the real consequences of fire injuries, including the long and painful series of skin grafts and disfiguration, are more convincing to college and high school students who generally believe they are invincible (ABA, “Leaving Home”). So I included a

gallery of black and white photos of two freshman students who were injured in a dormitory fire; these photos are part of a slide presentation the ABA delivers across the nation to high school and college audiences. A short sentence before the link explains that the photos show people in surgery and close-ups of their burned and scarred faces and arms. I also included a gallery of photographs of homes damaged or completely destroyed by fire as further evidence showing the consequences of unsafe behavior (see figure 5.3). Each photograph has a short caption to explain what is shown.

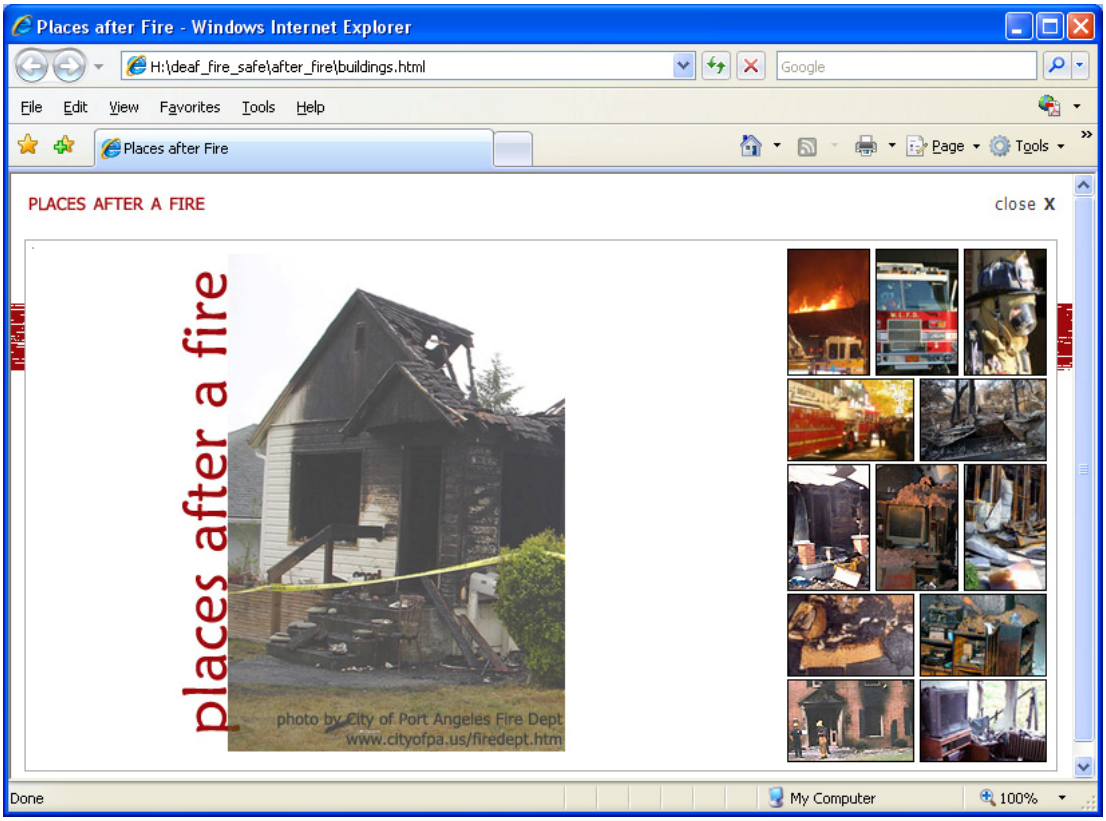

Figure 5.3: Photo gallery within Deaf Fire Safe

Finally, to balance the layout of the page, I used a dark red sidebar with large numbers to highlight the statistical information, such as the numbers of people injured or killed by fire and the numbers of fires started by various methods. This sidebar is visually balanced by the dark red navigation menu on the left side of the page. Placing the same

type of information inside the sidebar allows users to anticipate where to look on the screen for specific information or which spaces to ignore when skimming for other types of information.

Evaluating the New Site: Results of the Think-Aloud Interviews

The most important part of designing a website is testing it with the intended audience, so for my study, I conducted think-aloud interviews with 20 students selected from the pool of students who completed the first two research phases (see appendix D for the interview script and questions).[60] I selected a balance of students who identified themselves as deaf versus those identifying themselves as hard of hearing. I also ensured that half of the students used hearing aids and at least one used a cochlear implant given that other studies have shown differences in reading levels among students using different types of assistive technology and those without it (Fagan et al. 2007, Vermeulen et al. 2007). The last selection factors were gender and grade level to determine any differences that might emerge when using IM.[61] The complete demographics of the students selected for the think-aloud interviews are shown in table 5.1.

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[60] Although 20 students may sound like too small of a sample size, Jakob Nielsen (2000) claims three to five users can find 75 percent of a website's usability problems. This finding has been confirmed and recommended by Carol Barnum (2002) and Joseph Dumas (2001). Furthermore, Colleen Pettit Jones used Nielsen's guidelines for discount usability testing in 2003 to evaluate a CDC site and found them effective for revealing and correcting the site's problems.

[61] I excluded seventh-grade students because they were satisfied with the current websites available, believing them appropriate for their age group and helpful in answering their questions, and I chose more students in grades 10-12 who are the core constituency least likely to use the current fire safety websites for information, thus those more in need of a new website.

Table 5.1: Numbers of students, in each category, who completed phase 3

	8th grade	9th grade	10th grade	11th grade	12th grade	Total
Gender						
Male	2	1	1	2	2	8
Female	1	0	4	4	3	12
Race						
African American	0	0	1	4	0	5
American Indian	1	0	0	1	1	3
Caucasian	2	1	3	1	4	11
Hispanic	0	0	1	0	0	1
Identification						
Deaf	2	0	1	5	3	11
Hard of Hearing	1	1	4	1	2	9
Use of AT						
Cochlear implant	0	0	1	0	0	1
Hearing aid(s)	2	1	2	3	2	10
None	1	0	2	3	3	9
Family info						
At least one parent is deaf	2	0	0	1	1	4
At least one family member uses ASL	2	0	2	3	3	10
Total	3	1	5	6	5	20

The purpose of these interviews was two-fold: 1) to test the usability of the new site and 2) to test whether IM software is a feasible method for conducting usability testing with teenagers who are deaf. The average length of time for the interviews was 35 minutes and 52 seconds, with the longest interview lasting 51 minutes and 45 seconds and the shortest interview lasting 22 minutes and 5 seconds. To determine the feasibility of using IM versus using an ASL interpreter, I conducted ten interviews with the

interpreter—the same interpreter used during Phases 1 and 2—and the other ten interviews via AOL IM. Analysis of IM as a research tool is at the end of this chapter.

COMPREHENSION OF ALARMS AND ESCAPE MAPS

I began and concluded the interviews with two questions to determine whether these students could identify specialized smoke alarms for people with hearing impairments and to determine whether they could identify an escape map and describe its purpose (see appendix D for the complete interview script). Although some students wrote smoke alarms and escape maps as what they knew about fire safety on their questionnaires, I wanted to ensure students understood the value of the combined visual and tactile alerting mechanisms rather than believing the alarm with only the visual alert, much less an alarm with only the audible alert, was sufficient. I also wanted to ensure students not only could identify the escape map but that they could create one correctly showing two ways out.

When asked to choose from three options—each with a picture of the alarm and with a textual description of the alarm's parts—14 students said the best alarm for people who are deaf was the alarm with the vibrator and strobe light, but six students believed the alarm with only the strobe light was best; one student said the alarm with two alerting mechanisms was best, but he admitted that his house used the alarm with only the strobe light. No students chose the other option, an alarm with only an audible alert. At the end of the interview, 18 students selected the correct alarm—the alarm with two alerting mechanisms—leaving two students who selected the alarm with only the strobe light because they thought the light was bigger, thus better, than the light shown on the third alarm. The increase in students who could identify the alarm with visual and tactile alerts

as the best alarm for people who are deaf confirms that the website communicates this information appropriately.

Eighteen of the students at the beginning of the interview could identify the escape map. Two called it an "emergency plan" or "emergency map."[62] Others responded that it "showed the ways out" or "showed where when the light flashes," indicating that they understand the concepts but may not name it "escape plan" or "escape map," terms commonly used in fire safety education. Only two students did not know what the graphic represented; one of these students said the meeting place was for when people in the family needed to discuss something privately. At the end of the interview, all the students recognized the escape map and could describe its purpose, also noting that they needed to plan many ways out rather than relying on a single way. When told to pretend they were trapped in one of the rooms, each student could name the fastest way out and name other ways out if fire blocked the primary way. This finding means that the wording on the website works well to illustrate an escape map and indicate its purpose and that showing a complete escape map, labeled with the concrete term "map" instead of "plan," and listing the short steps of how to create an escape map help the teenagers think through how to make and use the map.

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[62] Because my study is focused on the students' responses to the website, not on their use of ASL, I have presented any direct quotations from the students in English translation, according to the statements of the ASL interpreter. None of the students' ASL is glossed. This decision also made it easier to combine and compare the students' responses from the two types of interview methods: those via interpreter and those via IM. The students' responses via IM are direct quotations, and I have purposely avoided correcting grammar or spelling with [*sic*] notations. I reserve the use of brackets to change the verb tense when embedding a student's response within my sentence context or when clarifying the context of the student's response, such as when he/she uses "this" or "that" to refer to something we discussed earlier in the interview.

FIRST IMPRESSIONS OF THE NEW SITE—DEAF FIRE SAFE

After briefly reviewing the purpose of the interview and asking two questions about fire safety, I encouraged students to explore Deaf Fire Safe as they wished, clicking different links while they expressed their initial impressions. They all began on the site's homepage (see figure 5.4). Most students expressed a positive attitude toward the site and subject matter. Many remarked that the site has "lots of good info" and "looks cool" even though two of them believed they knew most of the information presented on the site. One student said, "This is good. I'm glad it shows how many fires from smoking." Another student appreciated the layout change from the homepage with mainly graphics to the internal pages with the navigation menu, text, graphics, and the sidebar; she said, "That grabs your attention." She liked how the homepage gave a few choices, so teenagers were not overwhelmed with too much information, but then how they had more freedom to choose topics once inside the site with the main categories as part of a menu. Only one student expressed a negative attitude toward the subject matter, saying, "I know about fire safety since second grade."

