



Handbook on web accessibility for teachers



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Introduction

The Integration of Web Accessibility Courses into ICT Programmes (IWAC) project, funded by the European Union, establishes a unique partnership between higher education institutions and the private sector, with the overarching goal of mainstreaming accessibility skills in higher education curricula for ICT disciplines.

Web accessibility is about making sure that everyone can participate on equal terms in the digital society. Similar to inclusion in the physical world, the work is more about having the necessary insights, attitude and instinct to identify potential problems and solutions, rather than acquiring technical and specialised knowledge. Web accessibility affects the daily lives of everyone interacting with ICT in some way, either as a user or as a professional. And everyone working with digital interfaces in some way can contribute to accessibility in their day-to-day work.

This is why the topic is relevant for inclusion in a broad range of university level education programmes.

The manual that we propose finds its main target audience in university professors who want to stimulate their students to deepen their understanding of inclusion issues.

Rather than pointing out exactly what kind of knowledge is needed for a specific educational profile, this handbook aims at giving an overview of different aspects of web accessibility and its context. Our hope is that you will find not only the background information needed but also the inspiration to include web accessibility in course development, whether it is a small module or a larger programme.

“The power of the web is in its universality. Access by everyone regardless of disability is an essential aspect”.

Tim Berners-Lee

Chapter 1. Introduction to Web Accessibility

This first chapter will introduce the subject, including an overview of the societal, organisational and policy context for web accessibility. The focus of the first chapter is to give an overview of why it is important to talk about web accessibility, what it is about, and a bit of context on why it should be practiced.

1.1 Rationale for learning/teaching web accessibility

This section looks at how web accessibility is having an impact on society from three different perspectives: legislative, social and policy level, and from a public service and business point of view. It provides a background on why it is important to learn about web accessibility. It also serves as a contextual support to the following chapters that focus more on the practical aspects of the subject.

1.1.1 Legislative perspective

ICT accessibility has in recent years made its way into legislation in several domains in the European Union. Public sector organisations now have to consider accessibility both in procurement of ICT products and services and in the development and maintenance of websites and apps. The requirements will also apply to a selection of products and services provided by the private sector through the European Accessibility Act (see Chapter 2). Legislation is, for the moment, the single most important factor driving demands for accessibility in the employment market, especially in the public sector. Students who will later take up employment in the public sector, working on anything to do with public websites or ICT services, will be required to know about and know how to apply the legislation in this field.

For more information about the current legislation and the upcoming initiatives, refer to Chapter 2.

1.1.2 Societal perspective

At its core, web accessibility is fundamentally about inclusion and making sure that everyone can participate in the digital society on an equal basis. This has become increasingly important in the last few years as more and more jobs and services both in the public and private sector are becoming digitalised. Advances in ICT carry with them the potential for increased opportunities, and there are studies that show that having access to a computer and internet has made it easier for persons with disabilities to work and/or participate in a community in their social life (Ferri & Favalli, 2018).

However, the increased digitalisation of services also implies that unless the services are developed to be accessible to all, it becomes a factor of exclusion and alienation. To promote accessibility and inclusion in the digital society, the best way is, therefore, to ensure that services and websites are developed in an accessible way from the early stages of design. Unfortunately, this is not always the case. The impact assessment leading up to

the Web Accessibility Directive showed that fewer than 10% of public and private websites in the EU complied with the requirements of the Directive in 2012 (European Commission, 2012).

There is, therefore, a real risk that large parts of the population become excluded from the community in different ways because of web accessibility barriers. In the EU, one in 6 persons, or 100 million people have a disability (Eurostat, 2020). In addition, many elderly people with or without disabilities also often experience barriers when it comes to web accessibility. The European Union estimates that almost 1/3 of its population will be older than 65 years in the year 2050 (Eurostat, 2019).

On a policy level, web accessibility is part of inclusion policies at both national and European levels. For example, it has a place in the EU disability strategy, in the context of a general aim to improve accessibility to services. But in a teaching and research environment, it is also important to look at how web accessibility connects to policies and initiatives related to ICT promotion and innovation (e.g. Digital Agenda for Europe), and to policies related to economic development and workings of the market (e.g. digital single market at European level). Looking at policies of inclusion provides only a partial understanding of the issues at stake, since the practice of inclusion or exclusion have concrete impacts in the economy and the society at large. This also means that much of the policies that affect both end users and ICT professionals are developed and implemented in contexts outside the sphere of social inclusion.

1.1.3 Service/business perspective

From a business perspective, web accessibility can be seen both as a constraint and as an opportunity. The opportunity is that inclusive and accessible design will attract more customers and generate a positive image of the company. Accessible services are generally said to be vital for a few, necessary for many, and helpful to all. Everyone can find themselves in situations where they are in need of higher levels of accessibility, as you will see in Section 1.2 User needs.

Because of a lack of knowledge on how to address web accessibility, it is often seen as a constraint in the operations. Since it is not generally taught in ICT education, there is a general lack of expertise among businesses and public organisations alike and this constitutes a barrier to implementing web accessibility in practice. The lack of knowledge among ICT professionals should not however be confused with a lack of advancement in the field. The field of web accessibility has evolved since the beginning of the web, and there are common frameworks of requirements for web accessibility that are widely accepted and used on a global level. In recent years, European standardisation organisations have also issued a standard for web accessibility in public procurement. This standard, the EN 301 549 “Accessibility requirements for ICT products and services”, is now the reference point for the new legislation on web accessibility in the public sector and will also lay the basis for the requirements in the upcoming European legislation for the private sector.

More information about the content of the standards and the generally agreed-upon principles of web accessibility can be found in Section 3.1. The point is that there are standards in place that help business and public organisations by pointing to precise requirements. Standards also act to ensure a level playing field by imposing these requirements to providers of products and services selling to the public sector. For future web professionals, it is highly likely that they will have to deal with these standards in one way or another, regardless of whether they are working in public organisations or for private sector IT providers.

1.2 User needs

This section outlines some of the major schools of thought regarding disability. It also provides a brief typology of disabilities and associated assistive technologies. Finally, the role of disabled persons' organisations (DPOs) and the importance of proper disability etiquette are discussed. The contents of this section provide vital information for anyone preparing to carry out user testing with persons with disabilities.

1.2.1 Disability models

There have always been persons with disabilities. Whether congenital or developed later in life, disability is an inescapable part of the human experience. Over the years, different models of disability have been developed within the context of different discourses in society. These models of disability reflect the background in which they were developed, and they also continue to influence both theory and practice in the field today (IAAP, 2020). For example, medical practice, social policies and antidiscrimination policies, to a large degree, derive from these models. When studying the policies and laws that are in place today, it is therefore important to also consider and discuss the different models in relation to these practices.

There are three main models that are often referred to. They are the medical, social and biopsychosocial model. All of the models have their advantages and weaknesses.

In the medical model, disability is viewed as being caused by physical or mental impairments in the individual human body. Addressing disability, then, entails medical intervention in the lives of individuals. The medical model helps us understand why functional impairments occur. The weakness is that it can be seen as looking at persons with disabilities as a problem to be solved; they are looked at as objects.

The social model sees disability as a product of barriers in society and exclusionary social practices, rather than an attribute of individuals. Addressing it means changing society. The strength of the social model is that it creates a clear political impetus for change, around which persons with disabilities can organise. However, some have criticised the social model for going too far in this direction, by downplaying or completely ignoring the reality of bodily function.

The biopsychosocial model takes into account the complex interplay between physical impairments and social barriers, without reducing the importance of either to the lived

experience of disability. The main strength of this model is that it is scientific and precise in its understanding of the two above-mentioned models. The weakness is that this model can be very bureaucratic, in a way that can affect political organisations.

Other models

Several other models of disability have been described over the years. Among them, are:

- **The economic model**, which seeks to measure disability in economic terms through levels of labour market participation, for instance.
- **The functional solutions model**, which focuses on the practical aspects of living with disability and seeks to create technical or methodological solutions to problems.
- **The social identity or cultural affiliation model**, which understands persons with disabilities as distinct social groups with shared interests and promotes pride in this shared identity (particularly prominent among Deaf people).
- **The charity model**, which seeks to address the problems persons with disabilities face through philanthropy and charitable donations.

1.2.2 Disability categories

Solutions to overcome barriers connected to accessibility are based on the user needs of people with various disabilities. When working with accessibility, it is therefore important to know about different types of disabilities in order to understand what measures to implement. However, it is also important to remember that needs are overlapping between different types of disabilities, and that accessibility measures are most often of great benefit for everyone, with or without disabilities.

Here is a short run-through of different disability categories. More information on each of them can be found in the Body of Knowledge for the Certified Professional in Accessibility Core Competencies (IAAP, 2020), and the work carried out by the W3C's Web Accessibility Initiative (WAI) (W3C-WAI, 2017).

