Web Accessibility on Thai Higher Education Websites

Rattanavalee Maisak
Edith Cowan University
School of Computer and Security Science
Perth, Western Australia
r.maisak@our.ecu.edu.au

Justin Brown
Edith Cowan University
School of Computer and Security Science
Perth, Western Australia
j.brown@ecu.edu.au

***Abstract*—This paper examines web accessibility compliance in a sample of universities in Thailand. The Thai government has made a commitment to higher education and e-learning and has also signed on to the Convention on the Rights of Persons with Disabilities (CRPD). This paper shows that the web accessibility does not appear to be adopted by the universities examined in this study, with minimal compliance to the W3C Web Content Accessibility Guidelines 2.0. In particular, the Perceivable and Operable aspects of the guidelines seemed problematic in terms of the numbers of reported accessibility errors.**

Keywords-web accessibility, higher education, WCAG, evaluation.

I. INTRODUCTION

In the context of a web connected world, it falls to governments and organizations to focus on how they develop online information that is accessible to all, including people with disabilities. The World Health Organization (WHO) estimates that there are over 600 million people with disabilities living across the world moreover, some of those people experience barriers in accessing information and communication technologies [1]. As a result, countries such as Australia, the United States of America and Canada have developed and promoted web accessibility in their policies in order to minimize the barriers which prevent disabled people from participating in those societies. This paper examines accessibility in the Thai context, as the Thai government has made a formal commitment to the development of e-learning in Thailand as well as that of web accessibility.

The Thai government has been a signatory to the Convention on the Rights of Persons with Disabilities (CRPD) since 2007 [2]. In terms of the CRPD, the Thai government devotes significant resources to ensuring that people with disabilities in Thailand have equal rights with others. The Rehabilitation of Disabled Persons Act 1991 and the National Education Act 1999 were passed in order to improve learning opportunities of Thai students with disabilities [3][4]. However, research indicates that there is still a lack of educational facilities for students with disabilities in Thailand resulting from insufficient law enforcement and negative attitude of stakeholders [5]. Consequently, the needs of students with disabilities are not adequately supported through educational options. It is the belief of these authors, and of the wider literature that students with disabilities should be treated as equals, especially in the context of access to education suitable to their needs. As higher learning predominately takes place within a nation's university sector, this research aims to investigate the accessibility of Thai higher education websites. The rationale is that the level of accessibility of these university websites will in some small way reflect Thailand's adherence to its own legal requirements for equitable access to higher education.

II. RESEARCH QUESTIONS

This paper examines the research questions of 'what level of web accessibility is apparent in Thai universities against WCAG 2.0 guidelines' and 'against which aspects of the WCAG are the most issues seen'? The paper will address these questions by examining a number of Thai university websites, looking at both the main university webpages and publically visible pages containing e-learning content.

III. LITERATURE REVIEW

A. Accessibility Guidelines

Web accessibility is not a new concept and one can trace its origins back to the mid twentieth-century. The Americans with Disabilities Act (ADA) approved by the U.S. Congress in 1990 cemented protections against discrimination to Americans with disabilities. It guarantees equal opportunity for individuals with disabilities in terms of public transportation (in Title II), public accommodations (in Title III) and telecommunications relay services (in Title IV) [6]. The potential protections of the Rehabilitation Act, ADA and the popularization of the Internet support the need to make the web accessible [7].

The World Wide Web Consortium (W3C) created the Web Accessibility Initiative (WAI) on 7 April 1997 in order to develop protocols and guidelines that ensure the web for all [8]. The Web Content Accessibility Guidelines (WCAG) were created in order to promote the accessibility of websites. The WCAG 1.0 guidelines were released on 5 May 1999 and were replaced with WCAG 2.0 in 2008. The aim of WCAG 2.0 is to increase the accessibility of websites for people with disabilities according to the four POUR principles [9].

"Perceivable" means that web content and user interface modules must be offered to users in multiple formats in order

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to meet users' perceptions. “Operable” means that the user interface and navigation components should be designed in a way that they work properly, especially in terms of assistive technologies. “Understandable” is about making websites understandable in terms of language levels, correcting errors and predictability. “Robust” refers to the capacity of websites to be interpreted by a variety of user agents.

WCAG 2.0 is divided into 12 guidelines, which are classified according to three conformance levels (A, AA and AAA) in order to respond to the different needs of people with disabilities. Moreover, WCAG 2.0 concerns problems of interference on the use of the page by unsupported technologies through four critical failures:

1. Checkpoint 1.4.2 Audio control - the control over audio is available to pause or stop.
2. Checkpoint 2.1.2 Keyboard trap - keyboard focus can be moved throughout webpage.
3. Checkpoint 2.2.2 Pause, stop or hide – providing the control over moving, blinking, scrolling, or auto-updating information which display more than five seconds.
4. Checkpoint 2.3.1 Three flashes or below threshold – content must not flash more than three times in one second.

