The Challenge of Web Accessibility: An Evaluation of Selected Government Websites and Service Portals of High, Middle and Low-Income Countries

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ABSTRACT

The Convention on the Rights of Persons with Disabilities of 2006 recognises the right to access Information and Communication Technologies as a human right – and proposed for inclusion in the upcoming UN Global Digital Compact. The objective is to enable the equality of persons with disabilities in exercising their fundamental human freedoms and rights for unhindered participation in social life. The access to and the accessibility of online content (i.e. web accessibility) defines the minimum standards required to enable easy access for persons with disabilities. Despite the recognised importance, the accessibility of the websites remains a serious challenge making their content partially or completely inaccessible to some categories of the population. This paper evaluates the legal adoption and practical implementation of the web accessibility standards and guidelines (WCAG 2.1, level AA) by the twenty best-ranked high-income, upper-middle-income, lower-middle-income, and low-income countries (i.e. five countries in each income-cluster) in the latest UN DESA E-Government Development Index (EGDI) 2022. The focus is on the main national public sector websites providing health, education, justice, employment, social protection, and environmental information, including the national citizens' one-stop-shop service portal (or similar). The paper finds that with the adoption of the required legal framework and standards for web accessibility, the compliance level in a majority of countries and associated sites and portals remains low and continue to be a serious challenge in the lives of all users and the level of digital inclusion, not least persons with disabilities.

CCS CONCEPTS

• **Applied computing – E-government**; • **Human-centered computing – Accessibility**;

KEYWORDS

Web Accessibility, Digital Inclusion, Persons with Disabilities, Digital Government

1 INTRODUCTION

The Internet has become the primary source of information [37]. Digital technologies have completely changed how people live, communicate, use services and work [34]. The use of the Internet and new technologies have enabled a complete transformation of how central and local authorities communicate with citizens, the way of sharing information, the inclusion of citizens in socio-political processes, the provision of services, and many other aspects of everyday life.

Digital transformation of the public sector is a process that, if successful, contributes effectiveness and efficiency of the public sector, simpler and more efficient services for citizens [17, 22, 32, 35]. Globally, Information and Communication Technologies (ICT) has also become a key enabler of both public and private sector innovation and productivity growth [32]. In that context, ICTs have also been identified as key to achieving the Sustainable Development Goals (SDGs) adopted by the United Nations (UN) [43] and the upcoming UN Digital Global Compact.

An ever-increasing number of public and private sector services are offered online. Past socio–economic divides now include digital inclusion- the availability, usability and accessibility of online content and services, not least Persons with Disabilities (PwDs). Unfortunately, the numerous obstacles navigated by PwDs in the physical world are combined with those faced in the digital realm. Numerous studies emphasise that the Internet and technology are not equally accessible to all [18, 26, 27, 33]. Despite the increased number of eGovernment users in the last decade, users with certain temporary or permanent disabilities continue to face challenges [18, 27, 33]. According to Brajnik, the lack of web accessibility effectively excludes PwDs as their assistive technology and devices cannot be effectively used [11].

To live in the digital era, access and opportunities to all individuals. Universal and equitable access to public services is key to both UN charters and the SDG objective of leaving no one behind. Bridging digital and socio–economic divides is, therefore, key. Essentially digital inclusion (eInclusion) means that all "...activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and ICTs"

[13]. Multiple studies examine barriers to the use of eGovernment solutions [15, 40]. Many conclude that eInclusion continues to be a problem including in countries with highly advanced infrastructure and high-income countries [14, 15, 39]. In practice, digital exclusion is found on three levels: physical access to a connection (connection), digital skills and knowledge, and practical use and use of the Internet and ICT [39]. Web accessibility is particularly related to the latter [27, 42]. Thus the accessibility of web content and mobile applications should be seen as a right for PwDs and an obligation for public institutions [46].

Currently, there is no globally unified definition of disability. Estimations on the number of PwDs similarly vary, but between 10-15% of the world's population has some form of permanent or temporary disability [31]. PwDs can include individuals with hearing, visual, cognitive and motor impairments. Each category can include a wide range of temporary or permanent conditions [45]. Accessibility nowadays has become the main precondition for enabling PwDs fully realise their rights, live independent lives and be included in society.

Web accessibility as a right (incl. for PwDs) refers to the ability of all individuals to have easy access to web content, information and services. This implies that websites are accessible to all users regardless of their physical and cognitive abilities. The web must be designed to work for all people, regardless of their hardware, software, native language, geographical location, or ability [19]. If appropriately designed and developed, websites should provide all users with easy access and full functionality [27]. This requires the websites to be "navigable and tractable by various user categories, especially those who have disabilities and normally face obstacles when interacting with the web via electronic devices (e.g. blindness) [4]. It means that PwDs can use, perceive, understand, navigate, and interact with the web [19]. This will enable PwDs to access the web content in a non-discriminatory way like every other user.

