

# 장애 학습자와 웹 기반 교수자의 웹 접근성에 대한 인식도와 이를 위한 효과적인 교수설계전략

## Perception of Students with disabilities and their WBI personnel about Web accessibility and its effective instructional design strategies

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### 요 약

본 연구는 1) 고등교육기관에 있는 장애 학습자와 그들의 웹 기반 교수자(Web-based instructional personnel: WBI 교수자)의 웹 접근성에 관한 인식도를 알아보고, 장애 학습자들을 위한 접근 가능한 WBI를 설계·개발하기 위해 WBI 교수자들에 의해 실제로 사용되고 있는 효과적인 WBI 교수설계전략들은 무엇인지를 밝혀내는 데 그 목적이 있다.

본 연구를 위해 미국 중서부 지역 소재 대학에 재학(직) 중인 16명의 장애 학습자와 WBI 교수자들이 개별 인터뷰에 참여하였다. 연구 결과, 장애 학습자나 WBI 교수자들은 웹 접근성에 대해 거의 알지 못하고, 이를 위한 준비도 되어 있지 않았다. 그러나 웹 접근성을 제공하는 것은 장애 학습자에 대한 기회와 평등과 삶의 질을 보장하는 것이며, 이는 혁신적인 기술에 의해 상당부분 해소될 수 있다는 강한 신념을 가지고 있었고, 웹 접근성 기준이나 지침을 통과하였다 하더라도 이는 웹 접근성을 보장하기 위한 최종 단계가 아닌 시작에 불과하다고 인식했다. WBI 교수자들은 또한 장애 학습자를 포함, 보다 다양한 학습자들의 요구를 수용하기 위해서는 다양한 교수방법 등이 제공되어야 하며, 비록 웹 접근성과 이를 구현하기 위한 구체적인 방안에 대해서는 잘 모르지만 접근 가능한 WBI를 설계·개발하기 위해서는 적절한 WBI 교수설계전략이 사용되어야 한다고 주장했다. 마지막으로, 접근 가능한 WBI를 만들기 위해 WBI 교수자들에 의해 사용된 몇 가지 효과적인 교수설계전략들이 기술되었다.

### Abstract

There are two purposes of this study: 1) to identify the perception about Web accessibility of students with disabilities and their Web-based Instructional personnel (WBI personnel) in higher education, and 2) to find out effective WBI design strategies actually used by WBI personnel to design and develop accessible Web-based instruction for students with disabilities.

Sixteen students with disabilities and their WBI personnel at a mid-western university in US were recruited for individual interviews. The results showed that WBI personnel did not know about Web accessibility and were not well prepared to make their WBI accessible. They have to provide the equality and quality of life to students with disabilities by making their instruction accessible. They felt that they could not guarantee whether their WBI was accessible even after meeting current standards and guidelines. WBI personnel also suggested that they had to provide students with disabilities with various methods and use appropriate instructional design strategies in order to address their needs. Finally, some effective instructional design strategies used by WBI personnel in order to make WBI accessible were listed.

☞ Keyword: 웹 접근성(Web Accessibility), 장애 학습자(students with disabilities), 웹 기반 교수자(Web-based instructional personnel), 효과적인 교수설계전략(effective instructional design strategies)

## 1. Introduction

As Internet technologies have tremendously improved, there has been an enthusiastic claim which requests high-quality education for all students through technology. To address this needs, new types of instructional delivery methods using

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these technologies have been developed [1]. WBI is an alternative format for many people who cannot appropriately attend face-to-face classroom instruction to pursue additional competencies or advanced degrees.

The shift to WBI, however, has also exposed enormous challenges to instructors and their institutions. For example, many disabled students who deserve high-quality instruction and equal opportunities for education and training via the Web have not yet fully received technical or educational support and consideration from their institutions and Web-based instructional personnel (hereafter, WBI personnel) because of their political, socio-economical, cultural, physical, and geographical differences [1, 2, 3, 4, 5, 6].

Some good examples of this inequality, known as "the digital divide," are the discrepancies of Internet access and usage of students by income level, educational level, age, race/origin, and household type. In the educational setting, especially, Solomon and Allen [4] contend that this kind of digital divide is more complex than we think. They suggest that:

Serious inequities exist, and the economic and social forces that underlie those inequities are complex. Race, gender, cultural heritage, linguistic ability, physical ability, and income still define who has access and the quality of that access... Access involves far more than hardware, software, and bandwidth. It involves complex issues, such as the quality of instruction, the availability of appropriate content, and the opportunity to participate in the production of knowledge. (p. xviii)

Wiburg & Butler [6] and Fulton & Sibley [7] also contend that the following four critical

components should be appropriately addressed in order to provide students who are caught in the digital divide with appropriate access to information and equal opportunities to education:

- (a) Access to up-to-date hardware, software, and connectivity.
- (b) Access to meaningful, high-quality, and culturally responsive content and the opportunity to contribute to that context.
- (c) Access to educators who know how to use digital tools and resources.
- (d) Access to systems sustained by leaders with vision and support for change via technologies. (pp. 12-24)

Despite efforts from various constituencies to reduce the digital divide, many critical problems remain unsolved. Although appropriate technological devices and adaptive/assistive technologies have been developed, for example, students with disabilities cannot easily or fully access resources provided through the Web. New technology should be beneficial to all learners, especially students with disabilities [8]. However, students with disabilities inadvertently face a new challenge, known as "the second digital divide," because of inaccessible content and/or resources on the Web. This second line divides students who can fully access the technological tools, services, and information from those who cannot. If this accessibility issue is not appropriately addressed, the result will be that the educational and technological potential of WBI cannot easily transfer into direct educational benefits for this audience, students with various kinds of disabilities.