WCAG claims that if a webpage does not meet those requirements, then people with disabilities will not be able to utilize the content of the given web page. There is a body of literature which argues that WCAG 2.0 provides guidelines only, and that they are not definitive when it comes to deciding if a webpage is accessible or not. However, this paper will be using WCAG 2.0 as the standard against which webpages will be evaluated.

B. Web Accessibility Evaluation

Automated tools are powerful evaluation tools for locating inaccessible elements in a website, however, relying on one tool cannot guarantee the accessibility of whole website [10]. The W3C provides a list of over 100 checkers in term of “Complete List Web Accessibility Evaluation Tools”, with these tools ranging from page-at-a-time checkers through to whole of site conformance evaluators [11]. Generally, automated tools are based around web accessibility standards and can typically be locally installed on a desktop environment, as a cloud service or as a local browser extension. One of the advantages of cloud based tools is that they do not platform specific as are most browser based plug-ins.

Manual testing is an alternative method, though in most cases should be considered a complimentary method to automated assessment. The evaluation of websites for accessibility requires human inspection moreover, W3C also recommends the combination of expertise and users in evaluation processes [12]. Automated tools are also troublesome in terms of presenting false positives and false negatives, issues that can usually be overcome by human evaluation. Obviously, the trade-of is that an automated assessment can cover a lot of pages or an entire site in a short period of time, whereas human evaluations can typically address only a small number of the total pages in a site.

C. Related Work

The evaluation of web accessibility for top international university websites reported that the websites of universities across different countries and regions had accessibility issues [13]. The study utilized a multi method approach using four automatic tools and manual tests, with the websites being selected from Times Higher Education Ranking. By looking at the average accessibility errors, universities in Asia were the most inaccessible websites followed by North America, Europe and Oceania (Australia and New Zealand). Moreover, the results when examining university policy indicated that less than half of those policies provide specific technical actions for resolving accessible websites issues. This implies that university websites may not be reliable resources to find accessibility solutions.

A study comparing the accessibility of one hundred universities’ website in The United States of America indicated that the university webpages failed to meet basic WCAG 1.0 guidelines, especially priority 2; moreover, the university homepages had the highest number of errors [14]. The authors suggest that universities should ensure compliance with web accessibility standards such Section 508 and WCAG guidelines in order to support services and facilities available to students with disabilities. However, the study used the superseded WCAG 1.0 guidelines and an automated tool called “Test Accesibilidad Web (TAW)”.

A study of the accessibility of Spanish university websites demonstrated that there was low level of accessibility conformance on Spanish university websites with 95.50% of webpages failing to meet the UNE 139803 [15]. The UNE 139808 is based on WCAG 1.0 and is the Spanish government’s policy document regarding accessible web content. Moreover, the study showed that over 60% of webpages failed HTML and CSS Validations. Again, this study use automatic tools, such as TAW, the W3C Validation Service and the W3C CSS Validation Service.

The investigation of accessibility in 20 Finnish higher education‘s institutes websites revealed that the tested websites had low inaccessibility levels in priority 1 (14 websites) and priority 2 (12 websites), followed by the high inaccessibility levels in priority 2 (8 websites) and the full accessibility level in priority 1 (6 websites) [16]. The study used TAW with the recommendations of Finnish Quality Criteria for web Services which is based on WCAG 1.0 and is published by the Finnish government. The authors suggest that those websites should be modified in order to achieve the full accessibility level (as defined in their study).

Finally, a study evaluating web accessibility and usability at Thailand Cyber University (TCU) for totally blind users stated that none of the selected webpages met a minimum requirement of WCAG 2.0 in automated testing [17]. The author claims that TCU which is the biggest e-learning provider in Thailand and that the entire website has endemic accessibility problems.