Many countries have adopted laws to ensure that public sector bodies' websites satisfy web accessibility requirements. Internationally, the most important legal instruments include the United Nations Convention on the Rights of Persons with Disabilities (CRPD) and the Optional Protocol to the Convention on the Rights of Persons with Disabilities (CRPD-OP). However, the mere adoption of a legal framework does not guarantee automatic results in compliance. Multiple studies have analysed web accessibility in specific [1, 6–8, 21, 31, 36] or groups of countries [16, 24, 27]. Some studies have critically analysed accessibility challenges [3, 4, 12]. No matter the angle applied, all studies identified barriers and challenges with respect to compliance with the adopted legal requirements and standards for web accessibility.

In light of past research, this paper evaluates the legal adoption and practical implementation of the web accessibility standards and guidelines by the governments of the twenty best-ranked high-income, upper-middle-income, lower-middle-income, and low-income countries (i.e. five from each income cluster) in the UN DESA E-Government Development Index (EGDI) 2022. Opting for a comparison of the best-preforming countries by the level of income rather (high, upper-middle, lower-middle and low) than the level of their EGDI group (very high EGDI, high EGDI, middle EGID and low EGDI) is a conscious choice. Specifically it enables the analysis to explore the corelation between the financial and economic

power of the countries and their compliance with the national and global web accessibility standards. The paper analyses the key government websites for health, education, justice, employment, social protection, and environmental information, including the citizens' one-stop-shop service portal (or equivalent). The aim is to ascertain the state-of-affairs and whether a country's level of development (defined by income) is directly associated with the level of compliance with web accessibility standards and guidelines. Thus, the paper aim to answer the following two interrelated research questions:

- RQ1: the adoption of an appropriate legal framework and standards for web accessibility increases the level of compliance with the web accessibility standards and make the web content more accessible?
- RQ 2: Does the level of income of a country have an impact on the compliance with the web accessibility standards.

In addition to the instruction which outlines and contextualises the topic, it's the relevance and purpose of the paper. This paper is divided into four sections. Section two analyses the web accessibility standards and the evaluation tools. Section three presents the research methodology. Section three is dedicated to analysing the existing legal framework regulating web accessibility in the selected countries. Lastly, section 5 summarises the research findings and key observations, , in relation to the two research questions, and concluding with a set of recommendations.

2 WEB ACCESSIBILITY STANDARDS AND EVALUATION TOOLS

The complexity of creating user-friendly and accessible websites and the evaluation of web accessibility is in itself a complex, time and resource-intensive process (Brewer, 2004). Different evaluation models have been proposed for years [27, 46]. Four approaches have been used to determine the accessibility of web content, including automatic evaluation using internet testing tools [41], expert testing [10], user testing (PwDs) [38], plus a hybrid approach combining Internet tools, expert and/or user testing [23, 25]. To date, no single approach has been deemed superior, as all models suffer from one or more weaknesses. For instance, the limiting effects of automated testing tools are anchored in their binary relationship (1 = meets, 0 = does not meet), which in practice (as seen by the user) may not always be true. The expert evaluation is prone to human error, inability to detect all problems, the time required for the evaluation, as well as the potential lack of objectivity by the individual expert. User engagement, incl. PwDs and the prerequisite training is often a long and expensive process, which does not always guarantee full precision and correctness of the results [9]. Recent studies [27, 46] find that reliance on a single automatic evaluation tool is prone to mistakes; thus, web accessibility evaluation should incorporate the results from multiple automatic evaluation tools.

That said, the 1999 launch of the first Web Content Accessibility Guidelines (WCAG) version 1.0 by the World Wide Web Consortium (W3C), the Web Accessibility Initiative project (WAI) goes some way to address these challenges but still requires the use of multiple assessment tools. Version 2.0 was accepted as an ISO standard in 2012 [20], with the latest 2.1 version published in 2018 [48, 50]. The WCAG Guide is globally accepted and used as the de facto world

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standard and standard tool for assessing the level of accessibility of web content on the Internet [9], including for PwDs, and is part of the legal systems of a large number of countries [6, 37, 46].

The guide contains recommendations for making web content as accessible as possible for PwDs, taking into account different web technologies [9, 49]. Currently, WCAG 2.0 is the most internationally adopted voluntary web accessibility standard. The guide contains 12 recommendations, divided into four groups (comprehensibility, operability, comprehensibility, and robustness), with each of them containing specific criteria [9]. The guide defines three levels of compliance and performance, namely: minimum level (A, i.e. 25 criteria), intermediate level (AA, i.e. level A plus an additional 13 criteria), and highest level (AAA, i.e. levels A, AA and additional 23 criteria) [48]. For a given website meets the required standard, all criteria of the given level must be satisfied without any errors or problems being detected (automatically or manually).

