UNIVERSAL DESIGN in Higher Education
PROMISING PRACTICES

An Exploratory Study of the Accessibility of Chinese Provincial Government and Postsecondary Institution Websites

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China has more than 82.96 million people with disabilities (PWD) and the population age 60 and above is greater than 194 million (Guo, 2009). With the rapid development of online content, access to Internet resources is critical to Chinese citizens, including students. However, a 2016 study (Zhao, Marghitu, & Mou) indicated that many websites from Chinese postsecondary institutions are inaccessible to a wide range of PWD. The study reported in this article gains further insights regarding the accessibility of websites that people access in China for legal, educational, and resourceful content; the results of this study are then compared to the prior study on the accessibility web resources at postsecondary institutions. The authors chose a sample of websites that are maintained by Chinese government institutions because, as a collection, they provide a large amount of online information and services. Specifically, this study evaluates the accessibility of Chinese province-level portals, analyzes their current accessibility issues, compares the findings with those of postsecondary institution websites, summarizes implications, proposes strategies and shares promising practices for improving the accessibility of websites in China.

Government portals are the primary gateway for residents, including students in higher education, to access information about laws, regulations and policies, services, and community participation. According to the latest statistic of CNNIC (China Internet Network Information Center; 2015), by June 30, 2015 the number of domains registered under gov.cn reached 57,923. All of the provinces, autonomous regions, municipalities, and special administrative zones; 99% of the cities; and more than 85% of the counties have built their own websites. However, many people with visual, hearing, physical, cognitive, neurological, and other challenges experience difficulties in using the web when it is not designed accessibly. For example, people who are visually impaired rely on screen readers to "see" a page, but screen readers cannot provide relevant information for image or video without the provision of text alternatives; people with colorblindness might have trouble filling out an online form that designates required fields in red; and some individuals may have difficulty controlling a mouse to activate small controls on a web page. Addressing the special needs of all PWD by reducing the barriers imposed by websites helps to ensure

equal opportunities in education, employment, and community engagement.

LITERATURE REVIEW

Website accessibility has become a focus of governments, scholars, and practitioners worldwide. The United Nations Convention on the Rights of Persons with Disabilities recognizes access to the web as a basic human right (United Nations, 2006). The World Wide Web Consortium (W3C) launched the Web Accessibility Initiative (WAI) to encourage everyone to make their websites accessible. WAI released the Web Content Accessibility Guidelines (WCAG) 1.0 in 1999 and WCAG2.0 in 2008. These guidelines have become the templates for many countries establishing their own web accessibility standards. WCAG 2.0 is organized around four principles: for websites to be perceivable, operable, understandable, and robust. Listed under each of these four principles are 12 guidelines and testable success criteria. For each success criteria, there is a list of techniques on how to meet the success criteria. WCAG 2.0 has been heavily referenced in web accessibility legislation and practices in many countries, including China (Yang & Chen, 2015).

China has realized the importance of web accessibility in the digital information age, as evidenced by its annual Information Accessibility Forum, which has promoted web accessibility since 2004 (Sun, Zhang, & Wang, 2007). In addition, the Ministry of Industry and Information Technology of China released the first version of the Information Accessibility—for People with Physical Disabilities—Technical Requirements for Web Accessibility (YD/T 1761-2008) in 2008 and updated it in 2012 to account for various existing and emerging technologies. Some local governments in China have made great efforts to make their websites accessible. In 2010, the Shanghai government portal "Shanghai China" became the first fully accessible Chinese province-level portal (Xiao & Chen, 2011). It provides pure-text, accessible navigation, voice prompts, and browsing tools; China started the "Beautiful China—Public Action for Chinese Government Information Accessibility" in 2013 and initiated "Beautiful China—Public Action for 100 Chinese Cities' Government Information Accessibility" in 2014.

During the past decade, many scholars researched the accessibility of Chinese government and university websites. Phoenix-sem (Guo, 2009) investigated the accessibility of government websites of 22 provinces, 5 autonomous regions, 4 municipalities and 2 special administrative regions in 2008 and found only the portal of Hong Kong Special Administrative Region met the testing standards. Zhao (2013) studied the accessibility of the government websites of Jiangsu province and the subsidiary 13 cities based on WCAG 1.0 and found that none of the websites passed the accessibility standards used in the study. Zhang (2015) evaluated the accessibility of 32 provincial government websites and found that nearly 50% of the websites met the requirements of WCAG Level A. Chinese universities are organized into 5 categories: the 985-project universities, the 211-project universities, the provincial key universities, the ordinary universities, and the vocational colleges. Many of the best Chinese higher education institutions are situated in Beijing, the Chinese capital. In the preliminary evaluation conducted by the authors of this article, of the accessibility of the portals of 10 institutions from each category (with the exception of 8 project universities in Beijing, since there are only 8 total), none of the 48 websites passed the evaluation. Based on previous studies, the overall accessibility of Chinese government and post-secondary education institutions websites, compared with other developed countries, is still lagging. More studies should be conducted to investigate the current