How can WBI personnel address this issue? As Bow [9] pointed out, "meeting all of the

tremendous variety of needs these students present is not something most teachers can do. What is possible is to design and deliver instruction that responds to most of these needs"(p.1). This is where the issues of Web accessibility for all students, especially for students with disabilities, come into play.

There is much research about Web accessibility. However, the majority of these studies focused more on technical aspects of Web development-related tools than on instructional or pedagogical perspectives [10, 11, 12]. In addition, most participants in those studies were mainly Web developers or instructional designers who had some experience in designing Web sites using complicated development tools but had little or no experience designing or teaching WBI. When developing WBI design guidelines and strategies, some researchers did not include in their research or even consider any students with disabilities who had taken courses via the Web. Alternatively, some researchers conducted their studies only with students having a specific type of disability (e.g., students with visual, hearing, or mobility impairments) [8, 13, 14]. Therefore, findings from the research may be incomplete and create serious problems due to the lack of comprehensiveness of the findings. Web developers and designers may commit serious errors if they apply guidelines from these studies without considering other research findings based on the direct experience of end-users who teach or take WBI courses.

WBI personnel who want to design accessible WBI for all learners, especially students with disabilities, cannot fully understand or recognize the various problems and issues involved in designing and delivering their WBI through research of the current literature. Given the lack of appropriate WBI

design guidelines and strategies that account for the complex situations occurring in the real WBI environment and that clearly identify problems through the real experiences of the key players who have taught or taken WBI, we cannot expect that WBI personnel can make their WBI accessible for all learners.

There are two purposes of this study: 1) to identify the perception about Web accessibility of students with disabilities and their WBI personnel in higher education, and 2) to find out effective WBI design strategies actually used by WBI personnel to design and develop accessible WBI for students with disabilities.

To achieve these purposes, the following research questions are addressed in the study:

- To what extent are students with disabilities and their WBI personnel in higher education currently aware of Web accessibility?
- What kinds of WBI design strategies are currently used by WBI personnel for developing accessible WBI to meet the needs of students with disabilities?

## 2. Literature Review

### 2.1 Web Accessibility

Accessibility means providing flexibility to accommodate each user's needs and preferences. In the Web context, accessibility is to make computer technology and Web resources useful to more people than would otherwise be the case.

Henry [15] defines Web accessibility as follows:

At the most basic level, Web accessibility is about people being able to get and use Web content. It is about designing Web pages that

people can present and interact with according to their needs and preferences. A primary focus of accessibility is access by people with disabilities. The larger scope of accessibility includes benefits to people without disabilities. (p. 7)

Waddell [16] also defines accessibility as "development of information systems flexible enough to accommodate the needs of the broadest range of users... regardless of age or disability." To some degree, these two definitions are slightly different because the former is more focused on content, while the latter focuses on physical structure. In this study, however, Web accessibility is defined as an index of how accessibly and flexibly a Web site is designed to accommodate the needs of the broadest range of users, regardless of age or disability.

One influential guidelines for Web accessibility, is "W3C Web Content Accessibility Guidelines 1.0 (WCAG 1.0)" published by the W3C (World Wide Web Consortium). Although WCAG 1.0 is not any mandatory regulation, it is the authority for designing creating accessible Web sites [17]. According to W3C [18, 19]:

These guidelines explain how to make Web content accessible to people with disabilities. The guidelines are intended for all Web content developers (page authors and site designers) and for developers of authoring tools. The primary goal of these guidelines is to promote accessibility. However, following them will also make Web content more available to all users.

W3C divides WCAG 1.0 into three categories, from Priority 1 (high priority; A Web content developer must satisfy this checkpoint.) to Priority 3 (low priority; A Web content developer may address this checkpoint.). (Table 1) shows the 15 Priority 1 Checklists (Priority 2 with 30 Checklists, Priority 3

with 20 Checklists; a total of 65 Checklists).

