How Accessible is EDUNET Contents?

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Korea has enacted "Individuals with Disabilities anti-Discriminatory Act" in 2008, and is actively promoting and propagandizing the law, but it is still at its infancy in comparison to other advanced countries in terms providing Web accessibility consideration for the recipients. Although the disability act was passed in April, 2008, and has been in legal force since the beginning of 2009, there still are many people who are having difficulties to obtain not only the Web accessibility but also for accessing media, obtaining telecommunication equipments, and accessing e-learning contents. This study is to investigate the accessibility of public contents offered for all students, teachers, and parents for free provided by the Korean Ministry of Education and Science such as EDUNET. The purpose of this study is to investigate the level of accessibilities of digital contents provided by EDUNET which is a part of public services. In the last 10 years, it provided and heavily used by K-12, and it has been most often used digital resources inside and outside of schools. Thus, EDUNET should guarantee access for all learners regardless of their physical or mental limitations. Based on FAE (The Functional Accessibility Evaluator) evaluation on five categories and its subcategories in its structures and styles, the contents fell far short in access. Thus, it requires immediate need of improvements to provide equal access for universal learners. Scripting had an average 'Pass' rate of 46%, but most of the contents received 'Fail' on HTML Standards, Scripting, and Text Equivalents. The result indicates that students with low visibility or hearing limitations cannot access the materials, nor benefit from using them. The implication of this study also points that all future digital contents should consider universal access and learning for all different learners. Digital contents, including EDUNET which is a part of public services, should guarantee equal access, and opportunities to benefit from them.

Keywords: web accessibility, universal design for learning, digital contents, EDUNET, functional accessibility evaluator (FAE)

INTRODUCTION

Based on 2008 statistics, majority of the population in Korea were Internet users getting educated or receiving instructions, and over 5.8 million primary and secondary students were receiving various forms of instructions and other instructional related services. Specifically, many teachers and students were receiving e-Learning through EDUNET services, e-Learning through The Cyber Home Learning System of National Teaching-Learning Center, and other e-Learning through EBS for during class as well as after-school programs. Among these EDUNET started its service at the beginning of the Internet era in 1996 by the National Educational Information Service System, and in 2008, applied the Web Service 2.0 to accommodate paradigm shift in which concept of opening, participating, co-ownership, and cooperation was applied for practicality for all users (teacher, students, parents) to support information whenever and wherever the easy and faster way. EDUNET is now one of many public services provided and often used to support public educations. Therefore, it must be practical enough to allow access to web contents and instructions without limitation for students with different limitations and abilities.

Instruction and education service – EDUNET is a type of universal educational information service system to meet the fast changing need of the informational society to actively accommodate and to support all educational information for all students, to share and to apply whenever and wherever. In 2008, "Individuals with Disabilities anti-Discriminatory Act" Section 21 Clause 14 mandated all public and private Web sites to apply accessibility for all citizens including disabled, seniors, non-disabled, youth and for all other users to be provided for the infrastructure and environment for all to have equal access to e-Learning contents.

This study intends to provide suggestions to improve Web accessibility of EDUNET and future national instruction and educational services by examining the National Teaching-Learning Center, EDUNET, as well as the concept of Web accessibility, the current status of national and international Web accessibility for all disabled citizens to view quickly the Web information and to utilize it, for all Web developers for structure and HTML styles relating to Web accessibility for using and evaluating functional Web accessibility using FAE (Firefox Accessibility Extension) in order to evaluate and analyze the web accessibility of the EDUNET to analyze problematic areas.

LITERATURE REVIEW

National Teaching-Learning Center – EDUNET

EDUNET is one of the main support systems to provide contents on national curriculum whenever and wherever needed for effective and practical e-Learning for teachers, students, and parents. It has strengthened and expanded relationships with 16 Districts of Educational Offices and education related offices to build a integrated support system to provide for instructional and educational informational systems for free professional counseling services, subjects based on national curriculum, mentor students by cyber teachers. In terms of services for students, city and district level Cyber Home Education was prepared to unify and to connect the services for teachers, students, and for service for national infrastructure to unify educational information services.

The following are the four services provided by EDUNET (KERIS, 2008).

First, it is the nationally decentralized educational system to connect all educational resources. It provides services for school instructional and educational linking services for all educational services in the central as well as city and district level educational information services to build a centralized central instructional and educational support center, city and district instructional and educational support system, and for school instructional educational help center.