status, uncover the existing problems, and identify and implement solutions for improving web accessibility in China. These efforts will improve opportunities in education, employment, and other life activities for individuals with disabilities.

METHODOLOGY

Chinese provincial governments manage the affiliated cities and are led directly by The State Council of The People's Republic of China. Compared with the websites of the central government, the relationship between provincial government portals and citizens is much closer and the page views of provincial government portals are also much higher. The authors of this article have observed that, compared with the local city-level government portals, the design and development of provincial government portals is more in line with the WCAG 2.0 Level A.

Since most people enter the home page to navigate website content, if the home page is not accessible, then the accessibility of other pages may not be relevant. The home page is often the best planned, designed and managed page on a website; if the home page is not accessible, then it's fair to conclude that other pages of the site are not accessible either. Therefore, this study evaluated only the home pages of Chinese provincial government portals. China has 34 provincial administrative regions including 23 provinces, 5 autonomous regions, 4 municipalities and 2 special administrative regions. The provincial government portals' addresses were obtained from the official website of The State Council of China (http://english.gov.cn/).

In this study, WCAG 2.0 Level A was used as the evaluation standard. The websites were evaluated with a combination of automated testing tools and manual testing. The open source web accessibility evaluation tool AChecker from the University of Toronto Adaptive Technology Resource Center was adopted in this study. It can review the accessibility of web pages based on a variety of international accessibility guideline such as WCAG 2.0 (International), Section 508 (U.S.), BITV 1.0 (Germany), and supports three ways to evaluate a web page, including entering a URL of a web page, uploading an HTML file, or pasting HTML from the clipboard, and generates detailed result reports. AChecker is widely used in web accessibility evaluation. AChecker reports 3 types of problems: known problems, likely problems and potential problems. Only known problems are identified with certainty as accessibility barriers. Likely problems and potential problems are those which AChecker cannot identify (e.g., any check that requires the evaluation of meaning, such as whether link text accurately describes the purpose of a link, or whether alt text sufficiently describes the meaning contained in an image. In these cases, a human being made judgments on problems AChecker cannot identify.

FINDINGS

The accessibility of the Chinese provincial government portals were evaluated between February 22 and 25, 2016. Results are shown in Table 1. Thirty three websites were evaluated successfully. Sixteen out of the 33 websites provided accessible versions. The other 17 websites without separate accessible versions were tested based on WCAG 2.0 Level A standards, and only 2 of the websites, of Tibet and Hong Kong, complied with WCAG 2.0 Level A requirements.

	Total Websites	Invalid Websites	Effective Websites	Accessible Websites	WCAG2.0 Level A Evaluation		
					Total	Passed	Not Passed
Result	34	1	33	16	17	2	15

Table 1: Evaluation results

Sixteen provincial portals (e.g., Beijing, Shanghai, Guangdong, and Xinjiang) built accessible versions for PWD or who are elderly. Among these 16 websites, 5 (31%) websites provided site maps and 10 (63%) provided alternate text pages. Fifteen (94%) websites, excluding the website of Chongqing, provided various assistive functions for accessible browsing (e.g., font size setting, color setting, reading auxiliary lines and big subtitle). Eight (50%) out of the 16 websites provided complete keyboard shortcuts enabling users relying on keyboards to more easily access pages. Eleven (69%) out of the 16 websites provided voice prompts, and 12 (75%) websites implemented content reading functions. Without installation of extra screen reader software and hardware, people with visual impairments can easily access and listen to the content of these websites. Moreover, Beijing, Qinghai, Hainan, and Xingjiang provincial portals were equipped with voice-activated functions. Users could give instructions by voice to control the browsing of the pages once they downloaded and installed the voice client. The combination of voice-activated and content reading functions provides assistance to people who are blind and those who have difficulty controlling the mouse and keyboard. The statistics of the assistant functions implemented by the 16 websites is shown in Table 2.