3 METHODOLOGY

To answer the research questions, this paper applies a qualitative analysis of the legal framework in the selected countries [23] in combination with [28, 30] an automatic evaluation method utilising a set of internet tools for testing the selected key government websites and service portals [33] in a chosen group of countries.

Twenty countries with different levels of socio-economic backgrounds and development levels were chosen. The selection criteria are: five best-ranked countries by income classification on the UN DESA EGDI (i.e. high, upper-middle, lower-middle or low-income group). Although not a perfect measure, this provides a broad geographical sample based on a sample of a country's relative wealth (defined by GDP per capita) and the relative level of technology application in the public sector. The case resulting case sample for each income cluster is shown in Table 1.

The primary government websites providing health, education, justice, employment, social protection, and environmental information and the national citizens' one-stop-shop service portal (or equivalent) are subject to assessment. The choice of government websites assessed is inspired by the objectives of the SDGs but also core government services of almost global universality and broad popular reach. In doing so, selected sites represent the key digital channels through which PwDs may access key information and transactional services, but also align with previous studies [29]. The aim is to provide evidence and analysis and understand whether a country's development level impacts compliance with accessibility guidelines. As online content is dynamic, all the tests were conducted on 4 May 2023, between 10:00 and 20:00 UTC, to objectively capture the state-of-affairs at a given point in time across all websites, in all countries, subject to analysis. Table 1 and Table 2 presents the list of the websites analysed in this paper.

Two automatic evaluation tools are used to evaluate the accessibility of the websites and their compliance with the WCAG standards, level AA: The AChecker tool (for WCAG 2.0) [5] and TAW (for WCAG 2.1) [44]. Both are part of the official list of automatic evaluation tools published by the W3C Consortium. The tools are chosen for to their simplicity, proven reliability of results and effectiveness in previous studies [27, 46]. The tools are available for non-commercial use and free of charge. The intermediate AA level

of the WCAG 2.0 standard is chosen as this is the compliance level recommended by the UN but also mandated by European Union Directive on the accessibility of websites and mobile applications, also known as Directive (EU) 2016/2102.

To evaluate the availability and accessibility of web content on mobile devices (smartphones, watches, tablets, etc.), an evaluation of the homepages of the selected institutions are carried out in terms of compliance with CSS stylesheet [2] and markup standards [2] using the validation tools created by the W3C consortium. Two automatic evaluation tools are being used to evaluate the validity of the HTML and CSS of the websites (Markup Validation Service [2] and CSS Validator Service [44], both provided by the W3C). For a comparative analysis between individual websites and countries, the following classification scheme is used to map compliance levels:

- 0 errors or known problems: full compliance (dark green).
- 1-10 errors or known problems: high level of compliance with minor accessibility issues (light green).
- 11-20 errors or known problems: intermediate level of compliance with some accessibility issues (orange).
- 20 or more errors or known problems: non-compliant with serious accessibility issues (red).

Warnings are also recorded. While warnings do not cause difficulties in terms of the accessibility of the web content, they may easily become errors and create obstacles for PwDs to access the content if not fixed.

4 FINDINGS AND DISCUSION

4.1 LEGAL FRAMEWORK

The availability of the legal framework that regulates both the rights of PwDs and web accessibility may observe from multiple angles, perspectives and with different objectives. The most important international legal instruments adopted internationally are the CRPD and the CRPD-OP. By adopting the CRPD, State Parties accept the legal obligations to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all PwDs and to promote respect for their inherent dignity. Apart from the other guaranteed rights, the CRPD regulates the rights of PwDs to equal access to information, communication, Information and Communications Technologies (ICT), full inclusion and participation in the community, and public services. In addition, the CRPD-OP regulates the establishment of an individual complaint mechanism for the CRPD.

With respect to RQ1, the analysis finds that all twenty countries are State Parties to the CRPD and thus are legally obliged to implement its provisions (acceded to the CRPD by formal confirmation, accession, or ratification). However, only 15 countries have ratified the CRPD-OP. The CRPD-OP is not ratified by the Russian Federation, China, and Uzbekistan and, thus, is not legally obliged to implement its provisions. Although they signed the CRPD-OP, Kazakhstan and Senegal are yet to formally ratify the treaty and are not considered 'State Parties to the CRPD-OP.