Second, the class materials, research and training materials, evaluation questions that teacher can easily utilize, Cyber Home schooling for students, excellent class contents as well as statistical and other information for self-study are provided.

Third, it provides services for exchange of knowledge for the locality, classes, and among individuals-to-individuals. It provides support to revitalize e-Learning and other classroom teaching methods for on- and off-line, and provides consulting services to exchange knowledge in the areas of classroom studies, methods, examples on 1:1 or 1:n basis. In addition, it is forming a nation-wide network of teachers to share research achievements, co-own achievements, and support growth for expertise.

Fourth, it is continuously forming foundations for the use, analysis, evaluation of usage, etc. of eCRM/CMS to support for demand for usage. Teacher, students' combined search functionality, login policies all fall into the category of individualizing services for customized usability.

As such, EDUNET is fulfilling its duty to provide public education service, and it is unnecessary to explain the importance of accessibility for all students.

Web Accessibility

According to Tim Berners-Lee who developed World Wide Web said that accessibility is the space where people without regards to disability can easily access information (Hyun, 2006). This is defined as the generalized demand for accessibility for facilities, services as the basic provision for appropriateness, skill levels, skills, need, preferences, environment for usage, content that may adhere to the use by the

users(Lee, 2006). As the importance of the Internet is expanding, Web accessibility is becoming more important although the definition of Web accessibility differs depending who or what institutions use it.

Table 1. *The Definitions of the Web Accessibility*

Sources	Definition of Web Accessibility
W3C WAI	Web accessibility means that people with disabilities can use the Web. Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web.
Wikipedia	The practice of making websites usable by people of all abilities and disabilities. When sites are correctly designed, developed and edited, all users can have equal access to information and functionality
Microsoft(2002)	Allow access for all to use all products and services

Web accessibility is accessing all Web-based information equally for the disabled, for senior citizens, or for anybody else, under any circumstances without expert knowledge.

National Policies on Web Accessibility

For the nation, provision for improved web accessibility started when Ministry of Information and Telecommunication enacted "Recommendation guidelines for improved accessibility for the Disabled and Senior Citizens" in January of 2002. As of December, 2005, technical standards for Web accessibility were enacted for the national standard, and starting from June 2006 web accessibility was included in the information related evaluation form by the Government Service Evaluation Standard Act. Based on TTA (Telecommunication Technology Association) which was enacted in 2004 to be the group standard for web accessibility of the KWCAG 1.0 (Dec 2003) was created with the focus of improving standardization of information communication accessibility. In April of 2008 according to the "Individuals with Disabilities anti-Discriminatory Act" compliance of Web accessibility in stages became mandatory for private industry, and the same law mandated compliance of the enactment of accessibility guidelines for Web contents.

In addition, government has been spear-heading the efforts to investigate in stages the current status of the Web accessibility, and is expanding the efforts to train the personnel for Web related public services with expertise in specific training as well as to select and award organizations with the excellent track records of Web accessibility (Ministry of Public Administration and Security, 2008). However, due to lack of training and understanding on issues relating to Web accessibility, not only are they incapable of securing Web accessibility but also the developers and operators do not understand how to obtain accessibility and therefore, end up developing Web sites without any consideration for accessibility.

Web Accessibility Assessment

There are many web accessibility tools available on-line. One of the worldly known organization leading and providing web accessibility guidelines lists more than 100 tools to assess web accessibility. These tools assess web and software accessibility. In Korea, as a national standard, KADO-WAH 2.0 was developed by Korea Agency for Development Organization, and it is available on-line.

Assessments for Web accessibility in the nation is evaluated using various assessment tools in various areas, and the following are the current activities that have been reported. First, the research project of Web Accessibility Evaluation of Cyber Universities' Contents in Korea was conducted with ten (10) cyber universities in the nation for assessment centered around the technological aspect of Web accessibility using the A-Prompt evaluation tool to analyze Web accessibility. The result of the assessment shows that the use of alternate text and support for manual for the use of assistive technologies have improved in many categories, however, problems for the use of Web contents provided by the national cyber universities still exist(Lee & Lee, 2007).