(Table 1) WCAG 1.0 Priority 1 Checklists

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- Provide a text equivalent for every non-text element.
  - Provide redundant text links for each active region of a server-side image map.
  - Until user agents can automatically read aloud the text equivalent of a visual track, provide an auditory description of the important information of the visual track of a multimedia presentation.
  - For any time-based multimedia presentation, synchronize equivalent alternatives with the presentation.
  - Ensure that all information conveyed with color is also available without color, for example from context or markup.
  - Clearly identify changes in the natural language of a document's text and any text equivalents.
  - For data tables, identify row and column headers.
  - For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.
  - Organize documents so they may be read without style sheets.
  - Ensure that equivalents for dynamic content are updated when the dynamic content changes.
  - Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.
  - Until user agents allow users to control flickering, avoid causing the screen to flicker.
  - Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape.
  - If, after best efforts, you cannot create an accessible page, provide a link to an alternative page that uses W3C technologies, is accessible, has equivalent information (or functionality), and is updated as often as the inaccessible (original) page.
  - Title each frame to facilitate frame identification and navigation.
  - Use the clearest and simplest language appropriate for a site's content.
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Source: Adapted from W3C. (1999). Web Content Accessibility Guidelines 1.0. Retrieved September 25, 2006, from <http://www.w3.org/TR/WCAG10/>.

Currently, W3C has released the WCAG 2.0 last Working Draft which builds on WCAG 1.0. According to W3C [19], the purpose of WCAG 2.0 is the same as WCAG 1.0: "to explain how to make Web content accessible to people with disabilities and to define target levels of accessibility" (para. 1). However, W3C attempts to "apply checkpoints to a wider range of technologies and to use wording that may be understood by a more varied audience" (para. 1). It should also be noted that although WCAG 2.0 is not officially published yet, it is expected that the final guidelines will have more general, technology-independent design principles.

In US, there are many regulations which have been created to ensure the enhancement of Web accessibility and information technology rights of people with disabilities. Two influential mandates are The Americans with Disabilities Act (ADA) of 1990 and Section 508 of the Rehabilitation Act Amendments of 1999.

ADA officially effected in 1992 prohibits discrimination "on the basis of disability in employment, programs and services provided by state and local governments, goods and services provided by private companies and in commercial facilities." However, ADA does not just apply to the physical world. According to the Justice Department [20], ADA also applies to cyberspace. The Justice Department stressed that covered entities under ADA are required to provide effective communication, regardless of whether they generally communicate through print media, audio media, or computerized media such as the Internet.

Section 508 directly deals with Web accessibility [17]. An important focus of Section 508 is to ensure access to electronic and information technology. This law mandates that technology be

accessible to people with disabilities that are federal employees or members of the general public. This law relies heavily on the procurement process to make sure there is compliance with the new standards. Compliance with the standards is required unless it would pose an "undue burden"- as defined in the standards - or if no complying product is commercially available. Actually, Section 508 does not apply to the private sector or to agencies or establishments not using federal funds. However, because of the magnitude of federal purchasing power, it is believed that Section 508 will promote competition in the technology industry by clarifying the Federal market's requirement for accessibility in products intended for general use.

Subpart B of Section 508 establishes 16 requirements related to Web-based intranet and Internet information and applications for federal agencies and departments [20]. Most Section 508 Standards (11 out of 16 items) are similar to W3C's WCAG 1.0 Priority 1 items listed earlier because the former was established based on the latter. Five different items are about scripting, applets and plug-ins, forms, skip navigation, and timed responses.

In Korea, on the contrary, there is currently no law regulating Web accessibility although there are some efforts to mandate it from the government. Two of them are 1) the recommendation guidelines for improving information and telecommunication accessibility for people with disabilities and the aged, which was enacted in 2002, and 2) Korean Internet Web Content Accessibility Standards enacted in 2005. Since Korea Agency Digital Opportunity & Promotion (KADO) has established by the "Law on Dissolving the Digital Divide" in 2003, this organization has evaluated the status of Web accessibility every year. In 2005, 77 public

organizations were evaluated by using the modified Korean Web Contents Accessibility Guidelines 1.0 (KWCAAG 1.0) consisting of 13 Web accessibility guidelines similar to Section 508 guidelines. The evaluation results showed that none of the organizations failed to pass all of the 13 guidelines and the overall average point was 72.2 points out of 100 points even though the overall average score was highly increased compared to the previous years' one [21].

## 2.2 Issues and Myths of Web Accessibility

### 2.2.1 Issues of Web Accessibility

The most critical problem of Web accessibility is the lack of awareness of Web accessibility among institutions, WBI personnel, and online learners, particularly students with disabilities [17, 22, 23, 24, 25]. WBI personnel or institutions offer WBI courses and will increase the number of courses offered without clearly understanding Web accessibility and its standards and guidelines or how online resources have been used by students with disabilities [23]. Particularly, the lack of awareness is more serious than lack of knowledge, skills, or technical complexity.

Closely related to lack of awareness, another big challenge for promoting Web accessibility is attitudes towards students with disabilities, which seriously impacts the reactions among three key players - administrators, WBI personnel, and students with disabilities - to overall Web design and perceptions of Web accessibility [26].

There is also the other reason that most institutions do not comply with Web accessibility guidelines is that they are oblivious to the laws that regulate them. As NCES [27] survey results clearly

show, 95% of 2- and 4-year educational institutions had used Web sites for distance education courses in 2000-2001. However, only 18% of the institutions that used Web sites for distance courses followed Web accessibility guidelines or recommendations to a major extent, 28% followed the guidelines to a moderate extent, 18% followed the guidelines to a minor extent, and 3% did not follow the guidelines at all. Also, 33% of the institutions did not know if the sites followed accessibility guidelines.