By adopting the CRPD, State Parties are obliged to undertake all necessary measures to guarantee the rights of the PwDs. The first step is to regulate the area by introducing mandatory legislation

Table 1: Government websites analysed (part one)

Government websites analysed			
High-Income countries		**Upper-Middle-Income countries**	
Denmark (DK)		**Kazakhstan (KZ)**	
Government Portal	https://www.stm.dk/	Gov. and Service Port.	https://www.gov.kz/?lang=kk
Citizens Service Portal	https://www.borger.dk/	Health	https://www.gov.kz/memleket/entities/dsm?lang=kk
Health	https://sum.dk/	Education	https://www.gov.kz/memleket/entities/edu?lang=kk
Education	https://ufm.dk/	Justice	https://www.gov.kz/memleket/entities/adilet?lang=kk
Justice	https://www.justitsministeriet.dk/	Social Prot. & Labour	https://www.gov.kz/memleket/entities/enbek?lang=kk
Employment	https://bm.dk/	Environment	https://www.gov.kz/memleket/entities/ecogeo?lang=kk
Social Protection	https://sm.dk/		
Environment	https://mim.dk/		
Finland (FI)		**Serbia (RS)**	
Government portal	https://valtioneuvosto.fi/	Government portal	https://www.srbija.gov.rs/
Citizens Service Portal	https://www.suomi.fi/	Citizens Service Portal	https://euprava.gov.rs/
Health & Social Prot.	https://stm.fi/etusivu	Health	https://www.zdravlje.gov.rs/
Education	https://okm.fi/etusivu	Education	https://prosveta.gov.rs/
Justice	https://oikeusministerio.fi/	Justice	https://www.mpravde.gov.rs/
Employment	https://tem.fi/etusivu	Social Prot. & Labour	https://www.minrzs.gov.rs/sr
Environment	https://ym.fi/etusivu	Environment	https://www.ekologija.gov.rs/
Republic of Korea (KR)		**Argentina (AR)**	
Government portal	https://www.korea.net/	Gov. & Service Portal	https://www.argentina.gob.ar/
Citizens Service Portal	https://www.gov.kr/	Health	https://www.argentina.gob.ar/salud
Health & Social Prot.	https://www.mohw.go.kr/	Education	https://www.argentina.gob.ar/educacion
Education	https://moe.go.kr/	Justice	https://www.argentina.gob.ar/justicia
Justice	https://www.moj.go.kr/	Social Prot. & Labour	https://www.argentina.gob.ar/trabajo
Employment	https://www.moel.go.kr/	Environment	https://www.argentina.gob.ar/ambiente
Environment	https://me.go.kr/	Gov. & Service Portal	https://www.argentina.gob.ar/
New Zealand (NZ)		**Russian Federation (RU)**	
Gov. and Service Port.	https://www.govt.nz/	Government portal	http://government.ru/
Health	https://www.health.govt.nz/	Citizens Service Portal	https://www.gosuslugi.ru/
Education	https://www.education.govt.nz/	Health	https://minzdrav.gov.ru/ru
Justice	https://www.justice.govt.nz/	Education	https://edu.gov.ru/
Employment	https://www.mbie.govt.nz/	Justice	http://www.minjust.ru/
Social Protection	https://www.msd.govt.nz/	Social Prot. & Labour	http://www.rosmintrud.ru/
Environment	https://environment.govt.nz/	Environment	http://www.rosmintrud.ru/
Iceland (IS)		**China (CN)**	
Government portal	https://www.government.is/	Gov. & Service Portal	http://www.gov.cn/
Citizens Service Portal	https://island.is/	Health	http://www.moh.gov.cn/
Health	https://www.stjornarradid.is/raduneyti/heilbrigdisraduneytid/	Education	http://www.moe.gov.cn/
Education	https://www.stjornarradid.is/raduneyti/mennta-og-barnamalaraduneytid/	Justice	http://www.moj.gov.cn/
Justice	https://www.stjornarradid.is/raduneyti/domsmalaraduneytid/	Social Prot. & Labour	http://www.mohrss.gov.cn/
Social Prot. & Labour	https://www.stjornarradid.is/raduneyti/felags-og-vinnumarkadsraduneytid/	Environment	https://www.mee.gov.cn/
Environment	https://www.stjornarradid.is/raduneyti/umhverfis-orku-og-loftslagsraduneytid/		

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Table 2: Government websites analysed (part two)