Hwang (2007) has applied KADO-WAH 2.0 and the national standard for expert level for web accessibility that have been used as an evaluation guideline for certification program to assess five (5) different content sites. The result of the assessment is that all five (5) web sites scored less than 50 points in average scores, which indicated that almost all web sites did not adhere to the standards for web accessibility. Another study evaluated compliance of web accessibility guidelines of three (3) hospitals' web sites located in Seoul using KADO-WAH 2.0 to specifically evaluate fourteen (14) categories for specific items including technical text of HTML pages, images, applets, and plug-ins (Lee, 2006). The result of the evaluation shows that in general users had difficulties in understanding and recognizing the contents provided in the web sites because none of the hospitals provided alternate texts for images, image maps, and scripts, which, by the way, did not provide a way for users to link to other appropriate sites when needed.

A Study on the Web accessibility evaluation of 5 public libraries in Seoul (Kang, 2005) conducted using the A-Prompt evaluation tool and HTML Validation evaluation of W3C. As a result all five (5) public library web sites were found 'Fails' with errors of Text Equivalents and HTML Standards. In other words, these public web sites need improvement to provide equal access for all citizens, and their web accessibility did not consider using alternative media to provide image or videos without text equivalents. Hyun, Kim, & Kim (2006) conducted a research study using automated evaluation tool, KADO-WAH 2.0, which was developed by KADO to measure the compliance of web accessibility of 40 financial web sites that are most heavily used in the nation. The result showed that the web accessibility level for domestic companies was much less compliant than that of the foreign companies, and stock brokerage companies showed the worst of all. In terms of compliance for usage of alternate texts, the domestic rate was 3.5 less and the use of frames was 2.2 less than that of the foreign companies.

RESEARCH METHOD

This study evaluated accessibilities of web contents on EDUNET using the automated evaluation tool called FAE (The Functional Accessibility Evaluator). FAE is a tool developed for the State of Illinois in USA to assess Section 508 of the federal "Anti-discrimination of Disabled Persons Act," and to ensure that all disabled citizens to access all web-based information. FAE is one of the many tools used to evaluate accessibilities of the web documents. Using FAE, automated tool, it provided detailed printout for each areas and ways to improve them. First, it identified which areas needed improvements on web documents/contents, and next is that the experts would go in to fix the problematic areas to improve their accessibilities. The reporting results could be used as guidelines for improvements, and developers would use HTML styles for functional web accessibility.

FAE is a tool developed for the State of Illinois to assess Section 508 of the federal "Anti-Discrimination of Disabled Persons Act" and to ensure that all disabled citizens to access web-based information, and requires all developers to evaluate HTML styles for functional web accessibility before posting it on the web.

FAE evaluated web contents using five main categories and 16 subcategories. FAE evaluated Main Home Page and 18 subpages of EUNET web contents. The FAE webpage shows the list of five main categories and 16 subcategories, and these are noted in Table 2 and Table 3 below.
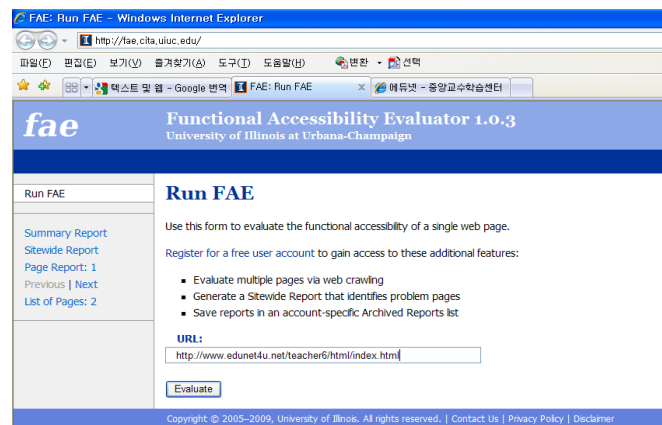
Figure 1. *Evaluation of FAE web accessibility*

Contents of the five Main categories are shown in Table 3, and Table 4 shows 16 subcategories. Status values are based on aggregated evaluation results of Pass, N/A (not applicable) and Warning, as defined in the following Table 2. If a web document has 100% shows Pass or N/A on a page, then it has no need of changes. However, Partially Implemented or Not Implemented shows 0-94% is considered failed. It is very important to notice that the results will show either 'completed' or 'failed.' When it showed 85%, it doesn't mean 85% pass. It is failed but it may have less Warnings.

Table 2. *Status Value Definitions*

Value	Percent	Result
Complete	100	Pass+N/A
Almost complete	95-100	Pass+N/A+Warn
Partially Implemented	40-94	Pass+N/A+Warn
Not Implemented	0-39	Pass+N/A+Warn

Table 3 and 4 shows 16 subcategories of the five main categories used by FAE to assess individual web contents' accessibilities. Table 3 shows five main categories of assessment, whereas, Table 4 shows Main categories vs. 16 subcategories as below.