Visual impairments imply that a person could have partially reduced vision, to complete blindness or be colour blind.

Auditory impairments affect a person's ability to hear, ranging from partial hearing loss to no hearing at all (deafness).

Mobility impairments affect a person's ability to move around, manipulate interfaces or lift heavy objects. Disabilities in this category include absence of limbs, full or partial paralysis or reduced muscle capacity.

Speech impairments affect a person's ability to produce spoken language and be understood, ranging from comparatively mild conditions such as stuttering to complete mutism.

Another important disability to know about is cognition, which affects a person's mental abilities. The cognitive impairments have a wide span, from learning disorders such as dyslexia, to neuropsychiatric diagnoses, such as autism, to intellectual disabilities.

There are also some other impairments or disabilities that do not fit neatly into these categories. Some people may have multiple concurrent disabilities, while others may have disabilities with more diffuse characteristics (e.g. chronic fatigue). Moreover, almost everyone will experience temporary or situational disabilities at one point or another in their lives.

1.3 Assistive technology



Figure 1.3 Photo of person using screen reader

In order to reduce accessibility barriers for the above groups, assistive technologies addressing different disabilities can be used, for example:

- For persons with visual disabilities: screen readers, audiobooks, audio description, magnification tools, contrast enhancing tools, tactile floor plans, Braille print.
- For persons with auditory disabilities: hearing aids, sign language interpreters, live captioning during presentations, subtitles, visual alerts or vibration for phones or doorbells, assistive listening devices, visual labels.
- For persons with mobility disabilities: wheelchair, remote devices, eye tracking, speech to text software, mouth mouse, sip-and-puff switch, head wand, voice recognition software, walkers, canes, crutches, stair lifts.
- For persons with speech disabilities: text to speech software, articulation aids, electronic communication boards.
- For persons with cognitive disabilities: simplified content, simplified interfaces; visual/audio alternatives to text in signage; messages; instructions; direct and adapted help; computer-assisted instruction for word recognition, math, spelling and social skills.

1.4 The disability rights movement and DPOs

The disability rights movement consists of disabled persons' organisations, so called DPOs, advocacy groups and charities and other organisations who provide services to persons with disabilities. The DPOs are controlled by persons with disabilities, as member organisations where the majority of staff, board and volunteers are persons with disabilities. The DPOs are based on the idea that persons with disabilities are their own best spokespersons and are often referred to as "for us, by us".

Some DPOs, for example, those representing children with disabilities, people with intellectual disabilities, and/or the Deafblind can include relatives of persons with disabilities. The primary aim of these organisations is empowerment and the growth of self-advocacy among the represented group of individuals.

The role of DPOs vary between countries, but almost always include:

- Providing disability communities with voices of their own.
- Raising public awareness about the needs of persons with disabilities.
- Advocating for equal rights, inclusion and accessibility.

Some DPOs provide services for their members, others are more active on the political level.

Most countries have umbrella organisations, where the DPOs are members. At the EU-level, the European Disability Forum is representing over 100 umbrella organisations across Europe. There are also diagnosis specific umbrella organisations like the European Blind Union, The European Union of the Deaf and Inclusion Europe (representing people with intellectual disabilities). At the global level, the International Disability Alliance is representing 1100 organisations around the world.

DPOs also have official standing through the UN Convention on the Rights of Persons with Disabilities (UNCRPD, see Chapter 2). In particular, Art. 4.3 stipulates that "States Parties shall closely consult with and actively involve persons with disabilities [...] through their representative organisations."

1.5 Ethical principles in web accessibility

Design and teaching practices related to web accessibility involve a moral vision whereby the assumption of responsibility by designers and teachers is oriented towards the flowering of capabilities and the well-being of students and users so that the unfair inequalities produced by disability are eliminated or at least reduced. This can be done not only by fully recognising the rights of persons with disabilities, but also their specific conditions and actively involving users in design and teaching. Functionality, reliability, usability, cost containment are moral commitments for those professionally involved in accessibility.

1.6 Disability etiquette

When carrying out user testing with persons with disabilities, there are a few rules of thumb that should be kept in mind in order to ensure a respectful testing environment. Collectively, these rules can be referred to as disability etiquette. Among the rules are the following:

- Speak directly to the person with disabilities, not to their companion.
- Avoid making assumptions about what someone can or cannot do.
- Ask if the person needs help.
- Do not attempt to help the person if you have not asked if they want your help – and especially not if they have declined it.
- Respect the person’s ability to decide for themselves.
- Do not refer to people by their disabilities.

1.7 Integrating web accessibility at work

1.7.1 How to approach accessibility from an organisational level

To be able to consistently practice ICT accessibility in all relevant activities, there needs to be a framework in place that allows for a systematic approach to the issue at organisational level. Web accessibility is an on-going process that needs to be considered in relation to key developments within the organisation regarding, for example, client base, strategy, working methods and engagement with the community. In other words, web accessibility should be practiced as an on-going program, not just as ad-hoc activities.

The Business Disability forum has established a maturity model regarding organisational practice of accessibility (Business Disability Forum, 2016). The model describes 5 levels of organisational maturity in the subject:

- Level 1 - Informal (No documentation or process in place)
- Level 2 - Defined (Documented but not actioned or completed once)
- Level 3 - Repeatable (Process established and actioned consistently)
- Level 4 - Managed (Process monitored & improved, business as usual)
- Level 5 - Best practice (Innovate, improve and share)

To assess the level of maturity, the framework evaluates the practices of the organisation on ten different aspects including, for example, accessibility know how, disability awareness, leadership from executive level, benchmarking, procurement practices and the development life cycle.

As with most organisational practices, the chance of success increases with the level of engagement and leadership from top levels in the organisation. A survey conducted by the International Association of Accessibility Professionals (IAAP) in 2019 shows that there is a

correlation between the increased maturity of accessibility programs and the organisation's level of investment in specific leadership and management components.

Based on the results of the survey, IAAP recommends 10 areas of investments that will help to ensure successful accessibility programs. Key recommended investments include:

- Dedicated funding & accessibility resources.
- Accessibility criteria in contracts and procurement orders.
- Accessibility in both design, authoring, engineering and testing practices.
- Engagement with the disability community.
- Written organisation-wide policy and senior leadership.
- Benchmarking and compliance practices.

1.7.2 Roles: accessibility is the responsibility of the whole team

Organisational level

As can be seen from the section above, accessibility touches on several areas of the activities throughout an organisation. To keep the commitment active, and most importantly, to translate it into action, all staff need to know how they should contribute in their own specific role. This is not limited to the roles working directly in web production, such as design, development, authoring, engineering and testing practices. The list of successful investment areas mentioned above, shows that the staff working in management, procurement, human resources and communication also need to have at least a basic level of awareness and knowledge of accessibility.

Web production

All staff involved in web production will be doing work that has a bearing on accessibility. But not all requirements will be relevant for all staff. To illustrate this, W3C published a table on how many of the success criteria in WCAG 2.0 (now superseded by WCAG 2.1) apply to different roles in a standard web production project. The table shows that around 10 different roles involved in a production team need to take criteria into account (a bit overlapping). Interaction design, graphic designers and backend developers will need to take into account almost the same number of criteria (32-36) (W3C, 2012a). In line with this, web accessibility experts and organisations strong in accessibility develop checklists on the criteria that are specific to the different roles within the organisation.

1.7.3 Motivation and benefits

There are several reasons for addressing web accessibility in the context of business studies and education. Even if on the surface it may seem like a mostly technical subject, the accessibility of digital interfaces has implications on the business side of operations in both public and private sectors. A number of factors act either as a carrot or a stick when it comes to the rationale for applying web accessibility in practice, as discussed in this section.

Legislation

Within the EU, the enforcement of the Web Accessibility Directive is currently the foremost factor driving demand for web accessibility knowledge and services in the public sector. With the upcoming European Accessibility Act, there will also be new legal imperatives on the private sector within the next few years. More information about the legislation can be found in Chapter 2.

The common EU-rules makes it easier for end users with disabilities to know their rights across borders and for the industry to follow the requirements no matter where they sell their products and services.

The enforcement of the Web Accessibility Directive is based on monitoring, self-declaration and the possibility for end users to complain. If the organisation covered by the directive doesn't fulfil its obligation, it can be fined.

Reaching a wider range of customer/audience

Another reason for voluntarily investing in accessibility practices is the ambition to reach a wider range of customers/audiences. This can be done either as an inherent part of the organisational strategy, for example, within public service organisations that have a mandate to reach all audiences, or as a deliberate strategy to increase the reach of the organisation into new customer segments. In a 2019 survey of the IAAP among their members, 59% of the organisations cited inclusion of all audiences as a driver for their investments in accessibility.