Government websites analysed			
Lower-Middle-Income countries		**Lower-Income countries**	
Ukraine (UA)		**Rwanda (RW)**	
Government Portal	https://www.kmu.gov.ua/	Gov. & Service Portal	https://www.gov.rw/
Citizens Service Portal	https://se.diia.gov.ua/	Health	https://www.moh.gov.rw/
Health	https://moz.gov.ua/	Education	https://www.mineduc.gov.rw/
Education	https://mon.gov.ua/ua	Justice	https://www.minijust.gov.rw/
Justice	https://minjust.gov.ua/	Employment	https://www.mifotra.gov.rw/
Social Prot. & Labour	https://www.msp.gov.ua/	Social Protection	https://www.minaloc.gov.rw/
Environment	https://menr.gov.ua/	Environment	https://www.environment.gov.rw/
Georgia (GE)		**Nepal (NP)**	
Government Portal	https://www.gov.ge/	Gov. & Service Portal	https://nepal.gov.np/
Citizens Service Portal	https://www.my.gov.ge/	Health	https://mohp.gov.np/
Hea., Soc. Pro. & Lab.	https://www.moh.gov.ge/	Education	https://moest.gov.np/
Education	https://mes.gov.ge/	Justice	http://www.moljpa.gov.np/
Justice	https://justice.gov.ge/	Social Prot. & Labour	https://moless.gov.np/
Environment	https://mepa.gov.ge/	Environment	https://www.mofe.gov.np/
Armenia (AM)		**Zimbabwe (ZW)**	
Government Portal	https://www.gov.am/	Government Portal	http://www.zim.gov.zw/
Citizens Service Portal	https://e-citizen.am/	Citizens Service Portal	https://zimeservices.pfms.gov.zw/
Health	https://www.moh.am/	Health	http://www.mohcc.gov.zw/
Education	https://escs.am/	Education	http://www.mopse.co.zw/
Justice	https://www.moj.am/	Justice	https://justice.gov.zw/
Social Prot. & Labour	https://www.mlsa.am/	Social Prot. & Labour	https://www.mpslsw.gov.zw/
Environment	http://www.env.am/	Environment	http://www.zarnet.ac.zw/evol/environ/
Uzbekistan (UZ)		**Senegal (SE)**	
Government Portal	https://www.gov.uz/	Government Portal	https://www.sec.gouv.sn/
Citizens Service Portal	https://my.gov.uz/	Citizens Service Portal	https://senegalservices.sn/
Health	https://ssv.uz/	Health & Social Prot.	https://www.sante.gouv.sn/
Education	https://uzedu.uz/	Education	https://www.education.sn/
Justice	https://adliya.uz/	Justice	https://justice.sec.gouv.sn/
Social Prot. & Labour	https://mehnat.uz/	Employment	https://www.travail.gouv.sn/
Environment	https://www.uznature.uz/	Environment	https://www.environnement.gouv.sn/
Republic of Moldova (MD)		**Uganda (UG)**	
Government Portal	https://gov.md/	Government Portal	https://www.gou.go.ug/
Citizens Service Portal	https://servicii.gov.md/	Citizens Service Portal	http://ecitizen.go.ug/
Health	https://ms.gov.md/	Health	https://www.health.go.ug/
Education	https://mecc.gov.md/	Education	https://www.education.go.ug/
Justice	https://www.justice.gov.md/ro	Justice	https://justice.go.ug/
Social Prot. & Labour	https://social.gov.md/	Social Prot. & Labour	https://mglsd.go.ug/
Environment	https://www.mediu.gov.md/	Environment	https://www.mwe.go.ug/

defining the rights of PwDs and the obligations of the public sector bodies. National practice varies. Some countries opted for the adoption of a general disabilities acts that cover all the PwDs rights (Republic of Korea, New Zealand, Iceland, Kazakhstan, Serbia, Russia, China, Georgia, Armenia, Uzbekistan, Moldova, Rwanda, Nepal, Zimbabwe, Senegal, and Uganda). Only a handful of countries have

gone a step further by adopting a *lex specialis* exclusively to regulate the issue of web accessibility (Denmark, Finland, Argentina). Notably, all of them have provisions regarding the various legal acts, e.g. Public Services, eGovernment, ICT, Electronic Communication, Audio-Visual, Public Procurements, etc. No matter the approach

Table 3: Evaluation Results (part one)