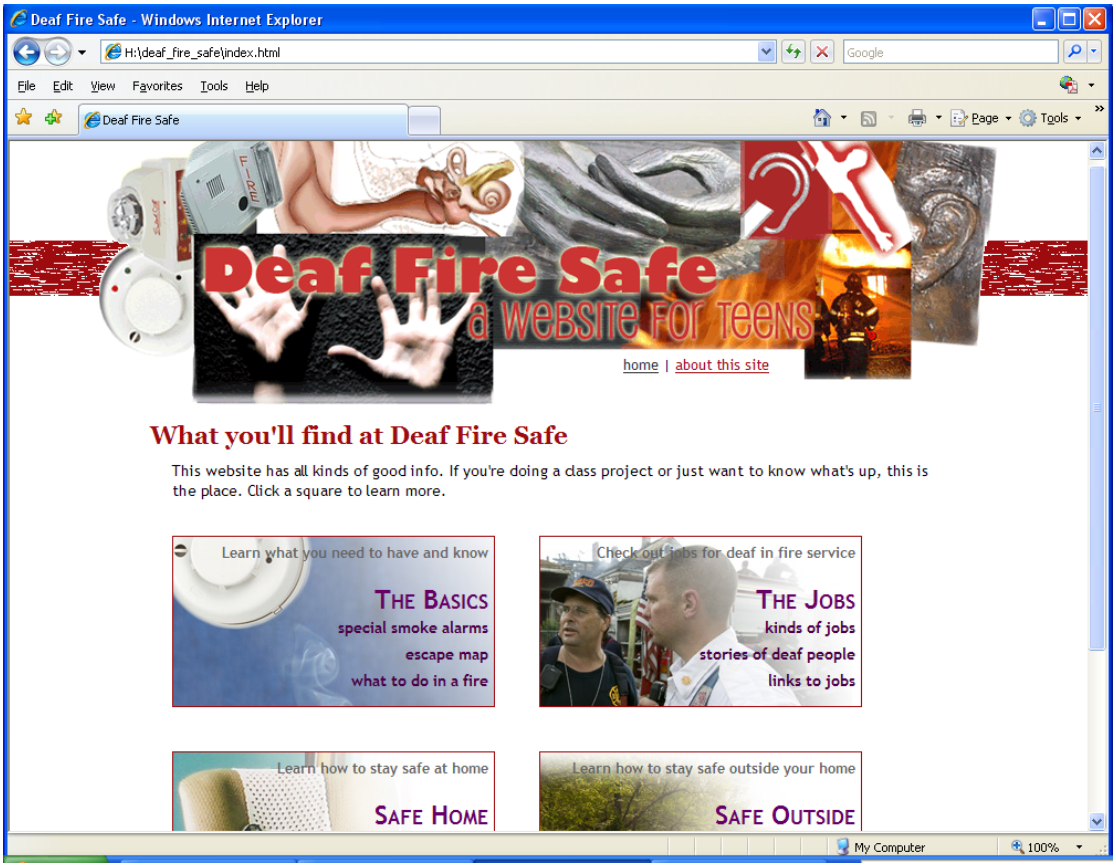

Figure 5.4: The homepage of Deaf Fire Safe

When probed for what they believed was not as effective on the site, several students responded that it needed a more interesting background or color scheme. For example, one student said the site "could be more exciting with a fire background." Another student replied, "Needs more color or idk? Maybe use yellow or orange for backgrd."[63] Another student suggested adding "more pictures of deaf people and deaf signing" to each other. The only other suggestion during the initial exploration was from a student who said she wanted games on the site. She suggested that a game focused on escaping a burning house would keep teenagers interested.

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[63] This student uses "idk" as text shorthand for "I don't know," and she uses "backgrd" to stand for "background."

Surprisingly, almost all the students explored only two sections of the site. Seven students (five males, two females) clicked the careers link on the navigation menu first and then skimmed career information and stories about those in the fire service. On this page, several clicked the links to read more about people who are deaf working in the fire service. One student commented, “I think it is hard for deaf to be a firefighter, but they still do it. It is cool to be one.” Another explained that he “didn’t know deaf could do” this, meaning be a firefighter. One girl was interested in the information about fire investigators and said she did not realize that job even existed. The other popular links students visited during their initial exploration were under the category of Safe Home with seven students reading the cooking page, four students reading the candles page, and three students reading the smoking page.

While skimming these pages, some students showed surprise, such as, “Whoa, I didn’t know that many fires happened and that many people got hurt or died!” Another student pointed to the number of deaths because of fire and signed “bad.” Several emphasized how much they liked the graphics, explaining that they could understand the graphics, that they are “really good pics,” or that they “like[d] how pictures tell what happened. Nothing bad on this [site].” A different student was motivated to keep skimming information, stating that he “want[ed] to know more so I don’t have a kitchen fire like that picture.” Only one student of the 20 interviewed seemed disinterested in surfing the site, the same student who claimed she already knew about fire safety.

CURRENT BEHAVIOR AND MOTIVATORS TO CHANGE BEHAVIOR

To determine whether Deaf Fire Safe presented relevant information, I asked students how often they or a member of their immediate family performed six activities

linked to causing fires (see table 5.2). Specifically, I wanted to know whether I should omit some of the topics on fire prevention, such as the information about campfires or about cigarettes.

Table 5.2: Frequency of completing activities linked to causing fires

(# of students responding = 20)	One time each week	One time each month	One or two times each year	Never
Light candles	12	3	4	1
Shoot fireworks	2	5	13	0
Cook with stove/oven	19	1	0	0
Cook with microwave	18	1	1	0
Go camping	1	3	11	5
Smoke cigarettes	4	0	0	16

Based on these results, much of the information, especially the cooking and candle safety information, is appropriate for the target audience even though some of the students indicated that they shot fireworks or went camping less often than lighting candles or cooking. The number of students responding that they shoot fireworks once a month or once a week was much higher than I anticipated—which may explain why several listed on the questionnaire that their friends played with fireworks—while the number responding that neither they nor any member of their immediate family smoke cigarettes is lower than anticipated. Perhaps the information on cigarettes and fire safety could be scaled down or replaced by a different topic according to the students' responses of what to add to the website or other topics given on the questionnaires.

I also wanted to know what these students believed would motivate other students like them to change their behavior so that they were more fire safe. They responded yes or no to each item, described any additional items they thought would motivate them, and then indicated which item was the most convincing for behavior change (see table 5.3).

Table 5.3: Responses of what motivates deaf teenagers to behave more safely

(# of students responding = 20)	Yes	No	Most convincing
Ways to prevent fires	13	7	0
Stories about fires and people who escaped	18	2	8
How to extinguish fires	11	9	0
How to escape fires	12	8	0
Number of fires each year	11	9	0
Number of people hurt by fire each year	15	5	1
Photos of people who survived fire/burns	19	1	10
Photos of burned homes	16	4	0

The students chose all the items as positively impacting behavior change related to fire safety, but they believed photographs of people who survived fires or were burned in fires along with true stories from these same people would be most convincing to teenagers and would motivate them to behave more safely. Both of these items are repeated throughout the new website, which contribute to the students' positive responses to the site as a whole. Three students suggested additional items that may motivate teenagers to behave safely; these items included videos of fires burning, of people telling how they escaped from fires (like news stories on television and news websites), of experts explaining why people died in fires (such as the lack of working smoke alarms to alert them or behaving unsafely), and of experts giving more information about the unusual causes of fires.[64] The student who suggested videos said more video throughout the site would make it seem more interactive and appealing.

[64] Interestingly, the idea of experts explaining causes of fires and giving more steps to prevent fire is an idea commonly articulated by fire and life safety educators. However, this information is often left out of media reports about fire. Many of the media reports focus on the damage or injuries/death caused by fires and fail to supplement the story with ways to prevent fires or reminders to check smoke alarms.

PERFORMANCE ON TASK SCENARIOS

The four task scenarios were presented in the same order and began on the homepage of Deaf Fire Safe. Once finding the information, several students pointed to it or signed it aloud. I encouraged them to summarize that information at the end of each task, so I could know whether they understood it. Nine students were able to complete all four tasks successfully. An additional six students completed at least three tasks successfully. The remaining five students completed at least two tasks successfully. But not a single factor—grade, gender, race, hearing status/identification, one deaf parent, family uses sign, or use of assistive technology—was related to how the students performed on these tasks.

The first timed task presented a scenario that the students needed to write a paper about fire beginning with the answers to two questions: "how many fires happen" and "what starts fires." Because this was the first task, I reminded them to find the answers for me on this website rather than guessing. The average length of time the students worked on this task was the longest of the four tasks (1min, 42sec), and three students gave up the search without finding any numbers or causes of fire on the website. One student provided a partial answer of what caused fires after following a link to a fire investigation site, but after I redirected him to the new site under review and then asked him to find how many fires happen, he could not find that information.

The length of time students needed to find this information was surprising because many pages and links contained information about the numbers and causes of fires. Furthermore, the numbers of fires and numbers of people injured or killed by fire are highlighted in the ride sidebar on six pages. Yet as Cooke revealed in her eye-tracking

study of navigation menus, people tend to ignore the right side of webpages, assuming that they contain advertising (2008, 188). Perhaps redesigning the sidebar as a box that changes locations and has a different color background will draw more attention to this information and help it look less like an advertisement.

The second task asked students to pretend they have graduated from school and that a friend told them they could be a fire investigator. I then asked, "What do they do?" Out of all the tasks, students completed this task the fastest (1min, 21sec). Over half of the students lost interest in this task when they scrolled far enough on the careers page to see the heading about people who are deaf working in the fire service. They began questioning whether people who are deaf could be firefighters, and several chose to read further by clicking the related links. Four of these students gave up searching for the information about fire investigators, choosing instead to follow each of the three links about people who are deaf in the fire service. Another student located the correct information about fire investigators, but she was unable to summarize that information in her own words, suggesting that the text was slightly above her comprehension level.[65] Overall, this information seems well categorized and easy to understand for most users of the target audience.

The next task encouraged students to think about moving to their own place and about what they should do to be fire safe in that new apartment, house, or dorm room. Interestingly, many students began listing ways they would ensure the space was safe, such as checking the wiring or asking whether the building had survived previous fires.

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[65] This student had much lower reading comprehension skills than the other students interviewed. I had to omit five questions from the interview script because of time constraints as her interview was more than double the average interview time.

Others said they would buy smoke alarms and extinguishers. To avoid biasing the search time for this task, I reminded students to find this information on the website and began timing their search only after they began skimming the website. Once they began searching, students found the information relatively quickly (1min, 34sec), and only one student gave up the task without locating the information. Perhaps one reason this task was easier for students is because correct answers could be found in two major categories, “Smoke Alarms” and “Escape Maps.”

The final task asked students to pretend they are going to the movies with friends and to find out what they should look for when they go inside the movie theater. This task proved the most difficult for students as the average time searching for the information was the second highest for all the tasks (1min, 41sec) and as five students gave up searching and one gave an incorrect answer. One of the five students who could not locate the information on the website actually listed several correct items before looking on the site, so it was surprising that he could not locate any of these items on the website.

As the students searched for the information, I realized they did not associate the category “Safe Outside” with going out or visiting public spaces. Even when they expanded Safe Outside on the navigation menu—revealing the three subcategories of “Public Buildings,” “Fireworks,” and “Campfires”—several students failed to click “Public Buildings,” indicating that this label, and perhaps the entire category, needs revision. In their think-after responses, some students suggested renaming this category “Going Out” or “Public Places;” they said “buildings” did not make them think of a restaurant, the movie theater, or the mall.

Watching the students complete these task scenarios and analyzing their responses of why they chose specific links or categories expands previous research with students who are deaf searching for information. The students I interviewed seemed to select a keyword or concept within the task scenario. For example, many selected "In a Fire" first, focusing on the word "fire," when looking for what causes fires or the number of fires. When looking for what to do to be fire safe in their new place, they translated this place into "home" and selected "Safe Home." When asked about fire investigators, they processed that term as a "job" and selected "Jobs." However, when their anticipated keyword could not be found in or translated as one of the navigation categories, then they resorted more to the "access-all" approach, described by Fajrado et al. (2008), rather than a targeted search for keywords or topics. A few students selected whatever they believed was the "first reasonable option" explained by Krug as "satisficing" (2005), but most clicked around somewhat unpredictably, hoping to find the information.

OVERALL OPINIONS OF DEAF FIRE SAFE

At the end of the interview, I asked each student several questions to summarize their opinions of Deaf Fire Safe and to learn what additional features they wanted available to make the site more appealing. Eleven students suggested adding the following items:

- More true stories and a way to leave comments about stories
- Videos of fires (similar to a news cast), videos of people describing how they survived or recovered from fire, and popup video of interpreters signing
- More information about fire safety in specific locations (public places such as Wal-Mart, workout facilities, and gas stations), about preparation for fire

emergencies (how and where to purchase smoke alarms and how to use bars on windows that are easy to open), and about how wildfires spread

- Games to teach how to be safe around fire (such as identifying and avoiding what behavior or items may cause fires)

Some of the information students requested was available on the site at the time of their interview; however, these comments reinforce the problems with link labels and categories revealed during the task scenarios. Students had trouble finding information about fire safety in public places and finding where they could purchase specialized smoke alarms. Clarifying some of the wording, so that it echoes that of the students' language, and adding more ways to access the information through textual links and graphics will make this information easier to find.