### 2.2.2 Myths of Web Accessibility

Researchers have found that there are several myths of Web accessibility which seriously prevent its wide-spread application [15, 26, 28, 29, 30, 31].

- (1) *An accessible Web page is made of dull, plain text and is not as appealing to users without disabilities.* Making accessible WBI courses does not mean that WBI personnel can only present the contents using text. The courses do not need to sacrifice a nicely designed visual illustration or image when the illustration or image is accessible or is given alternative text explaining what information the illustration or image contains [32]. In fact, sophisticated design elements such as various colors, images, and multimedia components can enhance students' understanding whether or not they have disabilities if these elements are carefully used and accessible [29]. The only limitation that WBI personnel face in terms of designing attractive Web sites is their creativity and imagination.
- (2) *Just provide one more option, adding a text-only version.* Text-only versions of WBI courses can cause several problems [33]:

- Many people with disabilities feel that text-only sites are exclusionary. A single site with appropriate accessibility is perceived as more inclusive of the entire Internet community.
- It's much more difficult to maintain a second site. Once it's out of date, [designers] are out of compliance because equivalent information is not available to everyone.
- Modern screen readers can actually process accessible HTML better than a text-only site.
- Text-only sites may address some accessibility issues specific to screen readers, but not all accessibility issues. (para. 5)

For these reasons and considering the original intentions of the Section 508 regulations and W3C's guidelines, it is not highly recommended for WBI personnel to provide students with disabilities with text-only versions of WBI courses.

- (3) *Designing accessible Web sites is too difficult for the average WBI personnel.* The most common accessibility problems that WBI personnel need to address are; (a) not giving any alternative texts for images, (b) overusing colors in a Web page, and (c) unclear description of the contents of a Web page. Of course, some technical or authoring skills may be needed if WBI personnel want to include relatively complex functions such as Flash movies, animations, or video captioning. To solve the most common inaccessibility problems, however, the average WBI personnel do not need to have or learn highly technical programming skills or complicated authoring tools. If WBI personnel have enough knowledge about the subject matter and know some basic HTML coding or Web authoring tools, they can

make at least more than a half of their courses accessible.

- (4) *Making WBI accessible is expensive and time-consuming.* Retrofitting the sites to address accessibility may take much more time and money than designing the sites to be accessible from the beginning [34]. In the worst case, the entire WBI course interface such as layout and navigation will have to be redesigned. Sometimes WBI personnel may need to reproduce video clips that are not captioned. It may be costly to convert inaccessible WBI courses into accessible ones. If WBI personnel consider Web accessibility from the beginning, however, they do not need to spend virtually any extra cost or time to redesign WBI courses.
- (5) *Web accessibility is only for students with disabilities.* Just as curb cuts and automatic door openers help people without disabilities who use strollers or carry heavy packages, accessible WBI contents provides benefits to almost everyone, not just students with certain types of disabilities. For example, well-organized content and navigation makes it easy for students with mobility or learning disabilities, as well as mainstream students, to understand and navigate. Just as a captioned video provides students with hearing impairments access to contents contained in the video, it can also benefit students without disabilities who are studying in a noisy place, or who are studying foreign languages [35, 36].
- (6) *Students with disabilities do not frequently use the Web.* Wellner & Gardyn [37] estimate that more than 40% of people with disabilities have access to the Internet in order to search for information just like people without disabilities

do. McGrane [38] even estimates that 76% of Americans with disabilities access the Internet. Wellner & Gardyn [37] further contend that some people with disabilities spend more time on the Web than people with disabilities. According to NCES's [39] survey results, specifically, about 9% of all undergraduate students with disabilities took at least one distance education course, while about 7.5% of undergraduate students without disabilities took a distance course. Furthermore, undergraduate students with disabilities took their programs entirely through distance education more often than students without disabilities (31.1%, 28.7%, respectively).

Given that more and more instructors offer their courses via the Web, most instructors nowadays post at least their syllabi on the Web, and more students with disabilities have enrolled in WBI courses [40].

### 2.3 Some Accessible WBI Design Guidelines and Strategies

The researcher extensively reviewed some practical WBI design guidelines recommended by literatures (mainly, books and articles) in order to make WBI accessible to all learners, including Section 508 Standards and W3C's WCAG 1.0. The following list shows the results of the effort. This list was divided into five categories (content design, navigation design, screen design, information architecture/infrastructure design, and Website maintenance). In this list, Section 508 Standards and W3C's WCAG 1.0 Guidelines were excluded because many guidelines were duplicated.

#### *Content Design*

1. Avoid graphical text as much as possible.
2. Do not make two versions of Websites (i.e., text-only version, graphic-rich version), if not absolutely necessary.
3. Do not use any acronyms if not absolutely required.
4. Group related links, identify the group (for user agents), and provide a way to bypass the group.
5. Keep the page title, the headlines, and subtitles short and communicative.
6. Make the dialogue of audio or video clips descriptive enough.
7. Make information conveyed with color available without color.
8. Place distinguishing information at the beginning of headings, paragraphs, lists, etc.
9. Provide information about the general layout of a site (e.g., a site map or table of contents).
10. Provide various types of materials for the same content if possible.
11. Put the course content on a page in a logical, easy-to-follow form; do not scatter the information all over the screen; do not intersperse sections within each other.
12. Reduce the file size of the course content as much as possible.
13. Remove or minimize background noise of audio or video if possible.
14. Test content by using various browsers.