However, according to the same survey, only 20-25 % of businesses deliberately use accessibility to increase their market (Sinclair. R, 2019). Other studies show that this lack of inclusion is already costly to business in terms of loss of custom. A British survey of online shopping shows that 71% of disabled customers will click away from a commercial website that they find difficult to use. The spending power of these customers was estimated to almost 12 billion pounds in the UK alone in 2016 (Click-Away Pound, 2016). Another demographic factor driving demand for accessibility is the ageing population. The European Union estimates that almost 1/3 of its population will be older than 65 years in the year 2050. The majority of this population is already used to digital services, and will be expecting to be able to use them throughout their life.

Operational effectiveness and savings

The business case for accessibility also includes savings at an operational and organisational level. W3C notes that much of the technical improvements in terms of increased accessibility also entails positive returns on the cost side. One of the most direct savings is a reduced need to provide material in alternative formats. But the direct benefits also include a reduced need for site maintenance and upgrades (W3C, 2012b). Working with accessibility in the early phases also helps to avoid additional work with repairs and corrections later on. According to a study by Forrester Research, the cost of fixing issues in web site development increases by a factor of 30 from the design phase to when the product has been launched (Gualtieri et al., 2011).

1.7.4 Procurement

Most of the public websites in the EU member states are not developed in-house. Often, the websites are set up and/or maintained by IT suppliers chosen through open procurement procedures. In this case, it is very important that the procurer has sufficient knowledge about web accessibility to be able to set up adequate requirements to be included in the procurement process, both in the selection criteria and also in the contract with the supplier.

This illustrates the need for wider training and education on web accessibility beyond the professionals working directly with the digital interfaces, such as web authors and developers. With the new legislative imperatives on public websites, an oversight with relation to accessibility in the procurement phase can prove costly both in time and money further down the value chain if errors need to be repaired after development and deployment of the digital service.

To make sure that all procurers know which requirements they need to apply in the process, there is a European harmonised standard on the subject that originally was developed for the specific purpose of public procurement. The standard EN 301 549 “Accessibility requirements for ICT products and services” was developed by the three European organisations for standardisation: ETSI, CEN and CENELEC on the explicit demand of the European Commission. With the introduction of the web accessibility directive, the requirements of the standard are now compulsory for public organisations in two areas, both in public procurement (Directive 2014/24/EU) and in the development and maintenance of public sector websites (Directive 2016/2102/EU). All professionals in charge of IT procurement and/or the management of public sector websites therefore need to be aware of the requirements and have some understanding of how to use them in practice.

1.8 Resources for further reading

1.8.1 Resources for rationale for learning/teaching web accessibility

- Ferri D., Favalli. S (2018). “Web Accessibility for Persons with disabilities in the European Union: Paving the Road to Social Inclusion”. Societies 8(2), 40
- Eurostat (2020). EU statistics on income and living conditions (EU-SILC) methodology – concepts and contents. Collected 2020-08-03 from [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_\(EU-SILC\)_methodology_-_concepts_and_contents&oldid=391031](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_statistics_on_income_and_living_conditions_(EU-SILC)_methodology_-_concepts_and_contents&oldid=391031)
- Eurostat (2019). Ageing Europe - statistics on population developments. Collected 2020-08-03 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Ageing_Europe_-_statistics_on_population_developments
- European Commission (2012). Impact assessment accompanying the document “Proposal for a Directive of the European Parliament and of the Council on the accessibility of public sector bodies’ websites” (SwD/2012/0402 final)

1.8.2 Resources for user needs

- IAAP (2020). International Association of Accessibility Professionals, CPACC Body of Knowledge. Collected 2020-06-12 from https://www.accessibilityassociation.org/files/IAAP_CPACC_BOK_March2020.pdf (Last accessed on 14 October 2020)
- W3C-WAI (2017). Diverse Abilities and Barriers. Collected 2020-06-23 from <https://www.w3.org/WAI/people-use-web/abilities-barriers/> (Last accessed on 14 October 2020)

1.8.3 Resources for integrating web accessibility at work

- Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC
- Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies
- Gualtieri et al 2011. "The Seven Qualities of Wildly Desirable Software." Forrester Research
- Sinclair, R. (2019). White Paper on Understanding Organizational Approaches to Accessibility. (IAAP Whitepaper, 2019) Atlanta, Georgia, USA
- Business Development Forum (2016). Accessibility Maturity Model. Collected 2020-06-23 from <https://businessdisabilityforum.org.uk/knowledge-hub/resources/tech-taskforce-accessibility-maturity-model/> (Last accessed on 14 October 2020)
- Click-Away Pound (2016). Click-Away Pound Survey 2016 - Final Report. Collected 2020-07-03 from <http://www.clickawaypound.com/cap16finalreport.html> (Last accessed on 14 October 2020)
- W3C (2012a). Accessibility Responsibility Breakdown. Collected 2020-07-01 from https://www.w3.org/community/wai-engage/wiki/Accessibility_Responsibility_Breakdown (Last accessed on 14 October 2020)
- W3C (2012b). Financial Factors in Developing a Web Accessibility Business Case for Your Organization. Collected 2020-06-23 from <https://www.w3.org/WAI/business-case/archive/fin#direct> (Last accessed on 14 October 2020)

Chapter 2. Web Accessibility Legislation & Policies

In recent years, Internet access has brought significant developments for society, simplifying and improving information and knowledge processes, making administrative procedures more efficient and reliable, ensuring transparency and increasing user satisfaction. This social and technological development has forced countries to question the equality of access for all persons, regardless of their abilities.

The focus of this chapter is to illustrate the main international framework, and EU policy and regulations on the accessibility of websites, and then to introduce the national regulations of the project partners, Sweden, Germany and Italy.

2.1 International framework and EU policy regulations

2.1.1 The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD)

The international framework for accessibility regulations refers to guidance documents issued by the United Nations, which are binding once transposed by the various countries. The first references on the subject can be found in the early 1990s, in the United Nations Rules on Equal Opportunities for Persons with Disabilities, adopted by the UN General Assembly in December 1993 (United Nations, 1993). These are recommendations addressed to Member States so that they adopt the necessary measures to guarantee disabled people the same opportunities as other citizens, combating any discrimination and ensuring the creation of conditions of accessibility. In particular, Article 5 specifies: "States should recognise the central importance of accessibility in the process of achieving equal opportunities in all spheres of social life. For persons with disabilities, States should: a) introduce action programmes to make physical environments accessible; b) find the means to make information and communication accessible; c) facilitate access to physical environments".

In accordance with the principles contained in the above recommendations, the United Nations has further developed the issue of accessibility and protection of the rights of persons with disabilities through the Convention on the Rights of Persons with Disabilities (CRPD).

This Convention represents an important goal for the international community as it is part of the wider context of the protection and promotion of human rights, reaffirming in favour of persons with disabilities, the fundamental principles of recognition of equal opportunities and non-discrimination. It is the first treaty with extensive human rights content and marks a turning point in relations with persons with disabilities, no longer individuals in need of charity, medical care and social protection but "people" able to claim their rights and make decisions for their lives, based on free and informed consent, and to be actively included in society.

The CRPD was adopted on 13 December 2006 by the General Assembly of the United Nations (UN) (United Nations, 2006a). On 30 March 2007, the CRPD was opened for signature at the UN headquarters in New York. At the time of publication of this handbook, 177 countries worldwide (91% of UN member states) are States Parties to the CRPD. In

Europe, the CRPD was also ratified in 2011. Ireland was the last EU Member State to ratify the Convention in March 2018. This is the first time there has been universal ratification of an international human rights treaty in the EU. All EU candidate countries (Albania, Montenegro, Serbia, the Former Yugoslav Republic of Macedonia (FYROM) and Turkey) have ratified the CRPD, as have all countries of the European Economic Area/European Free Trade Association (EEA/EFTA), with the exception of Liechtenstein. The European microstates of Andorra, San Marino and Monaco have also ratified (United Nations, 2017).

The Convention is accompanied by an Optional Protocol (United Nations, 2006b), composed of 18 articles.

The recognition of the relevance of accessibility is therefore part of a more general framework for promoting the rights of persons with disabilities, their dignity and their personal freedoms.

In particular, accessibility is identified as one of the general principles on which the Convention is based (Art. 3) and it is defined, according to Art. 9, in a broad sense that concerns places, transport, information and communication technology and systems.

In 2015 the United Nations published the document *Transforming our World: the 2030 Agenda for Sustainable Development* (United Nations, 2015), which identifies seventeen objectives (so-called Sustainable Development Goals or SDGs). The 2030 Agenda for Sustainable Development has become a reference in many areas. The European Disability Forum (EDF, 2020) has linked the SDGs with the articles of the Convention on the Rights of Persons with Disabilities.