	Website	AChecker 2.0 AA problems	TAW 2.1 AA problems	HTML Errors	HTML Warnings	CSS Errors	CSS Warnings
DK	Government Portal	1	2	19	3	4	172
	Citizens Service Port.	2	9	1	1	4	1985
	Health	2	10	14	5	24	1148
	Education	2	16	57	16	10	234
	Justice	2	7	4	26	8	2298
	Employment	0	2	0	11	11	194
	Social Protection	3	16	13	10	20	992
	Environment	8	13	5	19	10	985
FI	Government portal	20	6	29	169	113	1657
	Citizens Service Port.	error	9	13	2	6	522
	Health & Social Prot.	22	error	14	165	75	1360
	Education	15	5	16	172	82	1527
	Justice	16	5	15	173	82	1619
	Employment	25	5	11	176	117	1179
	Environment	13	9	22	153	79	1484
KR	Government portal	0	55	error	error	error	error
	Citizens Service Port.	34	1	3	33	1	342
	Health & Social Prot.	42	1	0	0	0	117
	Education	0	49	2	2	0	0
	Justice	0	7	error	error	error	error
	Employment	0	16	0	0	0	0
	Environment	0	15	0	0	0	2
NZ	Gov. and Serv. Port.	3	error	4	3	1	144
	Health	10	0	13	8	18	449
	Education	5	19	1	7	3	145
	Justice	1	2	3	18	error	error
	Employment	0	error	9	3	12	322
	Social Protection	2	7	4	19	2	39
	Environment	1	40	26	38	16	1136
IS	Government portal	2	13	43	9	21	588
	Citizens Service Port.	2	error	5	1	error	error
	Health	5	28	17	6	22	587
	Education	5	29	22	6	22	587
	Justice	3	29	16	5	22	587
	Social Prot. & Labour	3	28	15	5	22	587
	Environment	5	28	20	5	22	587
KZ	Gov. & Service Port.	error	error	1	1	57	3140
	Health	error	error	1	1	57	3140
	Education	error	error	1	1	57	3140
	Justice	error	error	1	1	57	3140
	Social Prot. & Labour	error	error	1	1	57	3140
	Environment	error	error	1	1	57	3140
RS	Government portal	91	56	67	61	67	229
	Citizens Service Port.	43	89	50	15	4	340
	Health	72	68	47	2	8	300
	Education	47	77	51	34	161	2988
	Justice	64	77	0	2	1	67
	Social Pro. & Labour	0	13	2	2	4	110
	Environment	22	1	22	7	0	77
AR	Gov. & Service Port.	23	6	0	0	3	351
	Health	26	32	2	3	4	390
	Education	26	27	2	4	4	390
	Justice	21	35	2	1	4	390
	Social Prot. & Labour	33	24	2	4	3	351
	Environment	18	15	2	1	4	390

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RU	Government portal	35	14	2	5	105	7537
	Citizens Service Port.	error	68	1	2	0	0
	Health	84	error	8	0	30	443
	Education	error	error	error	error	error	error
	Justice	error	error	error	error	error	error
	Social Prot. & Labour	error	error	error	error	error	error
	Environment	error	error	error	error	error	error
CN	Gov. & Service Port.	49	error	48	11	0	16
	Health	0	1	error	error	error	error
	Education	0	40	125	22	16	9
	Justice	183	80	22	7	18	197
	Social Prot. & Labour	47	79	85	26	0	8
	Environment	171	148	127	42	6	183

applied, they are only effective when the country provides oversight mechanisms to ensure the practical implementation of the obligations and for PwDs to enforce their rights in cases where compliance is lacking.

Considering the complexity of the web accessibility issue, the analysis finds that countries tend to operationalise web accessibility rights by adopting domestic standards and guidelines for web development. Most of cases, these domestic standards are a translation of the WCAG 2.0 or 2.1 standards, while guidelines are instructions and toolkits to help web developers ensure compliance with such standards. Denmark, Korea, Iceland, Kazakhstan, Serbia, Argentina, China, Nepal, and Uganda have incorporated the WCAG 2.0 standards into their national design standards for online solutions. Finland, New Zealand, Russia, Ukraine, Moldova, and Zimbabwe went a step further and opted for the newer WCAG 2.1 standard. Georgia, Armenia, Uzbekistan, Rwanda, and Senegal are yet to adopt their national web accessibility standards following international best practices.

In conclusion, all twenty countries have adopted at least a basic legislation to regulate the rights of the PwDs and prevent discrimination. Fifteen countries have adopted national standards, guidelines or instructions to help government authorities to comply with web accessibility requirements. However, only Denmark, Finland, and Argentina adopted special legislation to regulate the issue of web accessibility. While Georgia, Armenia, Uzbekistan, Rwanda, and Senegal must implement the domestic web accessibility standards and guidelines to operationalise the PwD rights.

4.2 EVALUATIUON RESULTS

With respect to RQ1, it is relevant assess the impact of adopted legislation, regulations and standards. Assessing the evaluation results in terms of errors detected, is an indicator of the impact and level of compliance. The number of known problems detected with automatic evaluation tools for compliance with the WCAG 2.0 AA (AChecker) and WCAG 2.1 AA (TAW) standards and the HTML and CSS validity results (errors and warnings) are summarised in Table 2 and Table 4. The colour coding classification scheme described in the methodology section is used to facilitate the mapping and readability of the results.