Province	Pure Text	Site Map	Font Setting	Colors Setting	Reading Assistance	Voice Prompt	Content Reading	Keyboard Shortcuts	Voice Activated
Beijing		X	X	X	X	X	X	X	X
Shanghai	X		X	X	X			X	
Chongqing	X								
Hebei	X		X	X	X	X	X		
Gansu			X	X	X				
Qinghai		X	X	X	X	X	X	X	X
Anbui	X		X	X	X	X	X	X	
Hunan			X	X	X		X		
Jiangsu	X		X	X	X	X	X		
Sichuan	X		X	X	X				
Yunnan	X		X	X	X	X	X		
Jianxi	X		X	X	X	X	X	X	
Guangdong	X	X	X	X	X	X	X	X	
Gujian	X		X	X	X	X	X		
Hainan		X	X	X	X	X	X	X	X
Xinjiang		X	X	X	X	X	X	X	X

Table 2: Assistant functions implemented by Chinese prvincial government portals

According to the testing results, nearly 50% of the Chinese provincial government portals provided special web accessibility related implementations (e.g., pure text version and assistant tools). If we consider these 16 websites with special accessibility constructions to be in line with WCAG 2.0 Level A standards, then 18 provincial portals met the requirements of WCAG 2.0 Level A, whereas 15 provincial websites failed to comply with WCAG 2.0 Level A with an overall passing rate of about 55%. Results are shown in Table 3.

	Total Websites	Invalid Websites	Effective Websites	Passed	Not Passed
Result	34	1	33	18	15

Table 3: Overview of the Chinese provincial government portals web accessibility

Table 4 summarizes the evaluation results of the 15 websites that failed to meet the WCAG 2.0 Level A standards. As seen in Table 5, the home pages of Jilin and Ningxia government portals each have more than 200 errors, and Tianjin and Liaoning provinces each have exceeded 400 errors. On average, 154 errors occurred on the home pages of the websites that failed to comply with WCAG standard. More than 50% of these sites' home pages have over 100 errors and none of the 15 websites' home pages has less than 10 errors. This data suggests the Chinese portals without special instructions for accessibility generally contain accessibility barriers that make it difficult, or even impossible, for many PWD, to benefit from the resources and e-services provided by these government websites.

Province	WCAG 2.0 Level A		
	Error Instances	Success Criteria Violated	Error Types
Liaoning	489	6	12
Tianjin	420	7	16
Ningxia	238	7	12
Jilin	216	5	7
Shanxi	178	7	10
Guangxi	138	7	13
Shanxi	119	6	8
Guizhou	107	7	10
Zhejiang	84	5	5
Hubei	75	5	6
Henan	73	8	10
Henongjiang	62	6	7
Macao	60	5	7
Shandong	30	6	7
Neimenggu	23	6	7

Table 4: The number of error instances, success criteria violated and error types of Chinese provincial government portals

From the perspective of WCAG 2.0 Level A guidelines, among the 15 websites that failed to pass the evaluation, every home page violated at least 5 success criteria with an average of 6 instances per website.

AChecker constructs a detailed report for each success criteria, and every check corresponds to a specific error type. Each of these 15 home pages has an average of 9 kinds of errors, 47% of the evaluated websites have more than 10 types of errors, and the home page of Tianjin contains up to 16 types of errors. The data shows that these inaccessible websites not only contain extensive errors, but also involve a large number of error types. There are two main kinds of errors: the first kind of error frequently appears on a website and seriously influences the accessibility of the website; the second kind of error is not as frequently encountered within a website but it appears in many websites and is a common but neglected problem. As shown in Table 5, there are 3 accessibility success criteria most often violated by websites. The first is success criteria 1.1.1: provide text alternatives for any non-text content, which has been violated 1350 times. The second is success criteria 2.4.4: provide clear link purpose to help users navigate, find content, and determine where they are, which has been broken for 473 times. The third success criteria with the highest amount of errors is success criteria 2.1.1: make all functionality available from a keyboard, which occurred 359 times. The total number of errors related to these three types of success criteria is 2182 and accounts for 95% of the total errors. Among the 15 websites that failed to pass the WCAG 2.0 Level A standard, 87% of websites have errors of success criteria 1.1.1, 75% have errors conflicted with success criteria 2.1.1, and all the 15 websites have errors related to success criteria 2.4.4. These 3 types of errors are frequently encountered, have high probability of occurrence, and are the main problems affecting the accessibility of Chinese provincial government websites. The other two common errors come from success criteria 3.1.1 and 2.4.1. 93% out of the 15 websites do not provide pages with language information as required by criteria 3.1.1, which is likely to cause assistant tools, such as screen readers, to fail to recognize correctly the page content. All 15 websites have neglected criteria 2.4.1 and fail to provide “skip to content” link, which will cause users relying on keyboard to have a hard time skipping navigation to the main content.