#### *Navigation Design*

1. Do not use markup to redirect pages automatically. Configure the server to perform redirects.
2. Ensure that the label is properly positioned for all form controls with implicitly associated labels.
3. Include the primary navigation bar on all pages



of the Web site.

4. Make buttons, links, and ALT tags descriptive enough to match the items they describe.
5. Provide a link to a plug-in or applet, if a Web page requires it to interpret the content.
6. Provide keyboard shortcuts to important links, form controls, and groups of form controls.
7. Provide navigation bars to highlight and give access to the navigation mechanism.
8. Provide redundant text links for each active region of a server-side image map.
9. Provide repetitive navigation links to skip.
10. Use consistent labeling and explanatory text for buttons and links.

#### **Screen Design**

1. Avoid the overuse of color. Do not use more than three colors in a Web page.
2. Avoid the use of FRAME if not absolutely necessary.
3. Do not create periodically auto-refreshing pages.
4. Minimize the number of window screens to be opened.
5. Organize documents so they may be read without style sheets.
6. Separate captions from video screens.

#### **Information Architecture/Infrastructure Design**

1. Create a logical tab order through links, form controls, and objects.
2. Do not change any user's environment or setting if not absolutely necessary.
3. Do not limit WBI courses to be delivered only with certain operating systems or browsers to deliver content.
4. Do not use or minimize the usage of inaccessible special features or formats (e. g., applets, plug-ins, frames, databases, forms, PDF

files).

5. Give META tags an accurate summary of the content in a format that can be easily used by search engines.
6. Give sufficient time or provide a way to change the time if a timed response is required.
7. Include default, place-holding characters in edit boxes and text.
8. Specify logical event handlers rather than device-dependent event handlers for scripts.
9. Use Cascading Style Sheets to control font and presentation, and allow user flexibility in preferences setting.
10. Use system standard on-screen controls whenever possible.

#### **Website Maintenance**

1. Perform high priority changes first, and then move on to lower priority items.
2. Provide instructor(s) and/or technical support contact information.
3. Use different combinations of assistive technology devices and methods to check the Web accessibility of Websites.

## **3. Methodology**

### **3.1 Participants**

For this study, four types of students with disabilities most affected by the inaccessibility of the Web [a) *students with visual impairments*, b) *students with hearing impairments*, c) *students with mobility impairments*, and d) *students with cognitive or neurological disabilities*.] and two groups of WBI personnel [a) *online educators* who have taught students with disabilities at least one or more course(s) through the Web, and b) *instructional*

*consultants or administrators* who support online instructors mentioned above] were recruited.

To recruit subjects, more than one criterion was applied, depending on the status of participants. If the subject were a student with disabilities, the participant was one of the students with disabilities listed above and he/she had to take at least a course through the Web. If the subject were an online educator, that participant should have at least one or more students with disabilities in his/her class and half of the class activities of that participant should be administrated through the Web. Finally, if the subject were an instructional consultant or administrator, the participant was full-time staff and should support online instructors mentioned above to make their instructional materials accessible.

Sixteen participants who met the criteria above were involved in this study: four online educators, two administrators, and ten students with disabilities. They were all from a mid-western university in US. This university had about 500 students with disabilities out of about 38,600 student populations. About 400 had learning disabilities and the other students were varied in terms of their disabilities.

The subject matter areas the online educators had taught were educational psychology, educational technology, special education, and library & information science. The participants were diverse in terms of their teaching experience both off- and on-line. Their face-to-face teaching experiences ranged from two to fifteen years and their online teaching experiences also differ from two semesters to sixteen semesters. Most course Websites and WBI contents were designed and developed by the online educators with the help of technical staff. One administrator came from the Disabled Students Services; the other administrator from the Adaptive

Technology Center.

Finally, ten students varied in terms of the types of disabilities and onset day of their diseases: Two students with blindness, three students with mobility disabilities including one student with cerebral palsy with language problem, three students with cognitive/neurological disabilities (one learning disability student with attention deficit order, one learning disability student with math and reading comprehension skills problems, one student with Dyslexia with concentration problem), and two students with hearing impairments (one had the total loss of hearing in left ear, caused by disease, and one had severe hearing problems in both ears, using hearing aids). The two students with blindness could only see some light perception and one of them came from Korea about one year ago. As a result, the student with blindness from Korea had also a language problem. Most of the student participants were born disabled.

### 3.2 Data Collection

To acquire data regarding participant perceptions about Web accessibility and WBI design strategies WBI personnel have used for developing accessible Web-based instruction, sixteen individual interviews were conducted.