Analysing the results, it is important to note that the automated validations of the Russian and Kazakh websites resulted in technical errors across all websites. This is likely due to cyber security measures blocking the AChecker and TAW tools. However, blocking the access of automatic software tools may result in additional obstacles for PwDs who use specially designed software for text-to-speech, braille smartwatches, voice assistants, screen readers, and many others. Similar challenges were observed for Rwandan sites being assessed by the TAW tool. That said, sporadic technical challenges were found in 15 of 20 countries, across all four income classifications and across all continents.

In terms of performance and compliance with the WCAG 2.0 AA and WCAG 2.1 AA standards, the Republic of Korea, Georgia, and Rwanda stand out with the highest number of sites with zero known problems regarding WCAG 2.0 compliance. Denmark, New Zealand, and Iceland also have high compliance levels, as the number of known problems is below ten for individual sites. By contrast, the lowest level of compliance with the WCAG 2.0 AA and WCAG 2.1 AA standards is found in Serbia, Argentina, China, Uzbekistan, Moldova, Nepal, Zimbabwe, and Uganda. This show that relative wealth of a country is not a single explanatory factor of a country's performance, but rather that the strategic focus and approaches to ensure awareness of the importance, capacities and processes to ensure compliance are even more important.

Regarding the HTML and CSS validation, the analysis finds that most countries still have serious challenges with compliance for specific websites. The Republic of Korea is the best-performing country, closely followed by Denmark, New Zealand, Argentina and Rwanda. By contracts, the countries with the largest improvement potential include Serbia, Moldova and Uganda. Again, the hints at the importance of strategic focus and approaches to ensure awareness of the importance, capacities and processes to ensure compliance as more important than a countries income level.

While the analysis does not find any clear patterns with respect to specific topics websites (e.g. education, health etc.), national service portals generally have similar (Denmark, Serbia, Argentina) or higher (Iceland, China, Ukraine, Georgia, Moldovia, Nepal, Senegal, Uganda, Zimbabwe) levels of compliance, particularly with respect to all four tests (i.e. WCAG 2.0, 2.1, HTML and CSS) compared to other national sites. The high level of compliance with WCAG 2.0 AA is seen especially in low-income countries, potentially due to their single window status. It should be noted that the higher

Table 4: Evaluation Results (part two)

	Website	AChecker 2.0 AA problems	TAW 2.1 AA problems	HTML Errors	HTML Warnings	CSS Errors	CSS Warnings
UA	Government Portal	6	4	error	error	130	534
	Citizens Service Port.	8	28	7	19	1	149
	Health	0	error	6	2	26	3339
	Education	53	95	19	21	12	407
	Justice	17	28	16	3	10	506
	Social Prot. & Labour	76	84	101	15	51	1787
	Environment	error	error	error	error	error	error
GE	Government Portal	0	46	3	0	25	1815
	Citizens Service Port.	0	21	3	5	21	1255
	Hea., Soc. Pro. & Lab.	16	30	4	48	1	1001
	Education	0	50	75	31	10	864
	Justice	172	38	33	8	9	270
	Environment	error	error	82	13	11	534
AM	Government Portal	36	55	120	3	10	510
	Citizens Service Port.	0	1	4	0	1	417
	Health	18	1	13	1	2	2
	Education	0	49	50	18	1	129
	Justice	51	7	55	44	6	819
	Social Prot. & Labour	71	16	46	39	67	3069
	Environment	20	15	2	2	4	427
UZ	Government Portal	42	error	43	12	9	391
	Citizens Service Port.	225	0	63	24	39	697
	Health	80	19	5	21	8	2289
	Education	271	2	25	18	1	869
	Justice	42	error	148	7	72	155
	Social Prot. & Labour	163	7	19	15	43	936
MD	Government Portal	63	40	25	72	1	545
	Citizens Service Port.	2	13	120	3	10	508
	Health	112	error	34	9	32	3413
	Education	79	28	29	19	29	172
	Justice	0	29	9	58	5	589
	Social Prot. & Labour	98	29	34	9	31	3374
RW	Gov. & Service Port.	0	error	8	0	13	1341
	Health	0	error	4	0	16	1368
	Education	0	error	4	0	16	1368
	Justice	0	error	4	0	16	1368
	Employment	0	error	5	0	16	1368
	Social Protection	0	error	3	0	16	1368
	Environment	0	error	4	0	16	1368
NP	Gov. & Service Port.	65	6	64	6	7	222
	Health	38	452	175	5	30	1010
	Education	106	error	46	12	9	757
	Justice	9	117	4	18	4	1381
	Social Prot. & Labour	147	66	97	16	79	505
	Environment	63	29	4	305	6	4
ZW	Government Portal	23	25	12	21	9	1525
	Citizens Service Port.	8	error	4	2	14	1
	Health	40	28	9	37	19	853
	Education	26	16	6	10	24	1733
	Justice	2	error	error	error	error	error
	Social Prot. & Labour	31	18	9	16	29	4508
	Environment	43	26	0	16	4	479