The United Nations mechanisms have consistently argued that the debate on disability rights is not so much about the enjoyment of specific rights, but rather about ensuring the equal effective enjoyment of all human rights, without discrimination, by persons with disabilities.

2.1.2 The European Disability Strategy

At EU level, the European Commission, the European Parliament and the European Council, in line with the UN Convention on the Rights of Persons with Disabilities, have addressed the issue of accessibility both with documents of a holistic nature and with documents referring to specific areas (transport, web, culture, etc.).

The European Commission has dedicated itself to the formulation of specific recommendations in order to promote the full integration of persons with disabilities, identifying accessibility as one of the basic conditions for achieving this objective. In particular, from 2000 to 2010, several communications have been disseminated - addressed to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions - in which the European Commission has formulated the feasible European strategy on disability.

These are the so-called "European Action Plans", i.e. policy documents aimed at enabling persons with disabilities to exercise all their rights and to participate fully in European

society and the European economy. In pursuit of this aim, the European Commission - as part of the strategy for the period 2010-2020 - has identified eight main areas for action: accessibility, participation, equality, employment, education and training, social protection, health and external actions. In particular, accessibility is identified by the European Commission as a prerequisite for participation in society and the economy and recommends its implementation through the use of legislative instruments in the fields of construction, transport and information and communication technologies.

The Council of Europe on 30 November 2016 adopted a new Strategy on the Rights of Persons with Disabilities 2017-2023 identifying five priority areas: equality and non-discrimination, awareness raising, accessibility, equal recognition before the law and freedom from exploitation, violence and abuse.

Accessibility, according to Articles 9 and 21 of the UN Convention, is generally understood as "a facilitator for persons with disabilities in all areas of life", stating that "differences in the ability of individuals to receive and communicate information and use information and communication technologies represent a division of knowledge that creates inequality".

2.1.3 Procurement Directive

The Procurement Directive (2014/24/EU) was transposed into national legislation in 2017. It covers public procurement over the threshold and increases the requirements for accessibility in public procurement compared to earlier versions.

2.1.4 Web Accessibility Directive

The Web Accessibility Directive (2016/2102/EU) was transposed into national legislation in 2018. It requires public sector organisations and bodies governed by public law (organisations that are more than 50 percent publicly owned, financed or managed by the public sector) in EU member states to comply with minimum accessibility requirements.



Figure 2.1 Timeline of the adoption and application of the Web Accessibility Directive, from the entry into force in 2016 until the review of the application of the Directive in 2022.

2.1.5 European Accessibility Act

The European Accessibility Act (Directive (EU) 2019/882), is a directive that will enter into force in the member states by 2022. The act covers the private sector and focus on certain accessible products and services that have been identified as being most important for persons with disabilities.

2.1.6 The European standard for ICT accessibility: EN301549

The European standard “EN301549 v.2.1.2 Accessibility requirements for ICT products and services” acts as the presumed conformance to the minimum requirements of the Web Accessibility Directive. The EN301549 contains functional performance statements and technical specifications for ICT in a broad sense. In addition to the web, the standard covers, among other things, vending machines, telephones and computers. It is probably the most comprehensive standard for ICT accessibility in the world and it has been developed in close collaboration with U.S. Access board to correlate as far as possible with the American requirements.

The standard is divided into Clauses, which can be seen as chapters. Clause 4 covers the functional performance statements, which means the different use cases of persons with disabilities using ICT. Clause 5 covers the general requirements, and the following chapters are dedicated to different parts of ICT such as hardware, software, web etc.

In Annex A of the EN301549, the relationship between the EN-standard and the requirements of the Web Accessibility directive is mapped.

Annex B covers the relationship between the functional performance statements and the technical requirements, and can be used to support the reader in understanding what noncompliance may mean to different user groups.

When it comes to the technical requirements for web accessibility, the EN301549 is referring to the international standard WCAG 2.1 AA.

2.2 Web accessibility regulations in Sweden

UNCRPD

Sweden ratified the UNCRPD in 2008. While government bodies have a responsibility to comply with the convention, it is primarily given effect through existing law. The Swedish Agency for Participation has been tasked with supporting and monitoring the implementation of the convention.

Discrimination Act

The Swedish Discrimination Act was updated in 2015 to also cover lack of accessibility as discrimination. The law is based on equal rights and opportunities regardless of sex, transgender identity or expression, ethnicity, religion or other belief, disability, sexual orientation or age. The focus of the act is the labour market and education.

Web Accessibility Directive

The EU Web Accessibility Directive (Directive (EU) 2016/2102) was transposed into Swedish law in December 2018. The law appoints The Agency for Digital Government (DIGG) as monitoring body.

Before this law entered into force, web accessibility requirements followed from a 2001 ordinance for public sector to support the Swedish disability strategy by making sure persons with disabilities are included in society when it comes to buildings, business and information.

Public procurement

The EU Procurement Directive (2014/24/EU) was transposed into Swedish law at the end of 2016. Chapter 9, paragraph 2, covers the requirements for technical specifications for persons with disabilities.

Language Act

The objectives for Swedish language policy are specified in the Language Act (2009: 600), which entered into force on 1 July 2009. The purpose of the law is above all to clarify the position of Swedish and other languages in Swedish society. Authorities and other public organizations have a special responsibility for the use and development of Swedish. The same responsibility applies to the promotion of the national minority languages and of the Swedish sign language. The law states that language of public services should be cared for, simple and understandable.

Working environment

The Work Environment Act states, among other things, that the employer must take into account the employee's special conditions for work by adapting working conditions or taking other appropriate measures. When planning and arranging the work, the employer must take into account that people's conditions for performing tasks are different.

2.3 Web accessibility strategy in Germany

In Germany, the Barrierefreie-Informationstechnik-Verordnung (Federal Ordinance on Barrier-Free Information Technology) was first revised in 2011 to reflect the changes brought about by WCAG 2.0, which resulted in BITV 2.0. The ordinance was amended again in May 2019 to transpose the European Web Accessibility Directive (Directive 2016/2102) into federal law.

BITV 2.0 applies to websites, mobile apps, administrative processes, and graphical user interfaces used for administrative processes. The following categories of IT products are exempt from this ordinance: reproductions of cultural heritage that cannot be made accessible due to their nature or the costs involved in the process, archives that are not used for administrative processes or that are not updated after 23 September 2019, and websites and apps by public broadcasters. The revised BITV 2.0 does not explicitly name the standards that these categories of ICT products and services need to conform to; instead, it states that accessibility requirements are assumed to be fulfilled if these

products and services conform to harmonised standards, such as those specified in the Official Journal of the European Union (German: Amtsblatt der Europäischen Union).

The revised BITV 2.0 also required the creation of a committee on barrier-free IT within the federal inspection agency (Bundesfachstelle Barrierefreiheit) that was created as a result of the Behindertengleichstellungsgesetz (BGG; Act on Equal Opportunities for Persons with Disabilities). It also charged this inspection agency with the task of providing consultancy and support regarding digital accessibility to public authorities.

Both BITV 2.0 and the BGG are pieces of legislation at the federal level and therefore apply to public authorities at the federal level. Each federal state (German: Bundesland) has its own legislation, not only with regard to anti-discrimination policy but also with regard to education and research. For example, in the state of Baden-Württemberg, the current anti-discrimination law is the “Landesgesetz zur Gleichstellung von Menschen mit Behinderungen” (Landes-Behindertengleichstellungsgesetz - L-BGG), which dates from 2014 and which was updated in 2018 to transpose EU Directive 2016/2102. This law applies to public authorities, public corporations, public trusts, municipalities and other legal entities regulated by public law. Art. 10.1 of this law states that the accessibility criteria for websites and apps are those specified by the federal BITV 2.0, thereby ensuring harmonisation between state law and federal law with regard to technical criteria.

As an example, Figure 2.2 illustrates the accessibility requirements for higher-education institutions in the state of Baden-Württemberg.