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IV. RESEARCH DESIGN

A. Scope of Investigation

From the larger study on which this paper is based, nine higher education websites in Thailand were selected from the top five ranked Thai universities [18], two open universities, one special college for students with disabilities and one online institution. We chose this list as it offered a variety of institutions and delivery modes, from online only through to mixed mode and disability specific. Seven representative webpages were tested from within each of the university web sites, including the university homepage, library, webmail login page, contact us, e-learning portal homepage, e-learning forums and publically available e-learning content. There is a significant body of literature regarding web accessibility auditing methodology, most of which indicate that common pages (that most web sites would have) should be evaluated as a priority. The Website Accessibility Conformance Evaluation Methodology (WCAG-EM) 1.0 also indicates that accessibility evaluation should include the common webpages of the target website such as homepage, login page and contacts page [19]. Moreover, homepage and level one (all links visible from the homepage) of a website are appropriate for accessibility auditing [20][21]. As this paper examined university web pages, an effort was made to audit pages from the university websites as well as any available e-learning content, which are typically housed in systems different to those containing the main university website. The universities examined in this study represented a number of different types, including;

- Common: primarily an on-campus teaching mode with some support for online delivery
- Open: primarily an online institution, with some required on-campus delivery, such as exams and tests.
- Online: a purely online teaching environment.
- Special: mixed mode of delivery aiming at supporting students with a variety of disabilities

The breakdown of the four groups in this study in terms of web pages (N = 189) examined by automated assessment is Common (105 webpages), Open (42 webpages), Online (21 webpages) and Special (21 webpages).

B. Method

A number of researchers suggest the advantages of combining automated and manual testing techniques in order to ascertain the level of accessibility of websites [12][22]. Automated testing is driven by those systems that can scan a web page or an entire site and report on the errors that can be tested without human intervention, such as issues with alt text, color contrast and markup validation. Manual testing sees 'expert' human evaluators examine a smaller subset of pages, looking at visual and coding elements to see where violations against WCAG 2.0 exist, as well as where actual usability issues may be apparent. The webpages were evaluated by automated and manual testing based on WCAG 2.0 guideline at level A and AA.

SortSite [28] was used to audit all pages at level one of each of the websites (i.e., all pages linked from the homepage), whilst WAVE was used on each of the seven pages being examined (as WAVE is page-at-a-time tool) manually. Manual evaluations were conducted for the same seven pages, and for each of the seven pages we counted the number of failures identified based on WCAG requirements, with the results being categorized by POUR principles. Table I shows the breakdown of WCAG 2.0 in terms of checkpoints, for A and AA only. As Table I illustrates, the Perceivable principle contains the most checkpoints (and points of potential failure), with nine at level A and five at level AA, through to Robust with only two checkpoints at level A.

TABLE I. POUR PRINCIPLES CHECKPOINTS ACROSS LEVELS A-AA

Principle	Level A	Level AA	% of total
Perceivable	9	5	36.84
Operable	9	3	31.58
Understandable	5	5	26.32
Robust	2	0	5.26
Total	25	13	100%

The scoring values are '0' and '1', with a '0' score meaning that no violation of a checkpoint was identified using either the automated tools or via manual assessment. A score of '1' did indicate that the page in question produced a violation of a given WCAG 2.0 checkpoint. Figure 1 shows an example of the data collection against the POUR principles using the various testing methods used in this research, being automated multi-page, automated page at a time and manual assessment.

WCAG 2.0 Principles and Guidelines	Level	Automatic		Comment	Manual	Comment
		WAVE Score	SortSite Score		Score	
1. Principle: Perceivable						
1.1. Text Alternatives						
1.1.1. Non-text Content -	A	1	1		1	Missing all ALT text.
1.2. Time-based Media: Provide alternatives for time-based media						
1.2.1. Audio-only and Video-only (Prerecorded)	A					
1.2.2. Captions (Prerecorded)	A					
1.2.3. Audio Description or Media Alternative (Prerecorded)	A				1	No CC on Youtube
1.2.4. Captions (Live)	AA					
1.2.5. Audio Description (Prerecorded)	AA					
1.3. Adaptable						
1.3.1. Info and Relationship	A	1	1		1	Incorret HTML coding the text represents as a list.

Figure 1. Example of data collection

V. RESULTS AND DISCUSSION

The collected data was tested for normal distribution. The Shapiro-Wilk test was used and found to be non-normally distributed with $p < .05$ [30]. Therefore, the analysis used nonparametric tests for comparing the differences in the

mean scores. The focus of the analysis was on the errors found overall as well as the distribution of errors across the POUR principles.