Every student articulated at least one specific aspect of the site that they believed was "good" or their "favorite" part of the site. Many students said they liked the information available or that the site "has lots of info," and they responded with the following as specific topics or pieces of information that they thought worked effectively:

- Ways to prevent fire in different settings, such as "ways to make you safe," how keep safe home," "campfires," and "because it gives you tips on how to react and how to control yourself, how to move" (5 responses)
- How to create an escape plan and how to exit during a fire emergency (4 responses)
- Jobs/careers in fire service, especially the information about people who are deaf serving as firefighters or fire investigators (2 responses)

- How to install and use smoke alarms, especially those with tactile and visual alerts (2 responses)
- True stories of how people cope with fire because these stories make the "fire real, like it could really happen" (2 responses)

Many students also liked the visual aspects of the site, including the colors and graphics. Six students wrote "pictures" as a good aspect of the site, explaining that they liked how the pictures "show what need to do." Other students responded with specific graphics that they liked on the site including pictures of the smoke alarm (2 responses), pictures of "how fire started" (2 responses), and the pictures in the banner at the top of each page (1 response). When shown two versions of the navigation menu—one version with text plus icons and one with only text—all but one student preferred the menu that combined text and icons. Most students explained that they liked the pictures or that the "pictures make it clear" or easier to understand. The one student who chose the menu without the icons said, "I don't like clipart." So the site's visual aspects complement the text and help this audience understand the concepts

As further indication that the students liked the new site, many responded that nothing was "bad" on the site or that they could think of nothing to add to the site. When asked about what they wished was on the site, four students responded with positive attitudes toward the current site. For example, one student said the site "looks good, has lots of information. It's pretty good. Good stories." Another said the site is "all good," and two other students said to add "nothing I like it." When asked what they would like to change about the site or what they considered "bad" on the site, eleven students said they liked the site as is, replying "everything fine" or "pretty good, nothing needed." One

student even explained why nothing should be changed on the site, typing an instant message, “no I think u should leave it the way it is. I like it, lots of info.”

Yet even with the students’ positive opinion of the site, six students provided specific aspects they believed were not effective on the site. Two said the colors needed to be changed, especially the background that they thought was too boring. One of those students suggested using “red/black with white words.” Another student said she did not like the escape part, but she could not explain what to change to make it better. She replied, “Escape map needs little more of something, it seems boring on that page.” In addition to the graphic aspects, one student said the font for the body text was too small and boring. She clarified her answer, saying that she could read it but that she thought it would be easier and faster to read if the font size were bigger. As a final suggestion about what to change or add, one student responded that he wanted more information about what to do if “you’re stuck and can’t get out. Maybe tell a story about what it’s like in a fire.” He also said that more photographs would tell that story effectively.

To verify the students’ opinions of the site, I asked whether they would tell their friends about the site. Eighteen students responded immediately and affirmatively that they would recommend this site to their friends. When asked why they would recommend it, many students replied that their friends needed this information or that they “need to know to stay safe.” One student feared that his friends “don’t know about things and people get hurt.” Another student seemed to grasp the bigger picture of fire safety education explaining that she would tell her friends “because it tells about fire and ho to prevent it so the numbers go down.” Along these lines, several students justified their

reasons of recommending the site because the site itself is “good because it helps you understand what to do” and that their friends “want to know what to do in future.” Another student said, “You can read it and understand. Know what to do.” Two students would recommend the site based on information they found on the site. One student replied that his friends “like true stories and can learn about how deaf working” while another student praised the site’s “cool facts” that she thought her friends would find helpful and interesting.

Only two students hesitated in recommending the site. The first student said, “Maybe tell them if they seemed interested. It has good stuff. Unles they already know.” He seemed to realize that his friends will only stay interested in the site if they believe the information is new or relevant to them. The other student who hesitated said, “Some of it is boring, but most okay. I’d tell friends. Better than other ones,” implying that her recommendation of this site was only because the other fire safety sites available were worse than this site. She emphasized that if the site had more video or a game that she would recommend it.

At the end of the interview, I provided one last chance for students to give me their opinions. I asked if there was “anything else” they wanted to tell me about this site. Their responses, again, echo their positive feelings about the site. For example, one student replied, “Cool, makes us more safe,” and another student said the site is “good for deaf people and helps them get more info like how they can be firefighters.” Another student praised the amount of information available while two students restated their desire for more “pictures,” especially those showing real fires and real survivors of fire.

Students also rated the new site on a Likert scale from 1-7 using the same site aspects they evaluated in Phase 2. I included one additional aspect for evaluation, "pictures are easy to understand," so there is no comparison of such aspect with the other websites tested. Table 5.4 shows the scores of each aspect. Because I tested Deaf Fire Safe without 7th graders, I have used the medians from Phase 2 that were calculated without the 7th graders' scores. Although the scores for each aspect of the new site are slightly below the best website of the nine sites tested in Phase 2, Deaf Fire Safe has more consistent high scores in every aspect than all the sites tested during Phase 2, and Deaf Fire Safe has the highest score possible for "overall, I like this website."

Table 5.4: Scores for the new website, Deaf Fire Safe

Website aspects (# of students evaluating = 20)	Likert scores for Deaf Fire Safe on scale of 1-7		Highest median score from phase 2
	Mean	Median	
Easy to find things	5	6	7 Staying Alive
Words are easy to understand	5.6	6	7 Staying Alive Get Fire Wise
Pictures are easy to understand	6.4	7	N/A
Good number of pictures/graphics	5.5	6	7 Sparky
Good balance of pictures and words	5.6	6	6.5 NY OFPC
Good colors/color scheme	5.5	6	7 NY OFPC
Overall, I like this website	6.4	7	7 OU PD

Given the positive first impressions and the extremely positive last impressions of Deaf Fire Safe, along with the median scores and overall high score, this site is clearly

more effective in meeting the needs of deaf teenagers when compared with the sites tested in Phase 2. Additionally, at least 75 percent of the students completed the task scenarios correctly, and, on average, they found the information in less than two minutes, which is well above Jakob Nielsen's averages for testing the usability of websites.[66] As a final indicator of the site's success, an overwhelming majority of students replied they would recommend Deaf Fire Safe to their friends.

Revising Deaf Fire Safe

Combining the students' qualitative evaluations with the quantitative scores shows an overall positive attitude of Deaf Fire Safe. Specifically, students appreciated the robust amount of information available on the new site compared with the sites from Phase 2, sites that targeted younger audiences. Several students were interested in the new site because they could explore career information and because the graphics helped them understand the main concepts. Furthermore, their responses indicate that real photographs of burned structures and fire survivors along with real stories are important tools when persuading teenagers to plan for fire emergencies and to practice fire safety.

CORRECTING DESIGN PROBLEMS

However, two significant design problems ensued from the testing. First, the subcategory "Public Buildings" under "Safe Outside" is confusing. Students did not understand the term nor did they relate "buildings" with information about locations like movie theaters, restaurants, and other places teenagers would visit. Because this

[66] Nielsen provides several average ratings for usability testing of websites. He argues that a website typically has eleven "catastrophes (design elements that prevent users from completing test tasks) . . . users are only able to complete 42% of the test tasks, users' average subjective rating of websites is 4.9 on a 1-7 scale" (http://www.useit.com/alertbox/980503.html).

information about what to look for in public spaces to ensure those spaces are safe and to ensure people who are deaf will be alerted in case of fire, I made a new category on the navigation menu and labeled it “Going Out,” a term suggested by some of the students. I also added links on some of the other pages about fire safety inside and outside the home, and I labeled these links “safety when going out with friends.”

After thinking more about reasons teenagers might visit this website, I decided to add two “to-do” lists. The first list has tasks to accomplish when moving into a new place. Because eight students chose “Safe Home” first when given the task about moving into their new place, I added the “to-do” list as a box on the Safe Home page. The second list has items to look for when going into a public place, and I added it to the new category Going Out.

A second design problem that involved links opening in new windows was solved more easily. Originally, I had the photos of burned buildings and fire survivors open in a new window separate from the website. This method was also used for all content that took users to a different website, such as links to news stories or websites with career information. However, when the students wanted to return to the main site, they all tried to use the browser back button, a button deactivated by the new window opening. Although the photos within Deaf Fire Safe opened in a new window with a link labeled “Close” at the top of the new window, the students still clicked the browser back button first when trying to return to the main site. I revised all links so that they replace the content in the open window rather than opening a new window, thereby retaining the site history and allowing users to click the browser back button to return to the previously-viewed page. I also revised the photograph sections within Deaf Fire Safe so that they

open within the main site instead of as new windows. These changes may mean that users will spend less time on Deaf Fire Safe as they follow links to news stories and other websites, but they will not be confused by the disabled back button or irritated by too many open windows.

Although I carefully revised the common fire safety messages and concepts to match with ASL and although I wrote them in a plain language style, some terms were problematic for these teenagers. For example, one student said he did not know the word "strobe" or what it meant; but "light" and "flashing light" were synonyms he could understand. Several students, as previously mentioned, had difficulty connecting "public buildings" with places they commonly go, such as movie theaters, restaurants, and shopping malls, but they could associate "tall building" with "apartment." As an outcome of this research, I created a list of problematic and recommended fire safety vocabulary to ensure that those in fire service organizations can word their educational materials effectively when trying to reach deaf audiences, especially deaf teenagers (see appendix H for the list of recommended vocabulary).

FUTURE ADDITIONS TO THE SITE

During the interviews, seven students told stories about their experiences with fire, either personal or through a friend. One student described a friend who was seriously burned in a car accident. Several students described starting small fires accidentally or watching a parent extinguish a fire started by a younger sibling. Another student described a fellow OSD student who survived a fire but was burned and now wears a wig. These stories confirm that this audience relates to this subject matter through stories, and they reiterate the findings of Nielsen and Loranger (2005) that teenagers like stories

with which they can identify or those they find credible. Thus, adding a feature to the website that allows users to add their own stories or to comment on the news stories may ensure the teenagers will visit the site and perhaps visit it more frequently.

Two features that will be more time consuming to add, but that were features highly recommended by the students, are videos and one or two interactive games to reinforce some of the main safety strategies. As a quick fix, I added two news videos from YouTube and plan to contact fire departments about video they may release to upload to this site. Creating a game for the site is far more difficult. I have included links to games provided on other fire safety websites, but these games are for younger audiences. Games that may be more appropriate for this audience are those guiding students through decisions related to fire safety—designing a new dorm room or apartment or evaluating a public space and determining risk factors. So creating such a game is the next major step of making this site more appealing to teenagers.

Using Instant Messaging for Usability Testing

Although the primary purpose of the think-aloud interviews was to test the effectiveness of the new website, a secondary purpose was to determine whether IM could substitute for sign language interpreters in usability testing, thereby providing a way for more people who are deaf to be involved with this process. I assumed the researcher could benefit in three ways by using IM:

1) IM produces an instant transcript of the interview, which saves the researcher time when analyzing the interview data

2) IM captures the actual words of the person who is deaf rather than those provided through the interpreter, which means the researcher may better understand how to use words and phrases familiar to people who are deaf
3) IM provides the spelling, or misspelling, of keywords that could be included as search terms for the website itself, thereby improving the odds that the site will be included within search engine results

To determine the feasibility of IM, I interviewed ten students through AOL IM. First, I will describe the students' opinions of using IM in lieu of an interpreter and their familiarity with the IM interface. Then, I will illustrate some of the problems of using IM as a testing tool.