The individual interviews were conducted in a semi-structured manner. The data were audiotaped with the permission of the participants. However, because of two students' physical conditions, email interviews were more appropriate. Depending on participants' physical conditions, the duration of the interview varied from 45 minutes to 6 hours (one of the students with blindness spent 6 hours to finish the email interview).

### 3.3 Reliability and Internal Validity of Data

To increase the reliability and the validity of the data, at least two interviewers (for this study, another researcher who was much knowledgeable about Web accessibility was involved only for the interviews) conducted each interview. The interview data were also transcribed by the interviewers, and then sent to each interviewee. Except three interviewees because of their jobs and disabilities, every interviewee ensured the credibility of their interview data. In the case that there were differences between the interviewers' transcript and interviewee's opinion, the data were reviewed until the differences were reconciled.

## 4. Results

### 4.1 Perception about Web Accessibility

#### 4.1.1 Lack of Awareness and Unpreparedness about Web Accessibility

The three Web-based online educators in this study, except one of the administrators, have developed their own individual teaching styles and instructional strategies throughout their career. Despite their personalized teaching styles and instructional strategies, they agreed that there were distinct differences between the traditional classroom and the Web-based instruction. That is, they agreed that traditional classroom strategies might not be appropriate for WBI. Especially, they felt that designing accessible WBI might be another challenge because of unpreparedness and the lack of experiences, knowledge and skills.

When asked whether they have known or heard about Web accessibility and its standards and

guidelines, unfortunately, most participants, except two administrators, regardless of WBI personnel or their students with disabilities, did not know or hear about them.

I don't know much about that kind of stuff. I would be surprised if any of the [my department] instructors is really using that just because I've never heard about it. (Online educator A)

[Web accessibility] is that I really haven't thought about them until this... I know that Bobby is out there but I haven't used them. (Online educator B)

In addition, two administrators indicated that even though Section 508 was already enacted, only a few faculty members were aware of Web accessibility and tried to prepare for the future classes:

I teach a Web accessibility class. I haven't had many faculty attendees. I had mostly individuals working for departments who have responsibilities for developing Web pages. Those probably would be more institutional information kinds of Web pages, not distance education or Web-based course kinds of presentation. (Administrator A)

I have had a number of groups come, but they've been primarily people who are developing online distance registration or library access or something like that. I had a very few faculty members working on distance education come to talk about issues that is creating their Web that could be accessible online by someone with disability. (Administrator B)

#### 4.1.2 Providing Equality of Opportunity and Quality of Life to Students with Disabilities

According to Foley and Regan [2], WBI personnel should consider Web accessibility because of the following reasons:

First, accessibility is the right thing to do. It serves to open doors for individuals with disabilities in ways that were not previously possible. Second, it is the law in many institutions. Third, accessibility offers benefits for all users by creating more usable Web sites. Fourth, accessible design is based on more contemporary architecture and design that allow for greater flexibility across a site. Fifth and finally, accessibility represents a growing market in need of software, hardware and design.

The participants in this study have similar perspectives on considering Web accessibility for students with disabilities. That is, providing accessible WBI to students with disabilities is the right thing to do. The following two quotations show those perspectives very well:

It's important and a real strive in diversity and equality for all people and we'll become as individual that recognize that people with disability is a part of our population just like people from different ethnic background. (Student with cerebral palsy with language problem)

If you don't provide services to individuals with disabilities, they miss an important part of their life... They may not be able to learn. They may not be able to take courses. They may not be able to learn and to have recreations through reading... I think it's very important to realize that individual with disability have same desires, wishes, and very frequently same

intellectual capacity that you and I would have.  
... That is humane, right and reasonable.  
(Administrator A)

#### 4.1.3 Strong Belief about Potential of Innovative Technology

Another interesting finding is that WBI personnel strongly believe that technology can, in the near future, effectively support students with disabilities taking Web-based instruction. One instructor gives a good example about how adaptive technology has helped a student with dyslexia disability:

I have students with hidden disability you would not know it from talking and looking to them. But they have disability because their disability is dyslexia. They cannot read. Their brain jumbles letters all around... Especially, in an example that I'm using, students with dyslexia, I have a student to come and say to me, "I never knew. Now the tools that you are giving me, I can read. Look at my GPA. It was 1.6 when I came to [this university]. This and last semester it is 3.6... I'm so proud of myself. "Why would you not make people feel like that about themselves if you can do it no matter what tools you use? Here fortunately, I can do it with technology. (Online educator B)

#### 4.1.4 Improving Knowledge and Skills for Making WBI Accessible

Those WBI personnel with extensive experience did not think the accessibility guidelines were difficult and saw them as more applicable to their work than those instructors who did not have much experience. In other words, the former felt that applying Web accessibility standards and/or guidelines was not difficult and complex because those standards and guidelines were clearly stated,

while the latter felt that even though those guidelines and standards, especially W3C's guidelines, gave some specific examples about how to use those specific guidelines, still it was not easy for novice WBI personnel to apply those standards and guidelines because of the vague statement of the guidelines and standards. An administrator, however, clearly indicated that the difficulties in applying those standards and guidelines into their real works were caused by the lack of their Web development knowledge and skills, not the standards or guidelines themselves:

Guidelines are stated very clearly. And basically, they are not that very complicated to follow. So, if somebody says that they can't follow them because they can't understand them, perhaps their Web development skills are not that good. It could be that they don't want to follow them because they want to use something flashy that they think they are going to be really cool, but might not meet the guidelines. (Administrator B)

#### 4.1.5 Passing Web Accessibility Standards or Guidelines is not the Final Step.

Section 508 standards were established based on W3C's priority 1 items. However, the standards and guidelines of other countries such as Canada and England are stricter than those of U.S. In England, for example, Web developers have to follow the whole priority items of W3C's guidelines. Even when WBI is accessible in the U.S.A., therefore, it is not guaranteed that there is no problem in accessing that instruction in other countries. The participants indicated that still there might be some problems which WBI personnel have to consider:

An institution recently changed its Web pages. This person is offended and very angry with that. They made those changes because they felt that now the Website was not accessible. She wanted me to make it right. Unfortunately, I could not make. She has low vision. I responded to her that I couldn't fix it and she needs to go to people in the institution. But if you run the Bobby checker, it works OK. It does not have any priority 1 errors. So I believe they took guideline into account. But that site may not be usable with that person. Guidelines are just guidelines. You still have to bring the usability issues. (Administrator A)

I think that Web designers should design Web sites with students with disabilities in mind, regardless of if they know that a student with a disability would be taking a class. Since making Web sites accessible helps everyone in general, it would be a good idea anyway... If the site is already designed for students with disabilities, people would be more like to take the class. (Student with learning disabilities with attention deficit order)

## 4.2 Some Effective Instructional Design Strategies Used by WBI Personnel for Making WBI Accessible

### 4.2.1 Providing Various Methods to Access WBI

Depending on the types of disabilities students have, it is recommended that WBI personnel should accommodate their WBI by using various methods in order to help students with various types of disabilities access easily.

That depends entirely on the disability of students and the type of course materials that they are accessing. If it's a fully developed

multimedia-based and Web-based course and it includes video clips, if the video clips don't have audio descriptions from the parts that something is happening and does not clear by talking in the film, someone who is blind doesn't get that part. ... If you have video clips and you have someone who is deaf, and you do not provide caption on that video, those people can't hear what the person is saying. So they would miss that. If you have your site designed as Web-based, and you don't follow the minimum of W3C guideline, people who are blind would have very difficult time in accessing your Website. (Administrator B)

In this study, WBI personnel mainly used three different formats in order to communicate with their students: email, listserv, and forum. They used email for communicating individually with the student, an email distribution list for announcements, and a Web forum for communicating publicly. Since it was not as easy to determine students' progress with a WBI course as it was in the traditional classroom, online educators frequently used individual email to check students' progress and to give individual feedback.

#### 4.2.2 Using Appropriate WBI Design Strategies

When WBI personnel design their WBI, they have to consider an extremely diverse student population, from mainstream students who have little experience learning through the Web to students with some type of disabilities, such as attention deficit disorder, learning disabilities, and mobile impairments, and so forth. To address the needs of these various students with or without disabilities and make their WBI access to all learners, therefore, WBI personnel have to first consider the physical and psychological characteristics of

potential students and use appropriate WBI design strategies based on that consideration. The following example demonstrates clearly what happened when WBI was not appropriately designed for students with blindness:

We have the accessibility guidelines, which is at a minimum, would make Websites accessible to someone with vision impairment. However, that site may not be usable by someone with impairment. In my opinion, next wave of concern would be related to what is the next step for people with disability, which is usability. For example, if you use graphic spacers between A and B of words on page because you think it looks nice, a student with blindness has to go to that page and he/she hears like "Graphic Spacers, Graphic Spacers, ..." He/she may have an ability to turn off to make her program not announce all those things but he/she is not sure what information is he/she may be missing... So if you design your Website, and poorly you don't group your information in a right way, maybe they will give up on your Web. (Administrator A)

Because of the lack of awareness about Web accessibility, as mentioned earlier, WBI personnel in this study did not much used the effective instructional design strategies for making their WBI accessible. Even though they did not clearly know whether an instructional design strategy was effective or not in order to make their WBI accessible and to accommodate the various needs of students with disabilities, they had used some of the effective instructional design strategies as follows: (a) providing more one-to-one interaction by spending extra time for emailing, (b) scaffolding and supporting supplementary help, and (c) providing visual aids such as giving visual outlines

or pre-organization planner.

One interesting finding related to this finding is that even though two other online educators did not know about Web Accessibility, they have used several guidelines or standards when they designed and developed their WBI although guidelines or standards used were very limited in terms of scope. According to Section 508, for example, WBI personnel have to provide a text equivalent for every non-text element such as "alt" for image. Still they have missed giving those alternatives for other contents like audio- or visual-elements, but most of them gave alternatives for image, without specific reasons.

In sum, Table 2 shows the results of this study: perceptions about Web accessibility and some effective instructional design strategies used by WBI personnel.