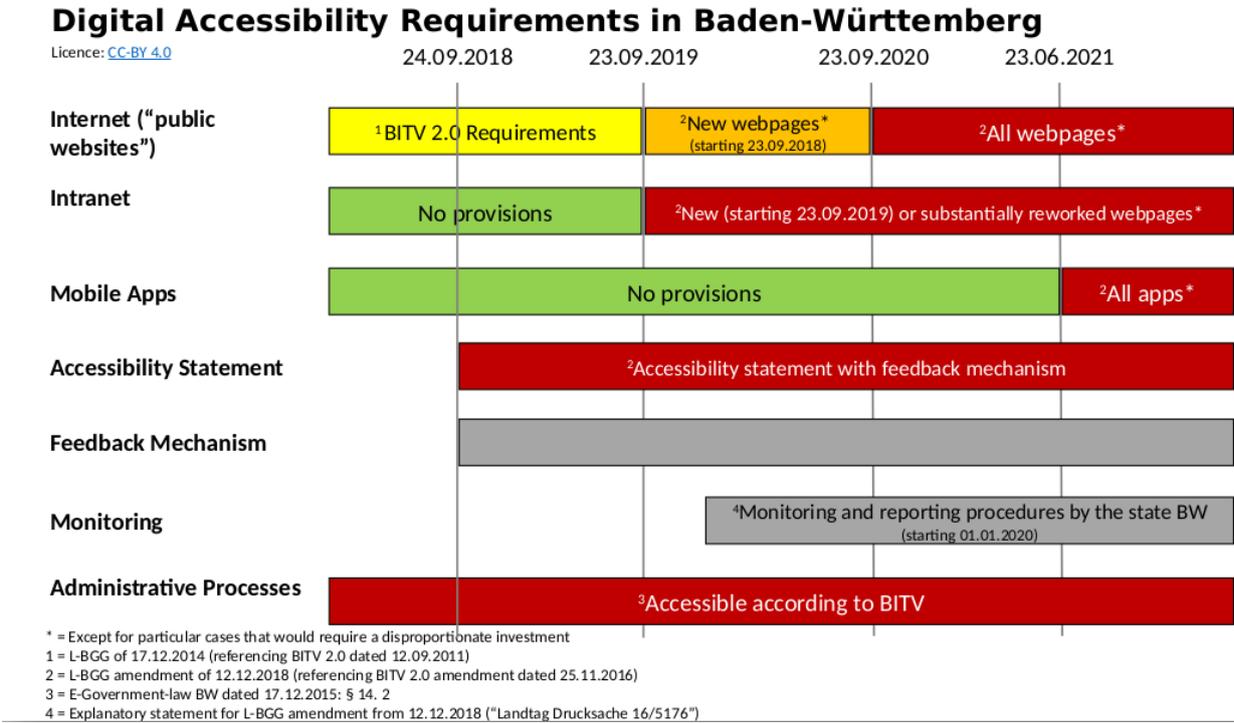


Figure 2.2 Digital accessibility requirements for higher-education institutions in the state of Baden-Württemberg.

The above image is translated from [Gesetze & Richtlinien](#) on the HdM website. Since 23 September 2019, the following requirements apply: both public websites created since 23

September 2018 and intranet pages must comply with BITV 2.0 and must have an accessibility statement. Apps will have to comply by 23 June 2021.

Similar requirements exist in other German states. For example, in Bavaria, the law on equal opportunities and integration for persons with disabilities ([Bayerisches Gesetz zur Gleichstellung, Integration und Teilhabe von Menschen mit Behinderung \(Bayerisches Behindertengleichstellungsgesetz – BayBGG\)](#)) from 9 July 2003 was updated on 1 May 2019 and now transposes the European Web Accessibility Directive (Directive 2016/2102) into Bavarian state law (see [Art. 13](#) regarding the accessibility of internet and intranet sites). The Bavarian eGovernment law ([Bayerische Verordnung über die elektronische Verwaltung und die barrierefreie Informationstechnik \(Bayerische E-Government-Verordnung – BayEGovV\)](#)) from 8 November 2016 requires that websites and apps by public authorities be accessible as defined by the European Web Accessibility Directive (Directive 2016/2102). In addition, certain categories of websites must also provide information in German Sign Language and “Leichte Sprache” (literally “easy language”) on their homepages. The [rules for “Leichte Sprache”](#) were defined by the Netzwerk Leichte Sprache (“Network Easy Language”) and should not be confused with the less formally defined concept of “Einfache Sprache” (literally “simple language”).

2.4 Web accessibility strategy in Italy

The fundamental regulatory interventions on accessibility in Italy are represented by Law no. 4 of 9 January, 2004, "Provisions to facilitate access of disabled people to IT tools" (Parlamento Italiano, 2004), the so-called Stanca Law, the subsequent implementing regulation no. 75 of 2005, and the decree of the Minister for Innovation and Technology of July 2005, which defines the technical requirements. The provisions envisage that public administrations, private entities that are concessionaires of public services and municipalized companies, create websites and web services in compliance with technical requirements in order to guarantee their full usability by all citizens, including those with disabilities. According to the definition contained in Art. 2 of law no. 4/2004, accessibility "is the ability of information systems, in the forms and within the limits allowed by technological knowledge, to provide services and information that can be used, without discrimination, also by those who, due to disability, need assistive technologies or particular configurations".

Legislative Decree no. 106/2018, implementing the European Web Accessibility Directive - WAD European Union Directive on the accessibility of websites and mobile applications of public bodies (Directive no. 2016/2102), has updated and amended Italian Law no. 4/2004 Provisions to facilitate access to IT tools for persons with disabilities, extending and clarifying the notion of accessibility.

The decree defines the general principles for accessibility as follows:

"1. The websites and mobile applications of the providers, are accessible if they are perceivable, usable, understandable and solid. 2. The services provided through computer systems, including websites and mobile applications, are accessible if they have the following requirements: a) accessibility to the content of the service by the user; b) usability of the information offered, characterized by: (1) ease and simplicity of use,

ensuring, inter alia, that the actions to be taken to obtain services and information are always uniform; (2) efficiency of use, ensuring, inter alia, the separation between the way the interfaces are maintained, presented and how they work, and the possibility of making the information available through different sensory channels; (3) effectiveness in use and responsiveness to the user's needs, ensuring, inter alia, that the actions to be taken to properly obtain services and information are independent of the device used for access; (4) satisfaction in use, ensuring, inter alia, access to the service and information without undue inconvenience or constraints for the user”.

In the implementation of WAD Directive EU/2016/2102, on December 20, 2019 the Agency for Digital Italy (AGID) published the "Guidelines on the accessibility of information technology tools" (AGID, 2019) on December 20, 2019, in force since 10 January 2020. They direct the Public Administration to the provision of increasingly accessible services. One of the most important innovations for administrations is the obligation to publish a "Declaration of Accessibility", in which administrations will have to indicate the state of conformity of each site and mobile application to the accessibility requirements. The Declaration will also contain a procedure, called "Feedback Mechanism", available to users who wish to report further problems of inaccessibility.

Recent “Simplifications” decree-law (DL n.76, 2020), which came into force on 17 July 2020 modifying the Stanca Law, has extended it to private individuals and anticipated EAA provisions to legal entities other than public administration. In case of non-compliance to WAD, Art. 29 states that the Agency for Digital Italy applies a fine of up to 5 percent of company turnover, exceeding nine hundred million euros, in last three years of activity. This applies only to companies offering services to the public through websites or mobile applications.

2.5 Resources for further reading

This section contains contributions to deepen the knowledge of the specific contexts in the national languages of the partners.

2.5.1 Resources for international framework and EU policy regulations

- United Nations (1993). Standard Rules on the Equalization of Opportunities for Persons with Disabilities A/RES/48/96. Collected from the website: <https://www.un.org/development/desa/disabilities/standard-rules-on-the-equalization-of-opportunities-for-persons-with-disabilities.html> (Last accessed on 14 October 2020)
- United Nations (2006a). Convention on the Rights of Persons with Disabilities (CRPD). Collected from the website: <https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/convention-on-the-rights-of-persons-with-disabilities-2.html> (Last accessed on 14 October 2020)
- United Nations (2017). The world ratification map is available on the United Nations webpage: <http://www.un.org/disabilities/documents/maps/enablemap.jpg> (Last accessed on 14 October 2020)
- United Nations (2006b). Optional Protocol to the Convention on the Rights of Persons with disabilities, A/RES/61/106, Annex II, Article 2. Collected from the