All ten students responded positively when asked, at the conclusion of the interview, whether they liked or disliked using IM. For example, they responded, "is cool," "like," "like a lots," and "it good." One student said, "it cool and nervous," later clarifying that she did not want to "mess up" an answer or misspell words. All the students had used IM before, and several said they used it frequently through Facebook and AOL. Because of this familiarity, they rearranged the windows, lengthening or shortening the IM window and moving it to the right or left of the website window. Only one student struggled with remembering to click inside the IM window, so she could type her response; often she began typing and then realized that no text was appearing in the IM window because the website window was still active. Moving between the website window and the IM window was effortless for the majority of students.

On average, the length of time for the interviews with the interpreter was much shorter (mean = 26min, 3sec) than that for the interviews via IM (mean = 45min, 42sec).

Several factors contribute to the longer length of time. The single most important factor is that these students consider ASL their primary language, so reading and typing English is communicating in a second language.[67] Throughout the interview, they are reading questions, interpreting meaning, skimming English sentences on the website, interpreting meaning, and then providing an answer by typing English.

Another factor is the students' typing ability. The majority of students I interviewed could type with a speed that was slightly slower than the interchange of ideas via an interpreter. Three students typed much more slowly than I anticipated because they hunted and pecked for letters or typed with only one hand. One student seemed overly concerned with spelling as she often deleted everything she had typed to correct a spelling error or change a word earlier in the sentence; in fact, this student's reading and typing skills were so slow that she was unable to complete all the interview questions within the allotted interview time.[68]

To decipher the students' responses, the researcher must be familiar with ASL syntax and with text messaging (SMS) codes, which are different from TTY codes.[69] For example, most of the students used SMS codes, such as "idk" for "I don't know," "u/ur"

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[67] The most basic form of ASL syntax is expressed as topic/comment, a structure similar to subject/predicate in English syntax. Plain language works well when writing English for people who use ASL as their primary language because both languages place the focus of the topic, or the main point, toward the front of the sentence or paragraph. For more description of ASL syntax, see *The Syntax of American Sign Language* by Carol Jan Neidle (2000).

[68] The two students with the most difficulty reading and typing came from hearing parents and families who do not use sign language. But this combination of factors was also present with students who read and typed proficiently. Given the limitations of my study, I cannot make definitive conclusions about whether family demographics impact language processing.

[69] TTY is short for teletypewriter. A TTY can transmit text over telephone lines, which was the primary method of communication for people who are deaf before the proliferation of the internet (email, IM), pagers, and cell phones (SMS—text messaging and Sidekick products). Recent scholarship shows that people who are deaf, especially younger people, are relying much more heavily on IM and SMS for their primary communication (Pilling and Barrett 2008; Power, Power, and Horstmanshof 2007; Akamatsu, Mayer, and Farrelly 2006; Bowe 2002).

for “you/your,” and “l8r” for “later.” Some SMS codes are also TTY codes, including “???” for “question” or “questions” and “c” for “see” and “r” for “are.” To further complicate these conversations, some teenagers have created their own codes; one student used “buz” for “because,” and another used “tho” for “though.” Sometimes the same code can represent homonyms, such as “2” for “to,” “two,” and “too,” meaning the researcher has to rely on context to determine which word the student intends. These codes combined with frequent misspellings, missing punctuation, and ASL syntax can make the IM responses unintelligible if the researcher is unprepared. Some phrases are more easily deciphered than others. Compare the following responses:

1) Question: “What should you buy or do to be fire safe?”

   Response: “u kno the spray red thing i dont want call it”[70]

2) Question: “What would you change on this site?”

   Response: “i didn’t like it when the land get all fires”[71]

3) Question: “Will you tell your friends about this site?”

   Response: “i want my friend safe for this safe fire house i teach to friend want learn”[72]

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[70] My interpretation of this response: “You know, the red thing that sprays. I don’t know what to call it.” The student is referring to a fire extinguisher. What a researcher could gain in this response is how to word a definition of a fire extinguisher so that teenagers who are deaf would understand what it sprays. For example, a red fire extinguisher sprays a foam of different chemicals to put out a fire.

[71] My interpretation of this response: “I don’t like it when the land is all on fire.” The student is referring to the section of the website that describes how to prevent wildfires; however, this response needs a follow-up question to determine whether the student does not like some aspect of that section on the website or whether the student does not like when wildfires occur. When I asked a follow-up question, I learned that the student thought that section of the site needed more pictures illustrating how to be safe with campfires.

[72] My interpretation of this response: “I want to keep my friend safe and his house safe from fire.” The second part of the student’s response requires a follow-up question for clarification. I asked, “Do you want to teach your friends about how to stay safe?” The student responded, “yes.” I then asked, “Do you think this website can teach your friends?” The student responded, “mb if they interest.” I interpreted that response to mean that he thought his friends would learn from this website if they were interested in the topic of fire safety.

These responses show that the researcher will need more time for IM interviews because many responses will need a follow-up question to clarify the meaning of the response.

Conclusions from Phase 3

This last research phase involved designing and testing Deaf Fire Safe along with determining whether instant messaging software was a feasible method for testing websites with teenagers who are deaf. Overall, the students liked the new site and found it relevant to meeting their information needs. They rated the graphics of the site highly, and many students commented that their favorite aspect of the site was how the graphics showed them what to do and how they made the site look like it was for teenagers. The interviews showed the site's design and labels are intuitive, but they also revealed two major design flaws. Interviewing the students also led to several good suggestions for improving the site by adding more interactive features and more graphic elements.

Using IM software to conduct half of the interviews provided the first empirical data regarding how teenagers who are deaf use this communication method. Although interviews via IM require almost double the amount of time for testing, the rich data elicited through IM is well worth the time. If the researcher is knowledgeable of text message codes and prepared to decipher meaning wrapped in misspellings and missing punctuations, then IM can provide the unfiltered language of the target audience, a language important to internalize when labeling links, defining concepts, using keywords in headings, and adding search terms to the code to make the site easily retrievable through search engines. Yet the researcher must also realize that even when rephrasing some questions or attempting to clarify responses through follow-up questions, that IM can leave a gap of misunderstanding between the researcher and the responder. IM can

develop new data during usability testing; however, using this method will need more testing in the future to determine more precisely its advantages and disadvantages in lieu of sign language interpreters.

The next and final chapter offers recommendations for how to design websites for teenagers and how to test websites with teenagers. The chapter also outlines the need for future research in designing and testing accessible websites.

Chapter 6: Recommendations

"Despite all of the hurdles which have threatened to thwart their progress, deaf people have found ways to go over, under, and around the barriers of attitude and access to distinguish themselves in many fields of endeavor. Imagine how much more they could do if society did not make it so hard for them" (Marschark, Lang, and Albertini 2002, 5).

Following the research of McGovern (2005), who argues that usability tests unveil only a narrow slice of context necessary for designing and refining a website, this project has combined needs assessment, content analysis, and usability interviews to provide a rich, robust analysis of current fire safety websites and to create an effective fire safety website for teenagers who are deaf. The first research phase used a questionnaire to define the information needs, fire safety knowledge, and internet preferences of the target audience. The second phase further clarified the fire safety knowledge and internet preferences of this audience by asking the students to evaluate the current fire safety websites with guided worksheets and through my own content analysis of the same websites. After analyzing the results of these two phases, I then designed a new website, which the third research phase tested through think-aloud interviews. Along with testing the new site, the third phase tested whether IM is an effective tool for conducting usability tests.

Working through this project has allowed me to test hunches, confirm previous research, refute some findings, and most importantly, to ensure the new site is appropriate and relevant to these teenagers. As I evaluated the current sites and revised content for the new fire safety site, I maintained a list of fire safety concepts and vocabulary that

might prove difficult for deaf audiences, especially teenage audiences. To help fire and life safety educators effectively communicate with this audience, I have included recommended fire safety vocabulary for clarifying the difficult concepts and terms commonly used by the fire service (see appendix H). To conclude this research in a broader sense, I offer recommendations for designing websites that target teenagers who are deaf along with recommendations for testing websites with this audience. At the end of this chapter are suggestions for future research projects with my hope that researchers explore these avenues to further expand access to the hearing world for those who are deaf, but also to enrich the hearing world with the outlook and insight of those who are deaf.

Designing Websites for Teenagers who are Deaf

Most importantly, deaf teenagers are visual learners, and the vast majority of them are using English as their second language, which means that any site targeting them needs to emphasize illustrations over text. Every graphic should have a clear connection to its surrounding text and preferably reinforce or illustrate the concepts described in that text. To get a general feel for the design of the sites teenagers like to visit, examine the sites they listed as their favorite sites (see appendix G) and ask your target audience what sites they consider their favorites. After testing Deaf Fire Safe and evaluating current fire safety websites, I can recommend the following guidelines for websites that target teenagers who are deaf:

- Provide short, descriptive, and frequent headings.

- Use graphics to reinforce the text, to explain concepts, to set the tone, to mirror the audience, and to replace the text when possible. The balance of graphics to text should weigh heavily on the graphics' side.
- Emphasize the main point using as few words as possible. Lead with the main point in every paragraph, and try to structure sentences with the main point toward the front rather than lost in a trailing clause. In fact, omit all bulky clauses and revise that information into declarative sentences with concrete subjects and verbs.
- Find ways to integrate color and lots of it. MySpace has significantly changed what teenagers expect for layout and design on websites. When targeting this audience, consider patterns and colors for background while maintaining a readable layout with at least an 11-point font size.
- Include interactive elements as much as possible, but ensure that these elements download and start quickly. Integrate short videos or quizzes.
- Subtly changing the layout of pages is acceptable as long as the primary navigation and some branding elements remain the same. Using secondary navigation elements that unfold or expand once a primary category is activated create interest when clicking through the pages. Changing the page layout so that a graphic dominates the text area and then reverting to a more textual layout works well to hold this audience's attention.

Testing Websites with Teenagers who are Deaf

Perhaps because I interviewed the teenagers on campus, they thought of the interview more as a school activity, another forced requirement within their class

schedule. Many walked into the interview room with concerned looks on their faces. They seemed relieved, though, when I explained how they could suspend the interview at any time and when we began to chat via the interpreter and IM. These first few minutes of the interview are important to gaining the teenager's trust and respect; they will not automatically begin the interview with the positive or helpful attitudes that seem more common with adult interviewees. Learning from this experience, I can offer the following recommendations to other researchers who want to interview deaf teenagers via interpreters, and especially via IM:

- Ensure plenty of time for each interview and know which questions to omit if time runs short. With this project, students were able to complete four task scenarios, answer approximately 15 questions, and complete a form with two multi-part questions (frequency of action table and Likert rating of seven aspects).
- Brainstorm potential follow-up questions to the main questions, synonyms for keywords, and ways to rephrase the main questions before the interview. Review this list several times before the interviews, so the information is second nature.
- Be prepared for responses full of misspellings and lacking all punctuation. Some teenagers who are deaf may know how to write grammatically correct sentences, but they omit punctuation and fail to type exact sentences because they view IM as an informal communication method.
- Review text messaging codes and be prepared for teenage slang. Know these codes and terms ahead of time, so you can interpret their responses appropriately.
- Although adults would either leave the interview or politely answer questions if they are having a bad day, teenagers tend to express their attitudes openly,

sometimes seeming hostile to the interviewer/researcher. Take it all in stride and know these teenagers will still provide helpful and important feedback.

Given its small samples sizes, my study is more appropriately viewed as opening a door to new avenues of research and to reassuring researchers that deaf teenagers are a population deserving more study. Yet my study offers not only data justifying using IM as a new tool for conducting usability studies, but also confirming the findings from the few studies that have explored what teenagers prefer when surfing the internet. Teenagers should not be lumped together with children for website studies because they have different information needs and expectations. Neither should teenagers be excluded merely because researchers have a slightly less complex process recruiting and gaining consent from adults. Web designers will miss opportunities to educate and advertise to a significantly large population if they continue to design with their hypothetical visions of teens rather than empirically testing both design and content with this audience. But the same is true for all deaf audiences, not only teenagers, who turn to the web for information and access to shopping, perhaps even more frequently than hearing audiences, because the internet offers a space where everyone communicates through the same medium of text and graphics. And deaf people deserve websites that strive for universal design, a design philosophy that strives to create the best space for every potential site visitor.