Success Criteria	Description	Website Instances	Error Instances	Percentage (%)
1.1.1	Provide text alternatives for any non-text content	13	1350	58.9
1.2.3	Provide audio description or media alternative	3	3	0.1
1.3.1	Ensure that information and structure can be separated from presentation	8	40	1.7
2.1.1	Make all functionality available from a keyboard	11	359	15.7
2.2.2	Provide users enough time to read and use content	2	2	0.1
2.4.1	Provide bypass blocks to help users navigate and find content	15	15	0.7
2.4.4	Provide clear link purpose to help users navigate, find content and determine where they are	15	473	20.6
3.1.1	Specify language of page	14	14	0.6
3.2.2	Make web pages appear and operate predictable	2	30	1.3
3.3.2	Provide labels or instructions for input	7	7	0.3

Table 5: Success criteria violated by Chinese provincial government portals

The distribution of the Chinese provincial government website errors on AChecker check points is shown in Figure 1. The check points with a huge number of errors are numbers 1, 174, 107, 178 and 106; the corresponding numbers of errors that occurred are 1036, 473, 237, 170 and 114. The total number of these 5 kinds of errors is 2030 and accounts for 89% of the total errors. The distribution of the websites that failed to pass WCAG 2.0 Level A evaluation on AChecker check points is shown in Figure 2. 87% of the 15 accessible web sites have errors on check 1, 93% have problems conflicting with check 48, and all 15 websites fail to meet the requirements of check 28 and check 174. Check points 107, 7, 106 and 188 are also frequently violated. More than 50% of the 15 websites violate check 107, 7 and 106; nearly 50% of the 15 websites fail to comply with check 188. These errors with huge quantity and high probability are the crux of the improvement of Chinese provincial government portals' accessibility. The descriptions of the main AChecker check points violated by Chinese provincial government websites are listed in Table 6.

The results of the preliminary accessibility study of 48 Chinese universities websites that used the same methodology are similar with the study of Chinese provincial government. The distribution of the 48 website errors on AChecker check points is shown in Figure 3 and can be compared with Figure 1. The distribution of the websites that failed to pass the WCAG 2.0 Level A evaluation on AChecker check points is shown in Figure 4 and can be compared with Figure 2. The descriptions of the main AChecker check points violated by the 15 postsecondary educational websites are listed in Table 7 and can be compared with Table 6.

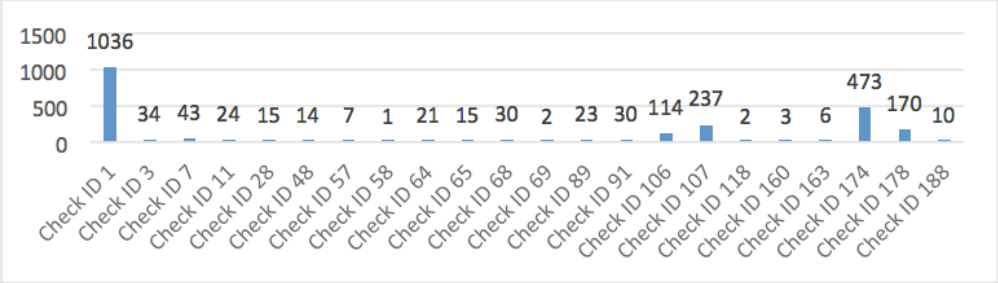

Figure 1: The distribution of the Chinese provincial government websites accessibility errors on AChecker check points

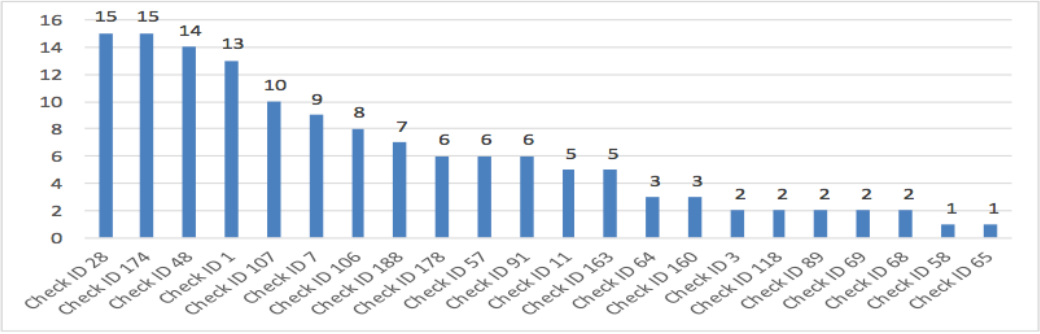

Figure 2: The distribution of the websites failed to pass the WCAG 2.0 Level A evaluation on AChecker check points