## 5. Discussion/Conclusions

### 5.1 Discussion/Implications

As shown in Table 2, this study found a consensus among the participants that ensuring accessibility is the right thing to do and that the development and appropriate use of technology will increase the possibilities of equal opportunities for education. However, it was revealed that students with disabilities and their WBI personnel were not aware of and did not know much about Web accessibility. In particular, Web contents accessibility guidelines such as W3C's guidelines and Section 508 standards were rarely used by the WBI personnel. Even though a few WBI personnel were aware of and knew of the standards and guidelines of Web accessibility, they were experiencing difficulties in understanding and applying those guidelines to their practice. Only those with

(Table 2) Summary of the Study's Results

#### Perception about Web Accessibility

- Lack of awareness and unpreparedness about Web Accessibility
- Providing equality of opportunity and quality of life to students with disabilities
- Strong belief about potential of innovative technology
- Improving knowledge and skills for making WBI accessible
- Passing Web accessibility standards or guidelines is not the final step.

#### Some effective instructional design strategies

- Providing various methods to access WBI
  - Use different formats in order to communicate with students
- Using appropriate WBI design strategies
  - Consider the physical and psychological characteristics of potential students and use appropriate WBI design strategies based on that consideration
  - Provide more one-to-one interaction
  - Scaffold and support supplementary help
  - Provide visual aids
  - Make good use of personal and course Web pages

extensive experience were applying the Web accessibility standards and guidelines as appropriate. The lack of knowledge, skills, and experiences of the WBI personnel was the main reason for the rare use of the Web accessibility standards and guidelines.

In order to tackle this problem, many efforts are being invested in passing over the Web accessibility standards and guidelines to more practitioners in education, but more discussions need to be sought beyond the dissemination of the guidelines. As stated earlier, W3C is currently updating their standards in order to provide more general and technology-independent design guidelines so that more audience can understand without difficulties. In addition, more efforts should be made to support WBI personnel to learn and exercise the Web accessibility standards in their practice, particularly with help from more knowledgeable and experienced people. Offering workshops at professional conferences could be considered. Communities of practice could be also helpful for sharing useful information and supporting one another in charge of Web accessibility matters.

The lack of awareness of the Web accessibility standards and guidelines linked to the rare use of design strategies related to Web accessibility. As also shown in Table 2, a few design strategies were in use by a couple of WBI personnel, who were applying them without knowing that those strategies pertain to Web accessibility issues. The Web accessibility standards and guidelines were initially created for those with disabilities but they are also beneficial to those without disabilities. It seems that WBI personnel are not aware of the universal benefits that the Web accessibility standards and guidelines can bring to anyone learning online. To make WBI personnel design their courses more

accessible to learners with diverse needs and characteristics, therefore, the guidelines or strategies identified in this study, including those guidelines or strategies from literature reviews, should be appropriately informed to WBI personnel. WBI personnel should also be trained to design and develop their WBI courses more accessible by applying those practical design guidelines or strategies. Without appropriate knowledge and skills, we cannot anticipate that WBI personnel will make their courses accessible.

Similarly, in order to address various needs and preferences of the diverse learners including students with certain type(s) of disability(ies) and the aged, WBI personnel should first be aware of the problems students with disabilities might confront if their WBI were inaccessible and should know the standards and guidelines for Web accessibility. They also need to know the practical instructional design strategies and skills which can be effective on designing and developing accessible WBI for more wider range of learners.

As shown in the literature section, Bowe [9] suggested WBI personnel should consider various ways which make "education more convenient ... more comfortable...and more flexible for persons having different styles" (p. 4). He also pointed out that WBI personnel should present information in multiple ways, offer multiple ways for students to interact with and respond to curricula and materials, provide multiple ways for students to find meaning in the material and thus motivate themselves, and make good use of personal and course Web pages. The findings of this study (see Table 2) confirmed his suggestions that WBI personnel should provide various methods and use appropriate WBI design strategies to help students with disabilities easily access their WBI.



## 5.2 Limitations/Further Study

This study has several limitations.

First, the number and variation of the participants are limited within a specific environment and institution. For example, only six WBI personnel and four types of students with disabilities were interviewed. As a result, the findings might be different if more and various participants were involved. It may be necessary to have diverse participants from various learning environments for further study.

Second, this study could not find many effective WBI design strategies closely related to make WBI accessible to all students, especially students with disabilities because WBI personnel, in this case online educators, did not know much about W3C's guidelines and Section 508 standards for addressing Web accessibility issue. As a result, they rarely used specific WBI design strategies related to these standards and guidelines.

Finally, the researcher did not observe the actual Web sites where students with disabilities and their WBI personnel used for their class activities. Without verifying their Web sites, the researcher could not know about what kinds of problems students with disabilities actually had. To compare whether there are some gaps between what the participants feel and what kinds of instructional design strategies were actually used by WBI personnel, verification processes need to be conducted using appropriate Web accessibility verification programs such as Bobby. In addition, further research need to be conducted 1) to identify the appropriateness and applicability of the WBI course(s) those practical strategies themselves identified from this study and literature reviews, and 2) to compare the WBI course(s) those practical

strategies are applied to the regular WBI course(s) those strategies are not applied.

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