Future Research

With universal design as a goal, it is important to more accurately understand how deaf people use websites, what they need or want and what aspects they find inaccessible. But current trends in collecting and reporting statistics related to the Deaf community are

lacking, which means researchers may have difficulty proving the need to customize website design or content for this audience. Therefore, my study can lead to future research in three areas: website accessibility for deaf audiences, instant message software as a research tool, and better methods for collecting and reporting statistics related to the Deaf community.

First, researchers need to explore several issues connected to website accessibility for people who are deaf, and as a subset, teenagers who are deaf. Although plain language is recommended for communicating with this audience, we still lack empirical data to support many of the attributes of such a style. Redish (2000) articulates that text written in plain language allows people to "find what they need, understand what they find, and use what they understand appropriately" (163). Plain language does not "dumb down" the concepts. But researchers must remember that a text written at a specific grade-level, earning a certain score from readability formulas, is only predicted to be readable for people who have that grade-level of education; these readability scores are not guarantees, so materials must be tested with the intended audience.

Researchers should also explore how people who are deaf use websites, specifically what features appeal to them and how they navigate through websites with complex information or large numbers of topics. For example, working with Cooke's study using eye-tracking software to determine how people respond to navigation menus (2008), researchers could test different types of menus and placement of those menus with deaf people to see if their visual expectations are similar. Using Livingstone's study of how teenagers use and respond to websites motivating their civic engagement (2007), researchers could test how deaf teenagers respond to these same websites. Are they more

or less motivated by interactive options on these sites? Do they search for information on these sites with the same methods of hearing teenagers? Much of the current research focusing on information retrieval and searching methods could be easily augmented to include deaf audiences.

Yet researchers may not have ties to the Deaf community, or they may believe it will be too costly to recruit deaf participants because of the additional costs of interpreters and the costs of finding deaf participants. Hopefully, my study shows that instant messaging software may be an inexpensive way to include more deaf people in usability studies. But this method needs more testing with both teenage and adult populations. Linguistic methodologies may be helpful in this area to analyze the data of interviews via interpreters versus those via IM and to determine whether IM encourages or prevents a richer discussion of the elements being tested. Other avenues of research include testing whether adults and teenagers without hearing impairments prefer to use IM to communicate during usability studies. What types of information does IM capture that may not be captured in the verbal exchanges of the interview? Does IM cognitively disrupt how people process the item being tested as they move from manipulating the test item to typing their answer in IM? Answering these questions could open a new way for researchers to capture reliable data.

In general, we need better statistics tracking deaf people in three areas: statistics showing the number of people who are deaf and those who use ASL, statistics measuring the reading comprehension of deaf adults and teenagers, and statistics related to causes of deaths and injuries. We have recognized the Deaf community as a population with unique characteristics, but we have little accurate data about this population. Specifically, how

many people in the United States are deaf or hard of hearing? Various surveys—including the National Health Interview, the National Health and Nutrition Examination Survey, the Survey of Income and Program Participation, the American Community Survey, and the Current Population Survey—attempt to collect data on the numbers of people who are deaf and those who are hard of hearing, but these vary in how they define deafness and whether it is an audiological condition or a social label or both (Mitchell 2005). How many of those people use ASL versus other methods of communication, information called for by Mitchell et al. in 2006? How many attend residential schools versus those who are mainstreamed in private and public schools? The last analysis of how deaf students performed on a standard achievement test was by Traxler in 2000, a source often cited when reporting that average deaf teen graduates high school with a fourth-grade reading level. But has this trend changed? Finally, given the problems in defining deafness on the surveys attempting to quantify how many people have hearing losses in the U.S., we have additional problems regarding the injury and mortality statistics, as explained in the beginning of my study when I outlined the various reporting mechanisms of the fire service. Without accurate representations of the numbers of deaf people who are injured or killed by different means, it is difficult to justify educational outreach and funding for special programs in these areas.

Conclusion

I began this study with a rich background in web design and informal usability testing. When I accepted the job working on the grant projects implemented by Fire Protection Publications and ABLE Tech, I had no idea my design background would later position me as someone capable of creating a customized fire safety website for deaf

teenagers. Before this study began, my experience working with people who are deaf was limited and involved mainly one-on-one exchanges. Immersing myself in Deaf culture and working on site at the Oklahoma School for the Deaf was intimidating at first, an emotion that deaf people must feel often as they step into environments that cater to hearing individuals. My fears subsided as I learned better ways to communicate and as the teachers and students began to recognize me and call me the fire lady.

This research process has confirmed my initial beliefs that we can learn much from one another if we can only overcome the initial fears and failures that seem to divide us. It is the very nature of this bridge-building that enables designers and audiences to collaborate and eventually produce the most effective design, a design that facilitates understanding and that encourages further collaboration. This principle applies to improving assistive technology devices that enable each of us to access information, to contribute our ideas, and to live independently and safely. For example, while I conducted this research, Silent Call changed the design of its smoke alarm, shrinking the size of the test button to 1.5mm in diameter and putting it at the bottom of a 2cm narrow shaft. The shaft is so narrow that the average screwdriver is too thick to fit. To test the alarm, people have to unfold a paperclip and stick it into the shaft to press the test button. Does this design seem intuitive, and is it likely to encourage deaf people to test their alarms regularly? No, but it illustrates why the intended users must always be involved in the design process. As researchers, we must not ignore poor design or allow assumptions about design to prevail; instead, we must continue to search for new avenues that will enable us to facilitate universal design.

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Appendices

A. IRB Materials

B. Questionnaire

C. Guided Worksheets

D. Interview Script and Questions

E. Questionnaire Codebook and Sheet

F. Website Codebook and Sheet

G. Students' Favorite Websites

A. IRB Materials

Original IRB Approval Letter (4/13/07)

IRB Approval of Modification/Continuation (3/17/08)

Parent Consent Form

Student Assent Form

Oklahoma State University Institutional Review Board

Date:	Friday, April 13, 2007
IRB Application No	AS0722
Proposal Title:	Creating Accessible Websites: Developing a Fire Safety Website for Teenagers Who Are Deaf or Hard of Hearing
Reviewed and Processed as:	Expedited (Spec Pop)

Status Recommended by Reviewer(s): Approved **Protocol Expires: 4/12/2008**

Principal Investigator(s

Lacy Landrum
Seretean Wellness Center
Stillwater, OK 74078

Linda Jaco
103 S. Wellness Center
Stillwater, OK 74078

Nancy Trench
216 Fire Prot. Pub. Bldg.
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C. Jacobs, Chair
Institutional Review Board

Oklahoma State University Institutional Review Board

Date:	Monday, March 17, 2008	**Protocol Expires:**	**3/16/2009**
IRB Application No:	AS0722		
Proposal Title:	Creating Accessible Websites: Developing a Fire Safety Website for Teenagers Who Are Deaf or Hard of Hearing		
Reviewed and Processed as:	**Modification/Continuation**		

Status Recommended by Reviewer(s) **Approved**

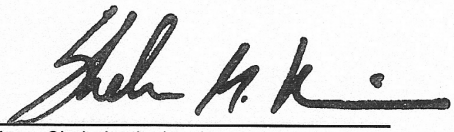
Principal Investigator(s) :

Lacy Landrum
215 E. Thomas St., Apt. B
Hammond, LA 70401

Thomas Warren
205 Morrill
Stillwater, OK 74078

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modifications to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

Signature 

Shelia Kennison, Chair, Institutional Review Board

Monday, March 17, 2008
Date

PARENT/GUARDIAN CONSENT FORM

PROJECT Building a Fire Safety Website for Teenagers who are Deaf or Hard of Hearing

INVESTIGATORS

Lacy Landrum, MA	Thomas Warren, PhD
Main Researcher	Adviser
PhD Student	Professor of Technical Writing

PURPOSE

This study will look at how teenagers who are deaf or hard of hearing use websites and if they understand the content presented. I would like to work with teenagers (grades 7-12) to learn their questions about fire safety, their words for finding that information on the internet, and how they click through fire safety websites. By the end, we will create a special fire safety website for teenagers who are deaf or hard of hearing.

PROCEDURES

If you agree, and if your teenager agrees, the teenagers will do 3 things:

1. **Complete a Survey**
   The survey asks questions about how your teenager uses the Internet and his/her favorite websites. The survey also asks questions about fire safety and what words they would use to find fire safety websites. The survey also asks questions about whether your teenager uses hearing aids or a cochlear implant, and about the parent's hearing status and use of signing in the home. This activity will last approximately 15 minutes.
2. **Look at Fire Safety Websites**
   The teenagers with work in groups of 2-3 to look at 3-4 fire safety websites. They will have questions to answer about the websites. The questions will ask their opinion about the websites to see if they can understand the information, if they can follow how to click around the website, and if they like the pictures and activities presented. All of this information will help us build a new website about fire safety. This activity will last approximately 40 minutes.
3. **Be Interviewed to Test the New Website**
   After the new website is created, 20 teenagers will be given some tasks within a 45-minute interview. During the interview, we will ask your teenager to look at the new fire safety website and evaluate the words and pictures presented. The tasks range from finding specific information within the website to summarizing the information found. After the interview, each teenager will complete a short quiz to see what he/she learned about fire safety. The interview and quiz will last approximately 50 minutes.

RISKS

The computer will be set up so that the teenager can only see the fire safety websites. But, the teenager may see pictures of fire or read words about fire burns or death. The purpose of each website is to help children and teenagers understand how to be fire safe. The school counselor will help if your teenager feels afraid or worried.

BENEFITS

Your teenager will know how to stay fire safe and what to do if there is a fire.

Over →

CONFIDENTIALITY

All audio- and video-recordings will be viewed and stored digitally on a computer. No one can use this computer except the main researcher, Lacy Landrum. The computer is password protected; the folder holding the files requires a second password; and the computer will not be connected to the Internet while Lacy works with the recordings. A fake name will be used for your teenager so that no one knows what he/she said in the interview or on the survey.

The recordings will be deleted entirely by August 2008. If you agree to the photo/video release, some of the video or stills (photographs) from the video-recordings will be used in Lacy's dissertation research and may be used in professional presentations, journal or book publications. But the fake names will be used to keep your teenager's identity secret. The OSU IRB has the authority to inspect consent records and data files to assure compliance with approved procedures.

The researchers will keep your teenager's responses and records confidential except under specific conditions required by law. For example, current Oklahoma law requires that any ongoing child abuse (including sexual abuse, physical abuse, and neglect) of a minor must be reported to state officials. Also, if your teenager reports that he/she intends to harm him/herself or others, we will report that information to the school counselor. Finally, if a court subpoenas any materials from our study, we will give the court the materials that the subpoena describes.

COMPENSATION

No compensation will be given to the teenagers for this study.

CONTACTS

If you or your teenager has any questions about the research and/or participant rights during the research process, please contact the principal researcher, Lacy Landrum; 215 E Thomas St, Apt B; Hammond, LA 70401; 985.687.9232; lacylandrum@okstate.edu. For information on subjects' rights, contact Dr. Sue Jacobs, IRB Chair; 219 Cordell North; Stillwater, OK 74078; 405.744.1676; or irb@okstate.edu.

VIDEO/PHOTO RELEASE

We would like to video-record the interviews to make sure we remember the teenager's sign language and facial expressions correctly. We would also like to use some videos of the teenagers on the new fire safety website. You may allow your teenager to participate in some of the 3 options or in none of the options. Mark the box next to the option(s) that you agree to. If you do not agree to the option, leave the box empty.

- ☐ **My Teenager Can Be Audio- and Video-recorded during the Interview**
  We would like to audio- and video-recorded the interview to capture any sign, facial expressions, or pointing that your teenager may do during the interview when looking at the websites. These videos would be used only to make sure we know exactly what your teenager communicated during the interview. The videos will be erased by August 2008.