Success Criteria	Check ID	Descriptions
1.1.1	1	All “img” elements have an “alt” attribute
	178	Alt text for all “img” elements that are not used as source anchors conveys the same information as the image
	7	Alt text for all “img” elements used as source anchors is not empty when there is no other text in the anchor
2.1.1	107	All “onmouseup” event handlers have an associated “onfocus” event handler
	106	All “onmouseout” event handlers have an associated “onblur” event handler
2.4.1	28	A “skip to content” link appears on all pages with blocks of material prior to the main document
2.4.4	174	Each source anchor contains text
3.1.1	48	Document has required “lang” attribute(s)
3.3.1	188	Each label associated with an “input” element contains text

Table 6: Descriptions of the main AChecker check points violated by Chinese provincial government websites

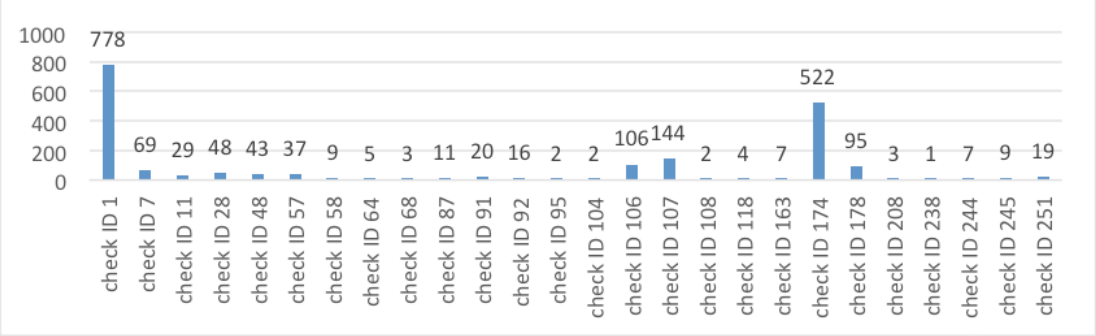

Figure 3. The distribution of the Chinese postsecondary websites accessibility errors on AChecker check points

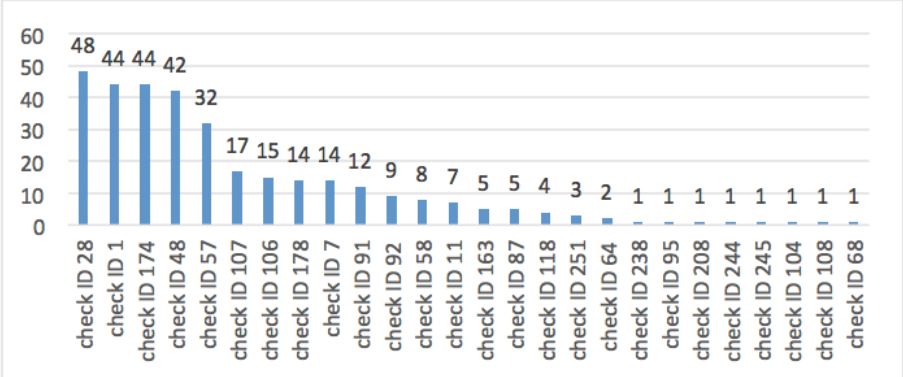

Figure 4: The distribution of the postsecondary education websites failed to pass the WCAG 2.0 Level A evaluation on AChecker check points

Success Criteria	Check ID	Descriptions
1.1.1	1	All “img” elements have an “alt” attribute
	178	Alt text for all “img” elements that are not used as source anchors conveys the same information as the image
	7	Alt text for all “img” elements used as source anchors is not empty when there is no other text in the anchor
1.3.1	57	All “input” elements, “type” of "text", have an explicitly associated label
	91	All “select” elements have an explicitly associated “label”
2.1.1	107	All “onmouseup” event handlers have an associated “onfocus” event handler
	106	All “onmouseout” event handlers have an associated “onblur” event handler
2.4.1	28	A “skip to content” link appears on all pages with blocks of material prior to the main document
2.4.4	174	Each source anchor contains text
3.1.1	48	Document has required “lang” attribute(s)