TABLE II. MEAN OF POUR VIOLATIONS

	P	O	U	R
Chi-Square	12.888	10.946	4.487	4.144
df	3	3	3	3
Asymp. Sig.	**.005**	**.012**	.213	.246

a. Kruskal Wallis Test
b. Grouping Variable: course mode

Table II demonstrates that there were statistically significant differences in mean scores of the webpages regarding POUR violations at Perceivable, X^2 (3, N = 189) = 12.89, p = .01, Operable, X^2 (3, N = 189) = 10.95, p = .01 however, there were not statistically significant differences in mean scores of the webpages regrading the course mode category at Understandable, X^2 (3, N = 189) = 4.49, p = .21 and Robust, X^2 (3, N = 189) = 4.14, p = .25. It can be interpreted that there are differences in the mean scores of the webpages (in terms of errors) regarding POUR violations at Perceivable and Operable principles, but not Understandable and Robust principles, which could be caused by the lower number of checkpoints and thus lower number of potential error points available within these principles. A Post hoc test was conducted to determine which university groups are different (Table III).

TABLE III. VIOLATIONS PER PAGE AGAINST UNIVERSITY TYPE

GROUPS		P	O	U	R
Common	Mean	**2.74**	2.18	1.86	.75
	N	93	93	93	93
	SD	1.950	1.628	1.486	.816
Open	Mean	2.15	1.94	1.39	.61
	N	33	33	33	33
	SD	1.839	1.478	1.116	.788
Online	Mean	2.00	**2.50**	1.64	.57
	N	14	14	14	14
	SD	1.301	1.557	1.550	.756
Special	Mean	**1.22**	**1.06**	1.17	.33
	N	18	18	18	18
	SD	.943	1.211	1.200	.485

By looking at the average errors in the POUR principle per page, most errors were found at the Perceivable followed by Operable, Understandable and then Robust principles. The Perceivable and Operable outnumber Robust violations, with almost double the number of errors. For example, the Common group had the average error at Perceivable (2.74 errors per page) and Operable (2.18) compared to Robust (0.75). This dataset indicates that most Thai institution websites have common accessibility problems related to providing information in multiple formats and lack awareness of control over the web interface (see Figures 2 and 3). By looking at the different course modes, the results indicate that the Special group performs the best in terms of web accessibility with the lowest numbers of errors at all POUR principles with average 1.22, 1.06, 1.17 and 0.33 respectively (see Table III). This may be because the special institutions are strongly committed to providing accessible resources and educational services for students with disabilities and is perhaps not surprising that those webpages contain content which is fit for purpose.

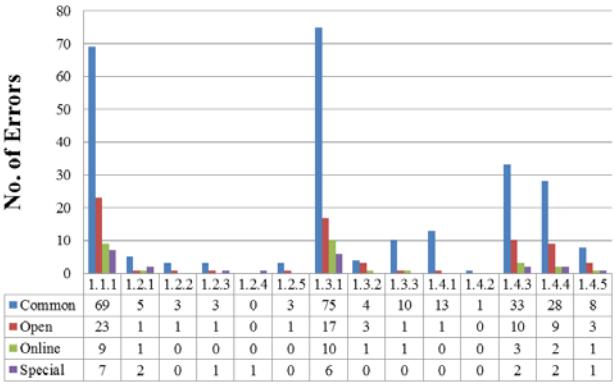

Figure 2. Breakdown of violations within Perceivable

By looking at the Perceivable principle, the highest total numbers of errors were found at checkpoints 1.1.1-Non text Content and the checkpoint 1.3.1-Info and Relationships with 108 errors (see Figure 2). Furthermore, the highest number of errors were found at checkpoint 1.1.1-Non text Content with 69 errors (Common), 23 errors (Open), 9 errors (Online) and 7 errors (Special) and the checkpoint 1.3.1-Info and Relationships with 75 errors (Common), 17 errors (Open), 10 errors (Online) and 6 errors (Special) respectively. This implies that most Thai institution websites have serious problems related to alternatives for non-text content and web structure and relationships (such as inconsistent use of heading styles to denote page structure).

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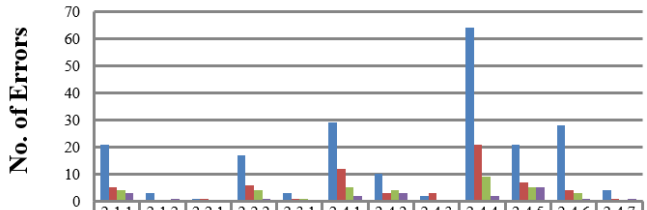
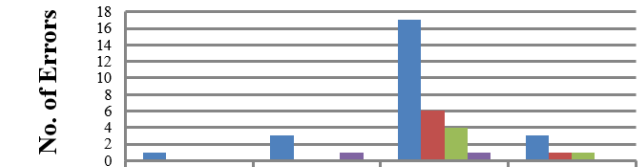