Table 3. *Main Category of Assessment*

Main Category	Analysis of Document
Navigation & Orientation	Inclusion of structural markup that facilitates navigation and contextual orientation
Text Equivalents	Proper use of images for interoperability and the provision of text descriptions for non-text content
Scripting	Avoidance of scripting techniques that compromise accessibility and interoperability
Styling	Use of CSS styling techniques to separate content and structural information from styling and presentation
HTML Standards	Support for HTML standards to improve interoperability and provide more choices in the use of technologies for rendering web content.

As shown in Table 4, FAE evaluation is heavily focused on Navigation & Orientation when compared to Styling or HTML Standards.

Table 4. *Subcategory of Main Category*

Main Category	Subcategories
Navigation & Orientation	Title(title & H1), Subheadings, Navigation Bars, Form Control Labels, Default Language, Data Tables, Access keys, Frames
Text Equivalents	Information Images, Decorative Images, Image Maps
Scripting	onclick, onmouseover & onmouseout
Styling	Text styling, Layout Tables
HTML Standards	W3C Specifications

To evaluate using the FAE, we need to categories the list of IP addresses into a table to make use of the results provided by FAE. When we insert IP address into FAE, it provides results by each category and its passing rates with some descriptive information. The procedures are as shown in the Figure 2.
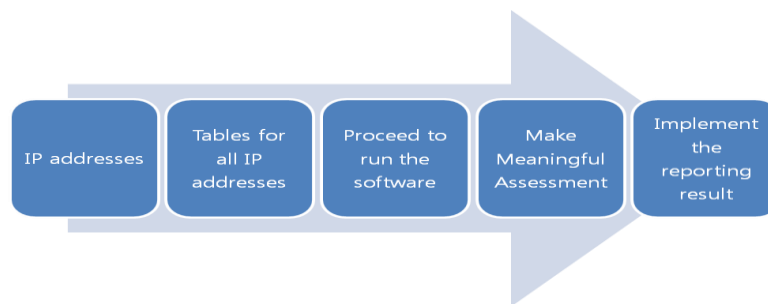

Figure 2. *The procedures for FAE*

RESULT

The evaluation of the study shows that, after the analysis of the EDUNET's main web page and 18 other sub pages were using FAE tool, while it was required that all categories should have been compliant of the web accessibility regulations, it was determined that even the basic needs were not fulfilled for those in need of special education.

The results showed that the main pages scored good accessibility scores showing 100 percent Pass, but the rest of the pages showed low scores ranging from 0 – 83 percent. This indicates that when a user visits one of the EDUNET's web pages for various services, one is not guaranteed to receive web accessible services. Of the five (5) categories, Scripting had an average of Pass 46 percent, Warn 54 percent, Fail 0 percent showing relatively low scores comparing to other categories, and in the evaluation of Text Equivalents category, the average of Warn was 24 percent, Fail 12 percent and Pass 63 percent. The result could be summarized as below Table 5.

Although according to W3C, WCAG (Web Content Accessibility Guidelines), and other web accessibility guidelines, all contents provided should be in the format that all could understand, such as, images, audio and video files, scripts, and alternate text to explain the meaning of the contents and functions rather than in text formats, however, of all the evaluative categories, the category of Text Equivalents that particularly relates to alternate text showed high rate of failure.

In addition, EDUNET evaluation results, Pass of 'onmouseover & onmouseout' in Scripting and 'Layout Tables' in Styling showed low scores. When using Mouse Event (onmouseover & onmouseout) Keyboard Event (onfocus, onblur) should be offered equally. In other world, web contents should be able to use with keyboard alone, the category of Scripting which relates to keyboard browsing of the web sites had an

average Pass rate of less than 50 percent, which practically means the web accessibility was not guaranteed.   As seen in Table 5, none of the pages had fully complied with the work.