Table 7: Descriptions of the main AChecker check points violated by Chinese postsecondary education websites

RECOMMENDATIONS, PROMISING PRACTICES, AND IMPLICATIONS

The accessibility levels of Chinese provincial government portals and of postsecondary institution websites cover a wide range. However, the major accessibility problems detected are problems that could be easily prevented and corrected (e.g., adding alternative text for images, specifying the language for page content). These are indications that web developers and managers lack awareness of web accessibility and do not sufficiently recognize and consider the accessibility issues for people who are aged or disabled. Many websites are simply not designed and managed in accordance with the relevant policies, regulations, and standards for web accessibility. Creators often just provide an alternative site for PWD —which can often leave out information, not highlight the same information, or leave PWD feeling disconnected—rather than provide one accessibly-designed site for everyone.

To improve the accessibility of provincial government and postsecondary portals, further work is needed, particularly in three areas of effort. First, it is important to promote web accessibility with more vigor. For example, most of the government website developers and managers are not concerned with accommodations for PWD and the idea of web accessibility has not been fully integrated into government services. Significant promotion of the need for web accessibility will help convince the web developers to move toward a people-oriented web design approach.

Second, web accessibility standards need to be enforced. Although China has formulated state standards for web accessibility such as Information Accessibility-for People with Physical Disabilities—Technical Requirements for Web Accessibility, Information Accessibility—for People with Physical Disabilities-

Testing Specification for Web Content Accessibility Evaluation, local governments do not implement these standards voluntarily. Only legal enforcement of the state standards for web accessibility can make the developers and managers comply with the requirements and create accessible web environment.

Third, the accessibility education and training of related personnel (e.g., website developers and managers) needs to be strengthened. Website developers are responsible for designing and developing a website while the manager is responsible for the daily maintenance of the web content. Their knowledge of web accessibility directly determines the accessibility of websites. Websites without these accessibility errors can only be built by equipping these designers, developers, and managers with the sufficient knowledge and skills. In terms of personnel training, web accessibility should be added into college courses (e.g. information technology and web programming).

Public postsecondary educational institutions enroll 93.4% of the Chinese post-secondary students, and many of these top institutions are working side-by-side with the government institutions toward maximizing web accessibility. Promising activities include the following:

1. The Special Education College of Beijing Union University, founded in September 2000 (Special Education College, 2010) is committed to accessibility training. It provides undergraduate and postgraduate students with web accessibility courses such as Introduction to Information Accessibility and Information Accessibility Assistive Technologies.
2. In January 2009, Zhejiang University in collaboration with China Disabled Persons' Federation, created the "China Information and Accessibility Technology Research Center of Persons with Disabilities" (2009), which has become one of the most important center for information accessibility research and personnel training.
3. In January 2013, Beihang University became the newest institution to host W3C toward offering enhanced opportunities for collaboration among Chinese companies, web developers, research institutes, and W3C's full international community, including members from more than 40 countries (W3C Beihang University, 2013).
4. In January 2016 the W3C Chinese Web Accessibility Community Group was created toward helping Chinese developers and designers to build an accessible web (W3C Chinese Web Accessibility Community Group, 2016).
5. In April 2016, Tsinghua University in cooperation with the China Disabled Persons' Federation, established the Accessibility Development Institute, which is committed to the theoretical and applied research and personnel training for the construction of a barrier-free environment (Accessibility Development Institute, 2016). It will provide great intellectual and manpower support for the boosting the accessibility in China. Web accessibility, as an important part of the barrier-free environment of today's digital society, will be one of the main goals of this initiative.

CONCLUSION

Government websites play an important role in the life and work of all citizens, including students in postsecondary education. Hence, it is critical that government websites be accessibly designed in order to guarantee equal access to information and services for everyone, including postsecondary students with disabilities. The study reported numerous types of web accessibility errors on provincial government

and postsecondary institution websites in areas that can be easily rectified with increased awareness and training. In order to further enhance the accessibility of these websites, practices should be implemented to promote the ideas of web accessibility, legally enforce the implementation of the state standards for web accessibility, and strengthen the education and training for web accessibility techniques. In such efforts the government can present an excellent role model for all Chinese websites and, ultimately, promote the successful participation in postsecondary education, careers and community life for Chinese citizens with disabilities.

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ACKNOWLEDGMENTS

This work was partially supported by the project No2014KY01 and project No2014WYY04 financed by 2014 Research Fund of Sichuan University of Science & Engineering.