- ☐ **My Teenager Can Be Video-recorded when Signing the Fire Safety Messages**
  We would like to use 4-5 teenagers to sign the main fire safety messages. Then we would like to put these videos on the new fire safety website. All videos we do not use will be erased by August 2008.

☐ **My Teenager Can Have "Stills" or Photographs Taken of Him/Her**
We would like to take "stills" or photographs of your teenager while he/she looks at the new website. These photographs may be used on the new fire safety website, as part of professional presentations, and/or as part of professional articles or books. All photographs we do not use will be erased by August 2008.

If you agree that your teenager can be photographed or video-recorded during the activities, then you are also agreeing to give up any right to inspect or approve the completed stills or website, which may include photographs or ASL videos of your teenager, and which may be used now or in the future, whether that use is known to you or unknown. You also agree to give up any right to money or other compensation related to the use of the photograph.

Finally, you are agreeing to release, defend, and hold harmless Oklahoma State University and its agents or employees, including any firm publishing and/or distributing the finished product or products in whole or in part, whether on paper or via electronic media, from and against any claims, damages or liability arising from or related to the use of photographs, including but not limited to any misuse, distortion, blurring, alteration, optical illusion or use in composite form, with intentionally or otherwise, that may occur or be produced in taking, processing, reduction, or production of the finished product, its publication or distribution.

PARTICIPANT RIGHTS

All participation in this study is voluntary. You or your teenager may stop participating or refuse to answer a question at any point during the interview or survey. This action will not result in any penalty to you or your teenager.

SIGNATURES

I have read and fully understand this consent form. I understand what my teenager might be asked to evaluate and agree that he/she may examine the fire safety websites. As parent/guardian, I authorize

_____[name] to participate in the described research.

_____	_____
Parent/Guardian Name [printed]	Area Code + Phone Number
_____	_____
Signature of Parent/Guardian	Date

I certify that I have personally explained this document before requesting that the participant's parent/guardian sign it.

_____	_____
Signature of Researcher	Date

STUDENT ASSENT FORM

PROJECT TITLE Building a Fire Safety Website for Teenagers who are Deaf or Hard of Hearing

INVESTIGATORS

Lacy Landrum, MA	Thomas Warren, PhD
Principal Researcher	Chair of Dissertation Committee/Advisor
PhD Student	Professor of Technical Writing

We are doing a study to learn how to create websites that talk about fire safety. We are asking you to help because we want to know what you think about the websites already out there. We also want to see if these websites answer your questions about fire safety and if they make the information easy to understand and follow.

If you agree to be in our study, we are going to ask you to do 3 things.

1. **Complete a survey** with some questions about fire safety and about websites. We want to know what you want to see and use on these websites. There are also some questions about if you use hearing aids or a cochlear implant, if your parent(s) are hearing, and if your family signs at home.
2. **Look at 3-4 fire safety websites**. This will be done with 1-2 other students from your school in the computer room. We will ask you questions about fire safety websites and ask you to find different things on those websites. We will also want you to tell us your opinion of the websites and what you think works well, what might be confusing, or what might be weird or stupid. This will let us know what to put in our new fire safety website.
3. **Test the new fire safety website**. This will be done by yourself with one person asking you questions about the new website. We will also ask you to find different things on the website. We will want your opinion of it. After the interview, we will ask you to take a short quiz to see what you learned about fire safety. But remember, the quiz is not graded.

   During the interview, we may be audio- and video-recording, if you and your parent say that is okay. The camera will focus on your face and hands. That way we can see how you reacted when working with the new website. But we will not share the recording with anyone unless you and your parent say it is okay to share it on the new website, at professional conferences, or in professional books or articles. All recordings will be erased by August 2008.

You can ask questions about this study at any time. If you decide at any time not to finish, you can ask us to stop. The questions we will ask are only about what you think. There is no right or wrong answer because this is not a test. Your teacher is not grading you. When we are finished with this study, we will write a report about what we learned. This report will not include your name or that you were in the study.

If you sign this paper, it means that you have read this and that you want to be in the study. If you do not want to be in the study, do not sign this paper. Being in the study is up to you, and no one will be upset if you do not sign this paper or if you change your mind later.

Your signature _____ Date _____

Phone or email address _____ (mark if cell or TTY)

B. Questionnaire

The questionnaire has been scanned to preserve the formatting used. The scan is 85 percent of the size distributed to students.

Name: _____

Questions on Fire Safety & Websites

Thank you for answering the questions. Your answers will stay secret, even from your parents and teachers. Your answers will be used to build a new fire safety website for teenagers who are deaf or hard of hearing. If you do not want to answer a question, pick "No answer" or leave it blank.

Your Opinions and Questions

1. If you had a question about fire safety, what would you do? **Circle 1 answer**.
    a. Ask a friend
    b. Go to internet
    c. Go to a library
    d. Ask a parent
    e. Ask a teacher
    f. Ask a firefighter
    g. No answer

2. List **3** things you know about fire or how to stay safe from fire.
    1.
    2.
    3.

3. What questions do you have about fire safety or firefighting, or what do you want to know more about?

Your Use and Opinions of Websites

4. How often do you use the internet to email or look at websites? **Circle 1 answer**.
    a. Many times a day
    b. 1 time a day
    c. 1 time every 3-5 days
    d. 1 time a week
    e. 1 time every 2-3 weeks
    f. No answer

5. How often do you Instant Message (IM)? **Circle 1 answer**.
    1. Many times a day
    2. 1 time a day
    3. 1 time every 3-5 days
    4. 1 time a week
    5. 1 time every 2-3 weeks
    6. No answer

6. List **3** of your **favorite websites** and **why** they are your favorites (youtube.com—easy to find things).

   1.

   2.

   3.

7. Your teacher assigned a paper about fire safety. You want to use information from the internet. How will you search for a good website? **Circle 1 answer**.
   a. MSN
   b. Google
   c. AOL
   d. Ask (Ask Jeeves)
   e. Yahoo
   f. Other: _____
   g. No answer

8. What words will you type in the search box to find a good website about fire safety? Write the **first 3 words or sets of words** you think of.

   1.

   2.

   3.

9. If you were going to make a website for teenagers about fire safety, what would you put on it? **Circle all that you want.**
   a. Games
   b. Facts about fires, firefighting, fire safety
   c. Photographs of fires, firefighting, fire safety
   d. Video with captions showing fire safety
   e. ASL videos
   f. Stories from people who have been in fires
   g. Screensavers
   h. Quizzes about fire safety
   i. Posters about fire safety
   j. Other: _____
   k. No answer

10. When websites are for you, how should they name you? **Circle 1 answer**.
    a. Kid
    b. Youth
    c. Child
    d. Adolescent
    e. Teenager
    f. Young person
    g. No answer

Information about You—mark 1 in each list

Grade
- ☐ 7th
- ☐ 8th
- ☐ 9th
- ☐ 10th
- ☐ 11th
- ☐ 12th

Gender
- ☐ Female
- ☐ Male

Race
- ☐ American Indian (Native American)
- ☐ Asian
- ☐ Black (African American)
- ☐ Hispanic
- ☐ White (Caucasian)

Are you...
- ☐ Deaf
- ☐ Hard of Hearing

Is 1 of your parents deaf?
- ☐ Yes
- ☐ No

Does your family sign?
- ☐ Yes
- ☐ No

Do you wear a hearing aid?
- ☐ Yes
- ☐ No

Do you have a cochlear implant?
- ☐ Yes
- ☐ No

C. Guided Worksheets

The layout of these worksheets has been modified to fit within the printing guidelines for this dissertation.

Sparky the Fire Dog

National Fire Protection Association

Staying Alive

New York State, Department of State: Fire Safety

The Fire Avenger

Get Fire Wise

USFA Kids

University of Oklahoma Police Department: Fire Safety

Illinois Firesafe Kids

1. Go to http://www.sparky.org/ **Sparky the Fire Dog (NFPA)**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. Click "Fun with Firetrucks". Then click "Fire Truck Exploration". In your own words, what is the apparatus cab?

4. Go back to the main home page [www.sparky.org]. Click "Sparky's Arcade Games". On the left, click "Sparky's Arcade Games" again. Play the Fire Drill Challenge. What do you think of this game? Did you find it easy or hard? Why?

5. Go to http://www.sparky.org/safety_tips.html Read through the paragraphs marked 1-4. Is any of this information new to you? Which numbers?

6. Rate the Sparky the Dog website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.nfpa.org **National Fire Protection Association**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. In the Search box, type "seasonal safety" and click "Go". Click the first link on the search results. It should take you to a page called "Seasonal safety". Click "Winter/holiday safety". Read the facts and figures quickly. Which of these is the most interesting or surprising to you? Why?

4. Use the back button to go back to Seasonal safety. Look at the 6 topics listed. Write down which ones of these are good for teenagers to know. Why do teenagers need to know this?

5. Click "Fireworks". Scroll down the page quickly. What do you like or not like about this page? List any words that you think are confusing.

6. Rate the National Fire Protection Association website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.stayingalive.ca/kids_zone.html **Staying Alive**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. On the 3rd row, click "Mrs. Aboutfire". Read this page fast. What does fire need to keep burning? What happens if you take out 1 of the things?

4. Click "Games & Activities". Do any of the games look fun to you? Would you like to do any of them? Why or why not?

5. Click "Flip the Fire Monkey". Look at tip #4. Use your own words to write what it means.

6. Rate the Staying Alive website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.dos.state.ny.us/kidsroom/firesafe/firesafe.html **Fire Safety**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. On the left, click "Fire Lessons". Then click "Escape Rules in a Fire". Do not print out the pictures. Just read them. How do you test the door?

4. Use the back button to click back to the homepage with Hershey's picture. On the left, click "Arson Dogs". Read this page fast. In your own words, what do arson dogs do?

5. Click "Fire Lessons". Then click "Operation EDITH". Read all 6 steps. Does your family have an EDITH plan? Where is your meeting place?

6. Rate the Fire Safety website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://167.193.82.12/ **The Fire Avenger**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. Click "Tips". Then click "Learn how to be prepared in case a fire starts at night". What is a smoke detector?

4. Use the back button to click back to Tips. Then click "If your clothes catch on fire STOP, DROP, and ROLL!" What do you think about the pictures?

5. Click back to the main home page with "Hi Kids!" at the top. Then click "Fun for Kids". Click "Coloring Pages". Do you think this website is good for teenagers? Why or why not?

6. Rate The Fire Avenger website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.firekills.gov.uk/seniors/index.htm **Get Fire Wise**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. Under Cool + Safe (bottom, left), click "How fires start". Read this page. Then take the quiz. Do you like the quiz? Why or why not?

4. On the left, click "Get out, stay out, call out". Read this page fast. At the end of this page, click the picture "Joe Calls 999". [999 is what they call in England. In US, we call 911] What do you think about this story? Is it easy to understand? Why or why not?

5. On the top right, click "Fun Zone". Play the first game, "Danger Spots". What is your opinion of this game? Did you find it easy or hard? Why?

6. Rate the Get Fire Wise website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.usfa.dhs.gov/kids/flash.shtm **USFA Kids**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. Under Learn About, click "Smoke Alarms". How do you clean smoke alarms? Take the quiz. What score did you get?

4. Under Fun & Games, click "Hazard House". Read the tips as you click on the hazards. What should you do with candles?

5. Under Learn About, click "Escaping from Fire". Read the text until you learn about escape plans. In your own words, what is an escape plan?

6. Rate the USFA Kids website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.ou.edu/oupd/kidsafe/fire.htm **Do you know what to do?**

2. Click the "Next" arrow and read the list of things "In case of fire". Why should you stay low in a fire?

3. Click the "Next" arrow and read how you can practice fire safety. Do you think these are good things for a teenager to know? Why or why not? Is anything new to you—you did not know it before?