- website: <http://www.un.org/disabilities/documents/convention/convoptprot-e.pdf> (Last accessed on 14 October 2020)
- EDF (2020). The European Disability Forum. Collected from the website: <http://www.edf-feph.org/> (Last accessed on 22 October 2020)
 - United Nations (2015). - Transforming our World: the 2030 Agenda for Sustainable Development. A/RES/70/1. Collected from the website: <https://sustainabledevelopment.un.org/post2015/transformingourworld> (Last accessed on 14 October 2020)
 - European Union (2019). European Accessibility Act. Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services. Collected from the website: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.151.01.0070.01.ENG&toc=OJ:L:2019:151:TOC (Last accessed on 14 October 2020)
 - W3C (2020). Web Content Accessibility Guidelines (WCAG). Collected from the website: <https://www.w3.org/WAI/standards-guidelines/wcag/> (Last accessed on 14 October 2020)
 - WCAG (2020). The WCAG 2.1 supporting technical materials:
 - WCAG 2.1 checklist: <http://www.w3.org/WAI/WCAG21/quickref/>
 - Techniques for WCAG 2.1 <https://www.w3.org/WAI/WCAG21/Techniques/>
 - Understanding WCAG 2.1 <https://www.w3.org/WAI/WCAG21/Understanding/>
 - W3C (2008). Mobile Web Best Practices 1.0. Collected from the website: <https://www.w3.org/Mobile/> (Last accessed on 14 October 2020)
 - W3C (2010). Mobile Web Application Best Practices 1.0. Collected from the website: <https://www.w3.org/TR/mobile-bp/> (Last accessed on 14 October 2020)
 - European Commission (2020). Implementation of the Marrakesh Treaty in EU law. Collected from the website: <https://ec.europa.eu/digital-single-market/en/implementation-marrakesh-treaty-eu-law> (Last accessed on 14 October 2020)
 - WIPO (2013). World Intellectual Property Organization
 - Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired or Otherwise Print Disabled, <https://www.wipo.int/treaties/en/ip/marrakesh/> (Last accessed on 14 October 2020)
 - Summary of the Marrakesh Treaty to Facilitate Access to Published Works for Persons Who Are Blind, Visually Impaired, or Otherwise Print Disabled (MVT) (2013). https://www.wipo.int/treaties/en/ip/marrakesh/summary_marrakesh.html (Last accessed on 14 October 2020)

2.5.2 Resource for web accessibility strategy in Sweden

- Sveriges Riksdag (2014). Förordning (2001:526) om de statliga myndigheternas ansvar för genomförande av funktionshinderspolitiken. Collected from: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2001526-om-de-statliga_sfs-2001-526 (Last accessed on 14 October 2020)

- Sveriges Riksdag (2017). Diskrimineringslag (20018:567). Collected from: https://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/diskrimineringslag-2008567_sfs-2008-567 (Last accessed on 14 October 2020)
- Konkurrensverket (2016). Swedish Public Procurement Act. Collected from: <http://www.konkurrensverket.se/globalassets/english/publications-and-decisions/swedish-public-procurement-act.pdf> (Last accessed on 14 October 2020)
- Ministry of Employment (2014). Swedish Work Environment Act. Collected from: <https://www.government.se/government-policy/labour-law-and-work-environment/19771160-work-environment-act-arbetsmiljolagen/> (Last accessed on 14 October 2020)
- DIGG (2020). Webbkritlinjer. Collected from: <https://webbkritlinjer.se/lagkrav/sprak/> (Last accessed on 14 October 2020)

2.5.3 Resource for web accessibility strategy in Italy

- Parlamento Italiano (2004). Legge n. 4 del 9 gennaio 2004, “Disposizioni per favorire l’accesso dei soggetti disabili agli strumenti informatici”. Collected from the website: <https://www.camera.it/parlam/leggi/04004l.htm> (Last accessed on 14 October 2020)
- DL n.108 (2018). DECRETO LEGISLATIVO 10 agosto 2018, n. 106 Riforma dell'attuazione della direttiva (UE) 2016/2102 relativa all'accessibilità dei siti web e delle applicazioni mobili degli enti pubblici. (18G00133) (GU Serie Generale n.211 del 11-09-2018). It modified Legge Stanca <https://www.gazzettaufficiale.it/eli/id/2018/09/11/18G00133/sg> (Last accessed on 14 October 2020)
- AGID (2019). Linee Guida sull’accessibilità degli strumenti informatici. Collected from the website: <https://www.agid.gov.it/it/design-servizi/accessibilita/normativa> (Last accessed on 14 October 2020)
- DL n.76 (2020). <https://www.gazzettaufficiale.it/eli/id/2020/07/16/20G00096/sg> (Last accessed on 14 October 2020)

Chapter 3. Teaching and Learning Web Accessibility: Fundamental Concepts, Needs and Skills

As already pointed out in previous chapters, web accessibility means that websites and related tools and technologies are designed and developed in such a way that persons with disabilities can use them. Designing and developing for web accessibility requires processes that are thorough and inclusive since accessibility is not a requirement that can simply be tacked on to a list of features.

Moreover (see Chapter 1), there are several roles that need knowledge about web accessibility, from interaction designers and web developers to procurement and management.

This chapter briefly explores some fundamental concepts, needs and skills to be taught and learned in different programs in higher education, with examples on how to incorporate them in ICT courses.

3.1 Web accessibility principles

This section introduces accessibility principles for the web as described by the W3C, including guidelines for multimedia and documents. W3C is an industry consortium created in 1994 to develop technical protocols and standards for the web.

3.1.1 WCAG 2.1 principles (POUR)

The Web Content Accessibility Guidelines (WCAG) 2.1 is a comprehensive standard for web accessibility. It is also currently the basis for legislation on web accessibility in many parts of the world. In Europe, the guidelines are referenced in the standard EN 301 549 Accessibility requirements for ICT products and services, which is the basis for EU legislation on web accessibility.

WCAG consists of 13 guidelines to follow for successfully designing and creating accessible web content (W3C, 2019a). Each guideline is organized under one of four guiding principles: Perceivable, Operable, Understandable and Robust (POUR) structured in the following way:

Perceivable

Information and user interface components must be presentable to users in ways they can perceive, i.e.:

1. Text alternatives for non-text content.
2. Captions and other alternatives for multimedia.
3. Content can be presented in different ways.
4. Content is easier to see and hear.

Operable

User interface components and navigation must be operable, i.e.:

1. Functionality is available from a keyboard.
2. Users have enough time to read and use the content.
3. Content does not cause seizures and physical reactions.
4. Users can easily navigate, find content, and determine where they are.
5. Users can use different input modalities beyond keyboard.

Understandable

Information and the operation of user interface must be understandable, i.e.:

1. Text is readable and understandable.
2. Content appears and operates in predictable ways.

3. Users are helped to avoid and correct mistakes.

Robust

Content must be robust enough that it can be interpreted by a wide variety of user agents, including assistive technologies. Robust content is compatible with different browsers and assistive technologies.

The guidelines include three levels of success criteria to be met when testing. These levels are denoted with A, AA and AAA, with AAA being the highest level of conformance and A being the lowest, while still conforming. Examples of success criteria include resizable text, error suggestion and reading level.

Different roles within the web development lifecycle are generally responsible for different success criteria. In this context, roles refer to project managers, graphics designers, interaction designers and other roles typically found contributing to web development projects. The interaction designer together with the content manager might be responsible for ensuring an appropriate reading level while the front-end developer is more concerned with proper error suggestion. While specific success criteria are assigned to specific roles, management requires overarching knowledge of the various success criteria to be able to plan accessibility at each step of the project and allocating the relevant web accessibility responsibilities to every role. (W3C, 2012)



Figure 3.1 Accessibility poster. An excerpt of posters by the UK Home Office describing the dos and don'ts of designing for a wide variety of users (UK Home Office, 2016).

3.1.2 User groups and user situations

As already discussed in Chapter 1, there is a wide range of disabilities, but accessibility aims to make sure that people can use the web no matter of their abilities. It is important to consider and design for different types of use cases, as listed in the EN301549:

- Usage without vision
- Usage with limited vision
- Usage without perception of color
- Usage without hearing
- Usage with limited hearing
- Usage without vocal capability
- Usage without manipulation or strength
- Usage with limited reach
- Minimize photosensitive seizure triggers
- Usage with limited cognition

Even though a person can have more than one disability, the standards and regulations are focussed on offering one alternative way to reach and use the content.

Some people are born with a disability, while others acquire a disability in connection with an illness or after an accident. There are permanent disabilities, but also temporary disabilities such as injuring your arm and wearing a cast for a period of time, or situational disabilities like noisy environments.

3.1.3 Accessibility for multimedia

Multimedia is one of the great strengths of the web, making it possible to really achieve accessibility for many different user groups. People prefer to receive information in different ways. Many have problems reading text and prefer audio while others learn and understand visual content better and prefer video.

If you want to make sure that as many people as possible understand your message, you should strive for a variety of formats; often called multimodality. This means that the content is presented with a combination of text, audio, photos, illustrations or video. Not all formats are suitable for all kinds of content, but it is important to remember that many users prefer something other than text.

For multimedia, two basic rules are important:

- To make sure hard of hearing users understand the content, dialogue and other important sounds must be captioned.
- To make sure blind users understand the content, visual elements must be audio described.

Captioning is sometimes seen as resource demanding, but there are automatic captioning programs that are improving fast. Another alternative is to provide a text version of the content, close to the video. Reading a text is, of course, not at all the same experience as looking at a video, but if no other alternative is possible to offer, it is better than no text at all.

Today, a majority of users claim to play short web-based videos without sound, especially in social media. Therefore, it is a good idea to provide captioning for all users.