The Challenge of Web Accessibility: An Evaluation of Selected Government Websites and Service Portals of
High, Middle and Low-Income Countries

ICEGOV 2023, September 26–29, 2023, Belo Horizonte, Brazil

SE	Government Portal	9	4	6	99	11	731
	Citizens Service Port.	0	17	error	error	2	96
	Health & Social Prot.	53	31	error	error	3	1078
	Education	119	84	192	27	16	1166
	Justice	14	34	3	11	1	396
	Employment	0	14	error	error	error	error
	Environment	19	12	22	22	0	9
UG	Government Portal	15	9	21	36	6	241
	Citizens Service Port.	0	error	error	error	error	error
	Health	94	101	56	87	78	4109
	Education	64	85	25	34	18	759
	Justice	28	error	29	95	50	4211
	Social Prot. & Labour	30	error	16	55	16	1335
	Environment	48	45	55	64	4	96

the country's income classification, the initial assessment of the content volumes increases on national service portals.

5 CONCLUSION

As the Internet becomes the main source of information, removing all obstacles for PwDs and creating equal opportunity and access for all individuals has become a priority nowadays. The utmost importance of web accessibility is to eliminate the new forms of the digital divide and contribute to greater inclusion of the PwDs.

With respect to RQ1, the paper analysed the legal framework in the selected countries that regulates the issue of the rights of PwDs, including web accessibility. The analysis concludes that all countries adopted at least a basic legislation to regulate the rights of the PwDs. Some countries, such as Denmark, Finland, and Argentina, adopted special legislation to regulate the issue of web accessibility. Most countries have also adopted national standards, guidelines or instructions to help government authorities to comply with web accessibility requirements. However, the mere commitment to the CRPD without its optional protocol does not improve web accessibility. The same is for the legal basis. In short, adopting legislation and associated web accessibility standards does not automatically lead to compliance with the WCAG AA standard or improved web accessibility. RQ1, can therefore not be supported by this papers analysis.

With respect to RQ2, the evaluation of the level of compliance of the key government websites of the selected countries with the WCAG AA standards, finds that all 20 countries can improve their web accessibility in general, and for PwDs in particular. Generally, high-income countries with more mature online service delivery ecosystems tend to lower errors and warnings despite a larger volume of online content (i.e. information and transactional services). Some emerging economies, such as Rwanda, Georgia, Armenia and Senegal, standard out for a relatively low number of errors and warnings. The emerging countries have in common their digital transformation strategies going back some 10-15 years. Web accessibility of national service portals generally has similar (Denmark, Serbia, Argentina) or higher (Iceland, China, Ukraine, Georgia, Moldova, Nepal, Senegal, Uganda, Zimbabwe) WCAG AA compliance levels compared to other national sites. The high level

of compliance with WCAG AA is seen especially in low-income countries, potentially as a result of their single window status. It should be noted that the higher the country's income classification, the initial assessment of the content volumes increases on national service portals. RQ2, can therefore be supported by this papers analysis, but the paper also finds evidence of lower level of relative wealth can be compensated for by introducing the right legal, regulatory and standards and ensuring that there is compliance with these.

The study and the method for automatic evaluation of the compliance of the home page of the selected websites show the limitation of this type of research. Namely, to achieve a more accurate view, an evaluation of hundreds of pages of each website needs to be checked to see the real image of compliance with the WCAG AA standards. The compliance of the home page does not automatically guarantee the compliance of the other pages. More importantly, web pages are a dynamic source of information being constantly updated. Compliance today does not guarantee that the webpage will be compliant tomorrow, especially if the new content is not prepared and published according to the WCAG AA standards.

Lastly, it should be noted that the use of automatic evaluation tools cannot replace expert or user testing, which may also reveal serious problems and errors. As a result, the paper cannot state which of the websites is the best or worst performing with respect to the technical and perceived web accessibility experienced by PwDs. What can conclude is that with the adoption of the required legal framework and standards for web accessibility, the compliance level remains a majority challenge in a majority of the countries analysed. Web accessibility of national websites and portals remains low – not least in light of national commitments to the UN CRPD and adoption of national legislation – and continues to be a serious challenge with respect to the digital inclusion of all users, not least PwDs.

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