4. Click the "Next" arrow and read what to do if clothes catch on fire. What do you think about the pictures on this website? Are they cool, weird, or silly? Why? Do they help you understand the words? Why or why not?
Opinion:

Help you understand?

5. Click "Stop". Then click "Menu". Click "Home on Fire" (middle of table) and read what if you wake up and your house is on fire. What should you do to help others in the house?

6. Rate the Do you know what to do? website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

1. Go to http://www.state.il.us/kids/fire/ **Illinois Firesafe Kids**

2. What is your first opinion of this website? What is good about it? What is bad about it?
First Opinion:

Good	**Bad**
1.	1.
2.	2.

3. Click "House of Hazards". In the room with the TV, click the plug with the cords going in. What is an "overloaded outlet"? Use your own words to write what it means.

4. At the bottom of the page, click "Firefighter". Click on pieces of the firefighter picture to learn about the equipment. Would you like to know more? Why or why not?

5. Do you think this website is good for teenagers? Why or why not?

6. Rate the Children's Fire Safety Tips website on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

D. Interview Script and Questions

The following script and interview questions were used with each student; however, some questions were rephrased when the student did not understand the question. Follow-up questions were also used that are not included in this script. After the interview questions, students were asked to complete the post-test form with two additional questions.

Script

Usability Tasks

Post-test

Script

Hi. Thanks for coming. Today we are going to look at a new website. I want you to find some things on the website and to tell me what you think about the website. Tell me the truth. What you tell me is secret. But it will help make the website good. If you do not want to answer a question or want to stop, just tell me. I am going to record your face and hands, so we can make sure we have your ideas right. But no one sees this video except me. Any questions?

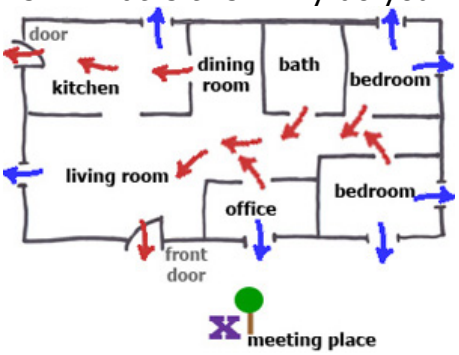
Usability Tasks

1. Show smoke alarm options.


Ask: What smoke alarm is good for people who are deaf? Why?

_____alarm _____alarm/strobe _____alarm/strobe/shaker

2. Show escape map.
Ask: What is this? Why do you need it? Or what does it do?



3. Click on some links. What are your first ideas of website: good/bad?

4. You have to write a paper about fire. You want know: How many fires happen? What starts fires? Where will you look on this website?

5. You're graduating from school. Your friend said you could be a fire investigator. What do they do?

6. You're moving to your own place. What should you do to be fire safe?

7. Would _____ make you want to be more fire safe? Yes or No?

Y	N	Ways to not start fires
Y	N	Stories about fires and people who got out of fire
Y	N	How to put out fires
Y	N	How to get out of fires
Y	N	Number of fires each year
Y	N	Number of people hurt by fire
Y	N	Photos of people who got out of fire
Y	N	Photos of burned homes

Is there anything else that would make you want to be more fire safe?

Which one convinces you the most to be fire safe?

8. You're going to see a movie with your friends. What should you look for when you go in the movie place?

9. Show menu with icons and menu without icons.
Ask: Which one do you like best? Why?

10. What do you wish was on this website?

11. What do you like on this website?

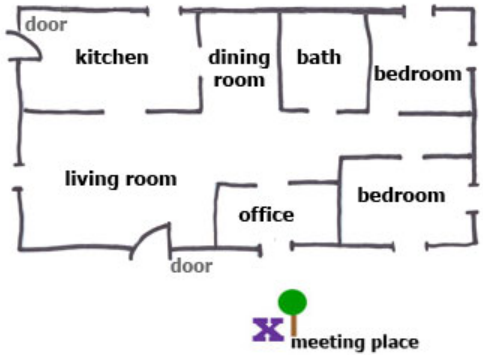
12. What do you NOT like on this website?

13. Would you tell your friends about this website? Why or why not?

14. Show smoke alarm options. (same pictures as #1)
Ask: What smoke alarm is good for people who are deaf? Why?

_____alarm _____alarm/strobe _____alarm/strobe/shaker

15. Show escape map with no arrows.
Ask: How many ways out should you draw on this map? What is the fastest way out? What if fire blocked ___? Where would you go then?



16. Is there anything else you'd like to tell me about this website?

Thank you for helping me today. I have two more questions on this paper that I need you to mark. Please ask if you have questions. [give student post-test]

Interview Post-test

How often do you or your family: (Mark 1 in each row)

	1 time each WEEK	1 time each MONTH	1-2 times each YEAR	NEVER
Light candles				
Shoot fireworks				
Cook with stove/oven				
Cook with microwave				
Go camping				
Smoke cigarettes				

Rate Deaf Fire Safe on a scale of 1-7:

	Disagree						Agree
Easy to find things	1	2	3	4	5	6	7
Words are easy to understand	1	2	3	4	5	6	7
Pictures are easy to understand	1	2	3	4	5	6	7
Good number of pictures/graphics	1	2	3	4	5	6	7
Good balance of pictures and words	1	2	3	4	5	6	7
Good colors/color scheme	1	2	3	4	5	6	7
Overall, I like this website	1	2	3	4	5	6	7

E. Questionnaire Codebook and Sheet

Codebook with definitions of each category for three open-ended questions (2, 3, 8).

Sheet showing coding agreement and frequency of each category for both coders.

CODER ID: WRITE YOUR ASSIGNED CODING NUMBER.

QUESTION 2: THREE THINGS YOU KNOW ABOUT FIRE/HOW TO STAY SAFE FROM FIRE

A. **Behavior or actions taken in a fire situation**, such as escape methods, contacting 911, going outside, warning others, or stop, drop, and roll.

B. **Tools or equipment that alerts someone to fire or that suppresses fire**, such as a smoke alarm, an extinguisher, a fire blanket, and fire sprinklers.

C. **Behavior or actions that prevent fire**, such as never leaving candles burning, not playing with fire or fuel sources, checking if items smell weird, and not putting paper towels by the stove.

D. **Characteristics of fire**, such as how it spreads or how it is dangerous

E. **Confusing or indecipherable responses**, such as "I will teeth out," "School out," "Fire," and "1 dog in the house. The house is fire."

F. **No response/blank**

QUESTION 3: QUESTIONS ABOUT FIRE SAFETY OR TOPICS OF INTEREST

A. **Behavior or actions taken in a fire situation**, such as escape methods, contacting 911, going outside, warning others, or stop, drop, and roll.

B. **Behavior and equipment unique to how a deaf person would be alerted to the presence of fire or would communicate in a fire situation**, such as how deaf people can use or buy special alarms and how they can contact firefighters.

C. **Behavior and equipment appropriate for everyone—not customized for deaf people—that alerts people to the presence of fire or helps them suppress fire**, such as strategies for preventing fire when cooking and how extinguishers, alarms, and sprinklers work.

D. **Characteristics of fire**, such as how it spreads or how it is dangerous.

E. **Aspects of a career in fire service**, such as whether people who are deaf can be firefighters, how detectives determine what started a fire, and how the fire service handles false alarms.

F. **Confusing or indecipherable responses**

G. **No response/blank**, including responses declaring no questions or desire for new information

QUESTION 8: SEARCH WORDS

A. Variations of the words **fire safety/safe**, such as “learn fire safety,” “fire safety tips”

B. Words related to **preventing fire or how to react if a fire**, such as “how to stop fire from starting,” “how you stay away from fire,” “how to put out fire”

C. Words related to **emergency responders or fire service equipment**, such as “call firefighter,” “firefighter safety”

D. Words focused on **fire itself with no mention of preventing or staying safe from fire**, such as “wildfire,” “what about fire”

E. Variations of the words **safety/safe with no mention of fire**, such as “safe house” and “building safety”

F. **Wrong words/intent or confusing combination of search terms**, such as “games,” “toys,” “website”

G. **No response/blank**

QUESTION 2 CODED RESPONSES

(Krippendorff's alpha = .760722)

	Coders		Frequency of Categories					
Student Responses	Co-1	Co-2	Cat_a	Cat_b	Cat_c	Cat_d	Cat_e	Cat_f
run out house	a	a	2	0	0	0	0	
call 911	a	a	2					
jump out windows	a	a	2					
Stay far away from the fire	a	a	2					
If it not a big fire just grab emeracy spray to keep the fire keep going	b	b		2				
The alarm tell you to know there a fire	b	b		2				
get away	a	a	2					
call firefighter	a	a	2					
out the window	a	a	2					
jump in toilent	a	e	1				1	
smell and feel weird make check sure	c	c			2			
Stay low when ther fire	a	a	2					
Cover your mouth Don't breath in smoke	a	a	2					
Get out of house quickly	a	a	2					
drop out & Roll on floor	a	a	2					
Use Baking Soda	b	b	2					
Call #911	a	a	2					
Stay a way	a	a	2					
if house is on fire dont go back in the house	a	a	2					
Call 911	a	a	2					
Pour out the water on fire if I saw	a	b	1	1				
I use bake soda if fire is on pan or whatever	b	b		2				
Call firefighter men if it fire in whole house	a	a	2					
water spray	b	b	2					

Student Responses	Coders			Frequency of Categories					
	Co-1	Co-2		Cat_a	Cat_b	Cat_c	Cat_d	Cat_e	Cat_f
Ax	b	b		2					
Warn	a	a		2					
			Total	42	7	2	0	1	0

QUESTION 3 CODED RESPONSES

(Krippendorff's alpha = 1.0)

Student Responses	Coders			Frequency of Categories						
	Co-1	Co-2		Cat_a	Cat_b	Cat_c	Cat_d	Cat_e	Cat_f	Cat_g
House	e	e						2		
I want to know like how can I put out the fire	a	a		2						
or what if you stuck you can't use the phone or anything it to dangors.	a	a		2						
Nope I know about safety, that what my father teach me about safety away fire.	f	f							2	
i want to learn more about how can prevent from not making fires	b	b			2					
If Deaf not have phone whatever. How they contract them?	b	b			2					
To be a firefighting do you have to be full hearing	d	d					2			
I want know bout how deaf know if fire on but the fire alarm is on and deaf cant hear but how they need know is alaert you know keep them safe not get hurt	b	b			2					
How do fire alarms work?	b	b			2					
Carfire	b	b			2					
Car police	e	e						2		
			Total	4	10	0	2	4	2	0

QUESTION 8 CODED RESPONSES

(Krippendorff's alpha = .884409)

	Coders		Frequency of Categories						
Student Responses	Co-1	Co-2	Cat_a	Cat_b	Cat_c	Cat_d	Cat_e	Cat_f	Cat_g
fire safety	a	a	2						
fire sigenal	b	b		2					
fire turker	c	c			2				
fire deparment	c	c			2				
police deparment	c	c			2				
emeracy	c	f			1			1	
No Answer	g	g							2
fire safety	a	a	2						
learn fire safety	b	b		2					
Smokey the bear	d	d				2			
fire safety	a	a	2						
How protect from fire	b	b		2					
what if I stuck in house, what should I do	b	b		2					
fire safty	a	a	2						
what about fire	d	d				2			
How to be safety around fire	a	a	2						
fire safety	a	a	2						
what use for fire safety	a	a	2						
How to learn fire safty	a	a	2						
safety	e	a	1				1		
Box	f	f						2	
website	f	f						2	
		Sum=	17	8	7	4	1	5	2

F. Website Codebook and Sheet

Codebook with instructions for how to locate elements and count them

Sheet showing coding agreement of Illinois Firesafe Kids

CODER ID: WRITE YOUR ASSIGNED CODING NUMBER.