Audio description is key in feature film, theatre and sports and requires a professional audio describer as well as a separate audio track – something that is not always possible to provide in an ordinary website. But when it comes to information videos, it is often possible to avoid the need for audio description by planning the speaker’s script and reading text that is visually presented out loud.

For born deaf users who have sign language as their maternal language, sign language is essential. It is not required in the EU directives, but provided to a certain extent in TV. In many countries a percentage of TV programs must be sign language interpreted.

3.1.4 Accessible games

One particularly interesting aspect of accessibility in multimedia is computer games. In theory, accessible gaming is something of a contradiction in itself, because to be a “game” there must be some kind of challenge involved. A challenge for some may be an accessibility barrier to others. But if we remove all barriers, it would no longer be a game, but rather a toy or a story.

Accessible gaming has been and still is improving a lot. In the U.S., the 21st Century Communications and Video Accessibility Act, CVAA, says that any game published after 1 January 2019 must meet accessibility requirements when it comes to communications functionality and the surrounding interface for navigation and operations. As many games are developed in the U.S., this will have an impact on the whole industry.

Accessibility in games isn’t about check lists; it’s an optimisation process. It’s about figuring out which barriers are necessary and which are not, and working to avoid the unnecessary ones. There are a few key accessibility issues that are both common and possible to solve in most games: the possibility to zoom or at least have a decent default text size, not to use color alone to convey meaning, re-mappable controls and captioning. These are the basics, you don’t need to invent anything; it’s just a case of doing them.

The platforms are also improving. These days many include text to speech for system UI, mono toggle for unilateral hearing loss, zoom functionality and so on. Xbox is currently leading the way by offering realtime transcription between text to speech as well as the co-pilot mode, making it possible both to customise the gaming experience and for players with different abilities to collaborate.

3.1.5 Accessibility for documents

Documents on the web mostly refer to the use of the Portable Document Format (PDF). PDFs can be just as accessible as html, but the overwhelming majority of documents on the web are inaccessible and many users struggle with them.

From an accessibility standpoint there are several concerns. Documents may need to be opened using an external reader, which can be cumbersome for any user and makes context switching a part of the experience. But in general terms, it is the accessibility for assistive technology users that fail most of the time.

Several groups such as the Nielsen Norman Group (nngroup.com) have published guidelines on how to handle accessibility in documents. Shortly, IAAP will offer professional certification in accessible document creation.

3.2 Universal design principles and methodologies

Universal design is the idea of creating products and services, not necessarily just web services that are accessible to everyone. In this section, universal design from an accessibility perspective is discussed, addressing user centred design, user need research, recruiting of persons with disabilities, personas, user stories, and personalisation

3.2.1 User Centered Design

User Centered Design (UCD) is one of the key means to developing products and services that are not only usable but also accessible. As the name of the process suggests, UCD puts the users of the product or service at the center of the design process. The design and development is characterised by three principles: early focus on the users and their tasks, evaluation and measurement of the product usage, and iterative design (Rubin and Chisnell, 2008). The process typically involves user need research as a first stage, and then the involvement of users throughout the process to test and evaluate the products in an iterative process.

The idea behind user-centered design is that it is naive to design for a particular user without ever meeting that user. It is difficult to near-impossible to evaluate whether a design satisfies the needs of a user if that user never tests your product. This is naturally true for users with disabilities as well.

3.2.2 User needs research

Understanding user needs is crucial not only for creating something accessible, but usable too. User research typically refers to data collection and analysis activities necessary to characterize users, their tasks and the context of use before any actual development even begins (Sharp et al., 2019).

User research has also been described as *“the process of understanding the impact of design on an audience”*. For a long time (in a rather short history of the web) it would have been unthinkable to present users with unfinished web sites. It was widely believed that branding and market positioning were the most important “features” of a web site, and that users were more of a nuisance than helpful allies in creating a web site for the very same users. Today those beliefs have been turned on their heads. While it is still not uncommon that products are developed without proper user research, truly successful products fulfil the needs of their users and that means conducting proper user research (Gvero, 2013).

Nielsen Norman Group (2014) lists some typical user needs research methods:

- Field studies
- Diary/Camera studies

- Surveys
- Data mining
- Analytics

To inform and optimize designs in order to reduce risk and improve usability the following methods can be used:

- Card sorting
- Field studies
- Participatory design
- Paper prototype
- Usability studies
- Desirability studies

To measure product performance against itself or its competition:

- Usability benchmarking
- Online assessments
- Surveys
- A/B testing (usability testing)

Out of these, usability testing is at the heart of user-centered design. While the specifics vary, the general idea with usability testing is to invite representative users to test a website in a controlled setting. The goal is to find out how the user interacts with the website when completing pre-defined closed or open-ended tasks that may relate to the website as a whole or just specific part of its functionality. The objective is not to see how well the user completes the task, but rather whether the website itself is easy to use and navigate. Usability testing is commonly confused with 'user testing' which is more akin to user research. The usability of a website is tested, not the users. It is therefore important to value and respect the users when doing usability testing in order to make everyone feel that their contribution is valuable and that their experience of the usability testing is positive.

A common tool used for usability testing of websites is eye tracking where the users experience of navigating on a website is recorded and traced as they scan the website with their eyes during an assignment. This can be combined with methods such as talk-aloud where the user is describing their interaction with the website for a moderator during the assignment.

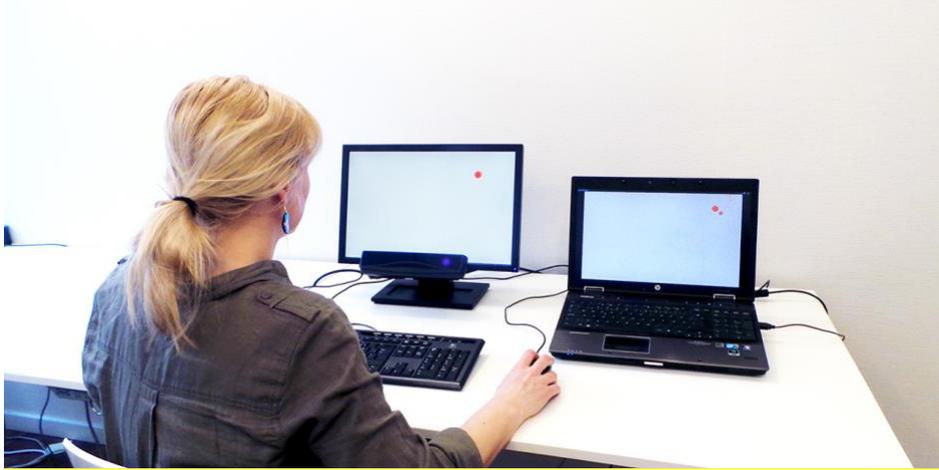


Figure 3.2 Testing websites with eye-tracking. By using eye-tracking, valuable data that would otherwise be difficult to obtain can be collected.

3.2.3 Recruiting of persons with disabilities for research and testing purposes

When conducting research it is important to conduct it in an accessible way. It is common to use surveys in order to gather data for analysis or the creation of personas and user stories. It is not uncommon to fail to include persons with disabilities in research, even when they are the target population. Reasons include not clearly delineating what constitutes a disability and the survey tool being used itself not being accessible.

Testing with users with disabilities gives insights that will improve both the usability and the accessibility of a given website. One avenue of reaching persons with disabilities is through various organisations representing them.

See also Disability etiquette, in Chapter 1.

3.2.4 Personas and user stories

Personas are descriptions of typical users that a designer can focus on and design the product for. They are realistic depictions of various users, rather than idealized, but never represent an actual, real user. Instead, they are created and synthesized using a number of real users. Some form of user research and web analytics always has to precede the creation of personas, as personas are only as good as the research behind them.

A persona is characterized by its user's goals and pain points. Typically, a persona will also include descriptions of the user's abilities, attitudes and environment. In order for personas to be more relatable and realistic they also include a photo, name and additional details such as what the persona does in their spare time. These features also makes it easier to communicate about the personas within the design team.

A well-designed persona:

- Represents a major user group for a target website.
- Expresses and focusses on the major needs and expectations of the most important user groups.

- Gives a clear picture of the users' expectations and how they are likely to use the website.
- Aids in uncovering universal features and functionality.
- Describes real people.

While a website generally needs several personas to represent their various user groups, it is important to not create too many (Usability.gov, 2020). Roughly 3-5 are needed for any given project. The goal with personas is to paint with broad strokes for the betterment of all, rather than trying to represent every potential user. This is also a limitation with personas as a tool ;it might very well miss underrepresented user groups with highly specific needs.