Table 5. *EDUNET Status Value Definitions of Main Category*

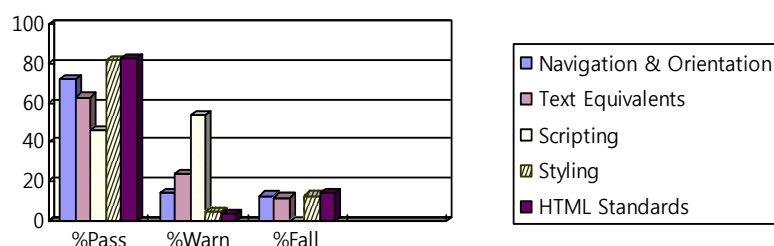| Subcategory	Status	Pass	Warn	Fail
Navigation & Orientation	Partially Implemented	72%	14%	13%
Text Equivalents	Partially Implemented	63%	24%	12%
Scripting	Partially Implemented	46%	54%	0%
Styling	Partially Implemented	82%	5%	13%
HTML Standards	Partially Implemented	83%	4%	14%

Figure 3. *EDUNET evaluation results of main category*

As shown above, of the five (5) categories, Scripting had an average Pass rate of 46 percent, Warn 54 percent, and Fail 0 percent, which indicate "better accessibility" than any other categories. Text Equivalents, however, had an average of Warn 24 percent and Fail 12 percent which indicates 'very poor accessibility.' This shows that the functionality of Text Equivalents that allows all users to access web contents just by keyboard alone using alternate text and 'HTML Standards' are not yet evidently accessible for all users, especially for people with disability and the students with special needs. The result could be summarized as below Table 6.

Table 6. *EDUNET Status Value Definitions of Main Category*

Category	Status	Pass (%)	Warn (%)	Fail (%)
Navigation & Orientation	Titles (title & h1)	53	33	13
	Subheadings (h2..h6)	63	21	15
	Navigation Bars	76	23	0
	Form Control Labels	79	0	21
	Default Language	58	0	42
	Data Tables	84	0	16
	Access Keys	100	0	0
	Frames	100	0	0
Text Equivalents	Informative Images	50	0	50
	Decorative Images	52	48	0
	Image Maps	100	0	0
Scripting	onclick	77	23	0
	onmouseover & onmouseout	36	64	0
Styling	Text Styling	90	0	10
	Layout Tables	45	29	27
HTML Standards		83	4	14

CONCLUSIONS

Accessibility has been gaining attention recently in Korea. However, it has been steadily progressed last ten years elsewhere in the world. In Korea, it drew attention due to enactment of the "Anti-Discrimination Disability Act" in 2008. This law requires guarantee access for all, and that includes digital web contents. Information provided on the web must contain alternative forms of media for "universal access and learning."

In this study, FAE evaluated web contents using five (5) main categories and subcategories for Main pages and 18 subpages of EUNET web contents. Those main categories include Navigation & Orientation, Text Equivalents, Scripting, Styling, and HTML Standards. As a result, there were many contents with a mark 'Fail,' especially for HTML Standards, Scripting, and Text Equivalents, and many 'Warning' indicate immediate need of improvements. Of the five (5) categories, Scripting had an average 'Pass' rate of 46% but   Text Equivalents had an average of 24% Warning and 12% Fail.

In order to overcome the problems associated with accessing instructional materials and services at anytime and place, as easily for anyone, and the ability to practically access the web contents related to instructions without limitations need to be improved first. In order to that, there needs to be a time to actively change the understandings of developers and operators. Even until this day, the developers and operators who are in active employment at this time lacks understanding for the needs of the disabled. With the correct understanding of the different types of disability and how web accessibility tools can be used to realize the true web accessibility levels, the users continuously need to assess the effort. Including the usability test for disabled as well as for senior citizens from the very beginning of the project will help improve web accessibility for all.

In addition, continuous development and maintenance of the web contents with accessibility is critical for continued effort. More and more educational web contents are revised to provide more diverse instructional and educational materials. Web contents should be developed to continuously provide educational materials for all users by considering web accessibility issues during development and for maintenance of materials, and not develop the disposable type of web contents. At the national level, more support for research regarding web accessibility is necessary to actively improve the understanding of the developers and operators regarding web accessibility, and also to develop and cultivate experts on issues relating to web accessibility through medium- to long-term educational programs, such as, the use of appropriate web accessibility examples and use of campaigns.

This study was focused on web accessibilities of EDUNET contents, and there are more digital resources such as digital textbook and e-Learning contents that need to study on its accessibilities. Currently, most e-Learning contents and Web sites use Flash to develop its contents. However, up until this day tools such as Flash for development of e-Learning contents as well as other evaluative tools have not yet been measured for compliance of web accessibility. Therefore, more research to study the relatively newly developed tools such as Flash for development of contents as well as e-learning contents accessibility specification and rules need to be examined.

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