	2.1.1	2.1.2	2.2.1	2.2.2	2.3.1	2.4.1	2.4.2	2.4.3	2.4.4	2.4.5	2.4.6	2.4.7
Common	21	3	1	17	3	29	10	2	64	21	28	4
Open	5	0	1	6	1	12	3	3	21	7	4	1
Online	4	0	0	4	1	5	4	0	9	5	3	0
Special	3	1	0	1	0	2	3	0	2	5	1	1

Figure 3. Breakdown of violations within Operable

By looking at the Operable principle, the highest total numbers of errors were found at the checkpoint 2.4.4-Link purpose with 96 errors (see Figure 3). The breakdown of errors at checkpoint 2.4.4-Link purpose were 64 errors (Common), 21 errors (Open) and 5 errors (Online and Special). The dataset indicates that the websites would have critical problems in terms of descriptive links, with the most prevalent issue being the 'read more' link issues, which users of assistive technologies find to be singly uninformative.

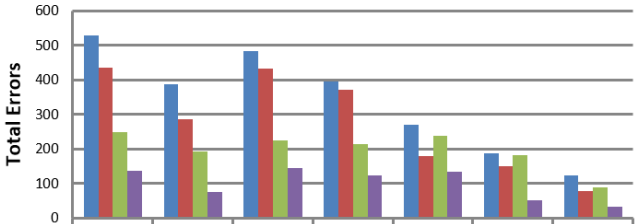


	1.4.2	2.1.2	2.2.2	2.3.1
Common	1	3	17	3
Open	0	0	6	1
Online	0	0	4	1
Special	0	1	1	0

Figure 4. Breakdown of critical failures

By looking at the critical failures, most errors were found at the checkpoint 2.2.2 followed by 2.3.1, 2.1.2 and 1.4.2 for all groups. The most errors were found at the checkpoint 2.2.2 Pause, Stop, Hide with 17 errors (Common), 6 errors (Open), 4 errors (Online) and 1 errors (Special) (see Figure 4). The dataset indicates that Thai institutions have problems involving the control over moving, blinking, scrolling, or auto-updating information which displays for more than five seconds – especially in terms of slideshows and carousels found on website homepages.

Figure 5 indicates the total number of errors found across the nine university sites for the seven pages tested in each of those sites. The results show that the university homepages had the most number of accessibility errors, not an uncommon finding in the literature [23][24] followed closely by the library pages. This is due in part to the number of links, content and multimedia items that both of these pages tended to contain, with contact us pages being problematic due to poor form design (lack of labels) and that the correct page language was not indicated (having English instead of Thai). Whilst the latter issue is not something every user would notice, lack of correct language identification for a page is an automatic fail of the Understandable principle, level A.



	University Homepage	E-learning Homepage	Library	Contact Us Page	Webmail Login Page	E-learning Forum	E-learning Content Page
P	529	387	483	396	270	189	125
O	435	287	433	371	179	151	78
U	248	193	225	215	239	182	89
R	136	77	144	124	134	52	32

Figure 5. Total violations across tested pages

The e-learning pages that were tested tended to fair better than the main university pages due to their general lack of multimedia content, with most of the content being text based materials coming out of e-learning tools such as Moodle [29]. Content management systems such as Moodle also address WCAG 2.0 guidelines to varying degrees [25], which is likely to have also contributed to a slightly higher level of accessibility for these pages as opposed to the main university pages.

VI. CONCLUSIONS

Whilst this paper represents the analysis of part of a larger research project, it does show that in terms of the Thai university system, there is still much work to be done in the web accessibility space. The results indicate that these university websites have accessibility problems even though the Thai government has signed the Convention on the Rights of Persons with Disabilities (CRPD). In particular, special institutions were created to provide an accessible online learning experience for students with a variety of disabilities, though in this study it seems even the web pages in that site were far from accessible (though better than the other non-specialist sites).

The limitation of this research is that the number of tested webpages is relatively small because there are only two open universities and one online institution in Thailand, which were examined in this study along with the top five universities. Moreover, the limitation of scoring method is that is essentially a binary one or zero, picking up the presence of an error but not the specifics of the error (which will be detailed in the larger study). However, we feel that

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the data presented here indicates that Thai universities are not offering an accessible online learning experience to people with disabilities. Whilst the possible causes of the current situation are beyond the scope of this paper, it seems likely they are the same as other institutions across the globe, including lack of awareness, lack of policy and lack of WCAG 2.0 implementation, testing and knowledge [26][27]. We recommend that the Thai government strengthen its policy and requirements around accessibility of online technologies, and that this policy is clearly communicated to stakeholders in the government and education arenas.

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