ADDRESS: HOW DOES THE SITE ADDRESS ITS AUDIENCE?

Look for instances of the following words. If you see at least one instance, type "1" next to the word. If you don't see that word at all on the website, leave it blank. Instances of adult positions, such as teacher or parent, should be counted as "adult."

GRAPHICS: COUNT AND CLASSIFY THE GRAPHIC ELEMENTS

Count only the graphics if they change. For example, if you see a full graphic, and then the next page has a close-up portion of the first graphic, then it counts as a second graphic because it's the close-up version or a different angle. If you continue to see the same border or logo on every page, count it only once.

- Cartoons: Drawing, sketch, comic strip, clip-art (not used as logo or graphic for bulleted lists)
- Photos: Image recorded by a camera and not drawn on or decorated with line art
- Icon/Logo: Images used to represent a category or institution
- Bullet type/Border/Horizontal Line: Graphic used to structure information in a bulleted list or to separate sections of a webpage
- Button/Arrow: Graphic used to facilitate navigation or submitting a form/quiz.
- Activity Pages: Coloring pages, mazes, seek-n-finds, crossword puzzles

NAVIGATION: COUNT AND TEST THE NAVIGATION ELEMENTS

Count only the links if they change. For example, count navigation menus or a set of links at the bottom of a page only the first time they appear. You can continue to test those links to see if they function, but do not count them after the navigation is structured into a menu or collection of links. If a button/arrow link is the only method for advancing through the material, count it each time you need to click it to move forward.

- Explicit (text): In-text or stand alone links that use the text as the link hotspot
- Explicit (button): Links that use a button as the link hotspot. These graphical links may also use text to label the button. The button should be counted under graphics, but because it functions as a button, it should be counted as a link also.
- Implicit (graphic): Links that use a graphic as the link hotspot, including several hotspots within an image map. Count each hotspot as a separate implicit link.
- Broken: Links that are broken and do not advance to the next page or advance to a "page not found."
- Page Numbers: Count the number of separate pages. Individual Flash screens should be counted as individual pages even though the website address may remain the same for all the associated screens.
- Navigation Categories: Count the number of categories that organize the internal pages of the site. Typically, these categories are within a navigation menu or collection of links (usually at the bottom of a page).

AUDIO/VISUAL ELEMENTS: HOW DOES THE SITE USE A/V ELEMENTS?

Look for instances of audio and/or video files. If you see at least one instance, list the type of A/V. Play the A/V element. Does the element use captions? Answer Yes/No.

VOCABULARY & JARGON: WHAT WORDS/PHRASES MIGHT BE DIFFICULT TO UNDERSTAND?

List any words or phrases that you think deaf students might have difficulty understanding. You don't need to provide a reason why. Look for fire safety jargon that you think is too abstract or needs a definition. You can also include bulky clauses or concepts that you think are just plain weird.

CODING SHEET OF RESPONSES FROM BOTH CODERS (ILLINOIS FIRESAFE KIDS)

(Average Krippendorff's alpha for three variables = .9272)

Mode of Address (alpha = 1.0)

	Child	Teenager	Kid	Youth	Young Person	Adult	Direct/Indirect
Coder 1	1		1			1	mostly direct
Coder 2	1		1			1	uses direct "you"

Graphic Elements (alpha = .870157)

	Total	Cartoon	Photo	Icon, Logo	Bullet, Border, Horizontal Line	Button, Arrow	Activity Pages
Coder 1	53	11	35	4	2	1	0
Coder 2	53	7	35	7	3	1	0

Navigation Elements (alpha = .911443)

	Working Links	Explicit (text)	Explicit (button)	Implicit (graphic)	Broken Links	Page #	Navigation Categories
Coder 1	90	18	27	45	2	48	6
Coder 2	90	19	28	43	2	48	6

Audio/Visual Elements

	Present	Captions
Coder 1	none	n/a
Coder 2	none	n/a

(not included in calculating alpha)

G. Students' Favorite Websites

Collected responses to Question 6 from questionnaire: List 3 of your favorite websites and why they are your favorites.

Favorite Websites Listed by Name

General Types of Sites/Topics, No Specific Website Listed

FAVORITE WEBSITES LISTED BY NAME

Website Name	Type	Votes
Yahoo	Directory/Search engine	25
YouTube	Video	17
MySpace	Social networking	16
Google	Directory/Search engine	5
Bebo	Social networking	3
Millsberry.com	Games/Comics	3
Mountain Dew Man	Video story in ASL	3
AOL	Directory/Search engine	2
Ask.com	Directory/Search engine	2
Facebook	Social networking	2
MSN/Hotmail	Directory/Search engine	2
AbcArcade.com	Games	1
AVSIM Online	News/Flight simulation	1
Cartoon Network	Video/Comics	1
Disney	Video/Comics	1
ESPN	Sports	1
FlightSim.com	Games/Flight simulation	1
G4tv.com	News/Video games	1
Gamestop.com	Games	1
Look Boy	Video story in ASL	1
MazeGame.com	Games	1
Miniclip	Games	1
NASA	News/Science	1
NASCAR	Sports	1
Oklahoma School for the Deaf	News/Research	1
Rumble in the Bar	Video story in ASL	1
Seventeen	News/Entertainment	1
Snipehunt.com	Video/Comics	1
UrbanChat.com	Social networking	1
Vidiac Live	Video networking/blogs	1

GENERAL TYPES OF SITES/TOPICS, NO SPECIFIC WEBSITE LISTED

Type	Votes
Urban legends/Ghost stories	5
Joke sites/Cartoons	4
Sports	4
News/Weather/Research	4
Games (themed, cards, mazes)	3
Movie/Video	3
Celebrity/Entertainment	3
Radio	1

H. Recommended Fire Safety Vocabulary

After identifying problematic fire safety vocabulary, I created a table of recommended vocabulary with solutions for explaining or revising the more difficult or abstract concepts.

RECOMMENDED FIRE SAFETY VOCABULARY

Problematic Vocabulary Identified on Websites	Recommended Substitution or Solution
Arson, Arsonists	Explain the term in a short definition—who is an arsonist? What do they do?
Accelerant, Fuel, Heat source, Flammable materials, Combustibles	Give examples in parenthesis next to the term. Include a picture of these examples
Intentionally	Do on purpose, choose to do
Canine handler	Works with dogs, uses dogs to help
Don't overload an electrical outlet	Explain how plugging in too many things can overload an outlet. Show a picture of an outlet with too many things plugged in. Give a numeric guideline
Smoke detector	Smoke alarm—describe how the alarm works
Upholstered furniture	Furniture with cloth or leather…not wood
Electrical appliances	Give examples in parenthesis next to the term
Fire extinguisher	Describe how the extinguisher works and show a picture
Frayed, Exposed, Worn	Cracked cord that shows wires—show a picture of a cracked cord
High traffic areas	Places in a room or hall where you walk a lot—tell a story, like when you come home, go to kitchen, sit down and watch TV. Then name the high traffic areas
Unattended	Stay by ___, Pay attention to ___, Keep an eye on ___
Seasoned wood, Green wood, Particle logs	Dry wood For particle log, give definition of a log made of sawdust and wood
Emergency assistance	Help
Portable space heater, Kerosene heaters, Alternative heaters	A small heater you can move around
Egress, Exit route, Exit path, Escape route	Way out, how to get out
Escape plan, Fire plan	Escape map shows how you get out
Strobe	Flashing light

Problematic Vocabulary Identified on Websites	Recommended Substitution or Solution
Vibrator, Vibrating disc	Bed shaker, Shake awake
Hazard, Risk	Danger
Certified professional	Expert
Emergency situation, Fire situation	Time when you need fast action, if a fire
Hearth, Chimney, Interiors	Show labeled picture and decide whether this level of detail is really needed
Dangling clothing	Clothing that hangs down
Designated meeting place	Meeting place outside—give examples in parenthesis next to term
Warn	Tell
Stories, Levels of a home	First floor, basement—show labeled picture
Manufactured home	Mobile home
Injured by fire	Hurt by fire
Extinguish	Put out
Stop, drop, and roll until the flames are extinguished	Stop. Fall down to ground. Roll until fire is out.
Identify	Draw, name, find
Twice a year, Bi-annually, Once a year, Annually	2 times a year, 1 time a year
Occupants	People inside
High-rise building, Skyscraper	Tall building
Window draws in smoke	If smoke comes in the window
Prevent	Stop
Enters	Comes in
Malfunction	Break, Stop working
Adult supervision	Need an adult with you, Need an adult in the room

VITA

Lacy Lee Landrum

Candidate for the Degree of

Doctor of Philosophy

Dissertation: CREATING ACCESSIBLE WEBSITES: DEVELOPING A FIRE SAFETY WEBSITE FOR TEENAGERS WHO ARE DEAF OR HARD OF HEARING

Major Field: English, Professional Writing

Education:

Earned a Bachelor of Arts in Sociology and English at Texas Tech University, Lubbock, Texas in May, 1998.

Earned a Master of Arts in English at Texas Tech University, Lubbock, Texas in May, 2000.

Completed the requirements for the Doctor of Philosophy in English at Oklahoma State University, Stillwater, Oklahoma in December, 2008.

Experience:

Program Coordinator/Technical Writer for Fire Protection Publications and Oklahoma ABLE Tech on a Department of Homeland Security grant concentrated on fire safety educational outreach for people with disabilities (May 06 – Jan 08)

Assistant Director of the OSU Technical Writing program (Dec 03 – Aug 05)

Assistant Director of the OSU Composition program (Aug 01 – May 03)

Teaching Associate for the OSU English Department teaching technical writing and composition courses (Aug 00 – May 06)

Professional Memberships:

Society for Technical Communication

Association of Teachers of Technical Writing

Technical Communication Area Chair for the Southwest/Texas Popular & American Culture Associations

Name: Lacy Lee Landrum Date of Degree: December, 2008

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: CREATING ACCESSIBLE WEBSITES: DEVELOPING A FIRE SAFETY WEBSITE FOR TEENAGERS WHO ARE DEAF OR HARD OF HEARING

Pages in Study: 244 Candidate for the Degree of Doctor of Philosophy
Major Field: English, Professional Writing

Scope and Method of Study: This study used three research phases to create an effective fire safety website for deaf teenagers. Participants were students in grades 7-12 from the Oklahoma School for the Deaf. First, 50 students responded to a questionnaire measuring their fire safety knowledge and interests along with their internet use and preferences. For the second phase, 50 students evaluated nine of the current fire safety sites via guided worksheets, and I performed a content analysis of the same nine sites. The third phase, with a stratified selection of 20 students, involved testing the new fire safety site through think-aloud interviews, half of which were conducted via Instant Messaging software to determine whether IM is a feasible tool for usability studies.

Findings and Conclusions: Deaf teenagers have unique fire safety information needs and internet preferences. Many were unaware of specialized smoke alarms, and they wanted more information about careers for deaf people in the fire service. Of the nine sites tested, none contained information customized to helping a deaf teenager plan effectively for fire emergencies, and many of the sites violated the accessibility guidelines outlined by the World Wide Web Consortium, especially as they used audio features without captions. Six of the websites used vocabulary levels well above the recommended fourth grade reading level for deaf teenagers, and eight sites were too juvenile in tone to appeal to this audience. Echoing the design and navigation aspects of Yahoo and MySpace, the new fire safety website scored well above the other websites tested and received positive feedback from the students. An overwhelming majority of students found the site's words and pictures easy to understand and relevant to their needs, and all the students said they would recommend it to their friends. IM also proved a useful tool for usability studies because the chat transcript shows the students' natural search terms and language structure. But when using IM, researchers must be prepared to rephrase questions and to decipher responses written in text message and TTY codes. Finally, a list of recommended fire safety vocabulary is included as part of the study's conclusions.

ADVISER'S APPROVAL: Thomas Warren