Another way to describe users is through user stories. Such stories can help highlight the effect of accessibility barriers that exist on the web. In contrast to personas, user stories describe only the most relevant features and habits of a person for the given story. A user story may present the most frequent issues the person regularly encounters and can also include positive experiences. These experiences can be associated with certain disabilities to give designers greater insight into the daily lives of persons with disabilities. There are many examples of user stories available online. At W3C Web Accessibility Initiative's website there are multiple stories of persons with disabilities using the web (W3C, 2019b). In addition to the stories, the website also provides helpful references to the accessibility principles and barriers including the recommended tools and techniques to be used to help the user described in each story. The pan-European project MOOCAP also provides stories based on extensive experience with persons with disabilities (MOOCAP, 2017).

3.2.5 Personalisation vs universal design

One particular challenge lies in personalising the design to fit the needs of specific users while also designing something that is universally accessible. The idea with universal design is to create an inclusive society where products and environments are designed and shaped to be accessible and usable by as many as possible without particular adaptations. There are plenty of examples of products which started out as adaptations or variations of the generally available product which later became industry standards. For example, water taps which can be used with one hand as opposed to two and the hydraulics used in buses to lower the entrance height as opposed to using steps.

Universal design is generally more focused on a single solution that can be used by as many people as possible, whereas *inclusive design* involves designing for a specific individual or use case, and extending this to others. Inclusive design focuses on recognising exclusion where a solution for one may be extended to many.

The persona spectrum

Using a persona spectrum helps in understanding limitations and how they are related to each other across a spectrum of disabilities. Generally speaking, by designing for someone with a permanent disability, someone with a situational disability can also benefit, as shown in Figure 3.2.

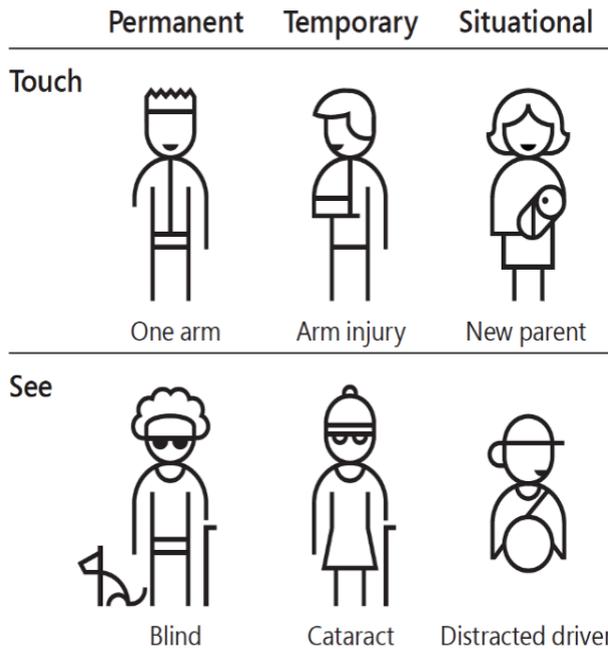


Figure 3.3 Persona spectrum. An example of a persona spectrum from Microsoft’s Inclusive Toolkit Manual (Microsoft, 2018).

In Microsoft’s Inclusive Toolkit Manual there are three key accessibility segments:

- People with a **permanent** disability
- People with a **temporary** disability
- People with a **situational** disability

For example, a device designed for a person who has one arm could be used just as effectively by a person with a temporary wrist injury or a new parent holding an infant.

3.3 Examples of how the accessibility and universal design principles can be applied in teaching and learning

This section briefly introduces some examples of teaching and learning activities inspired by good practices from universities around Europe.

3.3.1 Norm-critical personas

Norm-creativity is based on an awareness of the fact that norms and values of users and their perceived needs can limit and discriminate (Vinnova, 2016). Where norm-critical design might focus on visualising and critiquing norms, norm-creative design focuses on using this knowledge to ensure our various norms do not affect our design reasoning. Norm-creative design therefore requires an analytical element to focus on true situations and needs.

The students are presented with descriptions of user profiles with different needs and abilities. For example, the day-in-the-life stories from the MOOCAP project (MOOCAP, 2017). The personas can have one or several disabilities that are designed to challenge

the student's perception of users and user needs, and to provide them with new insights and an understanding of the necessity for designers to accommodate a variety of users with different expectations and needs. The students receive a user story and have to solve a challenge by using the personas they have learned about.

3.3.2 Norm-creative design

The students are given an assignment to analyse advanced apps for everyday tasks. The challenge is to explore how the apps align with inclusive design, and whether they support the needs of persons with specific user needs. The students also review whether the apps conform to EN 301 549. The students get to choose any app that they use every day.

3.3.3 Disability simulators

The students get to try out different challenges in accessing the web with alternative means. For example, the students are given tasks to complete using only the keyboard, or where the mouse does not follow command, or the display is blurred or moving around. The idea is to challenge pre-conceptions of the students and change their mindset to become more aware of the variety of user needs and experiences. This method is somewhat controversial as it does not fully reflect the actual experience of persons with disabilities. However, it does still have some value for raising awareness of what type of challenges a person with disabilities can face.

3.3.4 Emphatic modelling

The method involves simulating disabilities to give the students an opportunity to personally experience day-to-day situations from the perspective of a person that is blind or visually impaired. For example, the students get to make their way around in the physical environment in the city without using their vision. Another exercise involves using the web with the help of a screen reader. The objective is to get an insight into how persons with visual impairment experience the world. The students should then use this insight to reflect on how they can increase accessibility in their own work on web design.

3.3.5 Participatory design

Participatory design is a product and services design method focusing on the user. It involves stakeholders, end users and the team in the design process in order to help ensure that the end-product meets the needs of users. The university may collaborate with different disability organisations to involve the end users in the design process. As a complement, or when it is not possible to involve the users, accessibility guidelines like WCAG or personas to visualise user needs, can be used.

3.3.6 Hackathon "hackability"

Organize hackathons where students acting as designers and developers work together with persons with disabilities, elderly, children, to co-design apps and services based on personalized solutions that can improve people's lives.

3.3.7 Guest lecture with personal experience of a disability

A guest lecture by a person with a disability. The lecture could be followed by an exercise for the students. See example Norm-critical personas above.

3.3.8 Cognitive walkthrough

This is a usability evaluation method where the students complete a series of tasks where they are taking the perspective of the user, as described by Nielsen and Mack (1994): *“Cognitive walkthroughs involve simulating a user's problem-solving process at each step in the human–computer dialog, checking to see if the user's goals and memory for actions can be assumed to lead to the next correct action”*.

3.3.9 Workshop - test a website

Select one relevant guideline that contains one or more success criteria from WCAG 2.1. Manually evaluate a selected website, either on your own or together with other students, against the guideline and its success criteria with any tool from the Web Accessibility Evaluation Tools List (W3C, 2020). You could also try running any of the automated tools and observe similarities and differences in the results. Let the students reflect on the limitations of automated testing and how the various tools complement each other. Summarize your findings in a report.

3.3.10 Invite users with and without disabilities to test websites

Set up a series of user tests with persons with and without disabilities to test the usability of a website that the students either have created themselves or are evaluating as part of an assignment. Make use of eye-tracking where available and use talk-through methods to discuss the user experience together with the users.

3.4 Resources for further reading

3.4.1 Resources for web accessibility principles

In these resources, you will find accessibility principles and responsibilities as defined by the W3C. In addition to this, you will also find material suggesting how to make audio and video media accessible.

- W3C (2019a). Accessibility Principles. <https://www.w3.org/WAI/fundamentals/accessibility-principles/> (Last accessed on 14 October 2020)
- W3C (2012). Accessibility Responsibility Breakdown. https://www.w3.org/community/wai-engage/wiki/Accessibility_Responsibility_Breakdown (Last accessed on 14 October 2020)
- W3C (2019b). Making Audio and Video Media Accessible. <https://www.w3.org/WAI/media/av/> (Last accessed on 14 October 2020)

- Mozilla (2020). Accessible multimedia.
<https://developer.mozilla.org/en-US/docs/Learn/Accessibility/Multimedia> (Last accessed on 14 October 2020)
- Nielsen Norman Group (2020). Avoid PDF for On-Screen Reading.
<https://www.nngroup.com/articles/avoid-pdf-for-on-screen-reading/> (Last accessed on 14 October 2020)
- Nielsen Norman Group (2014). When to use which user-experience research methods.
<https://www.nngroup.com/articles/which-ux-research-methods/> (Last accessed on 6 November 2020)
- UK Home Office (2016). Dos and don'ts on designing for accessibility.
<https://accessibility.blog.gov.uk/2016/09/02/dos-and-donts-on-designing-for-accessibility/> (Last accessed on 14 October 2020)

3.4.2 Resources for universal design principles and methodologies

In these resources, you will find information on various methods employed when creating products that apply the principles of universal design.

- Rubin, J., Chisnell, D. (2008). Handbook of usability testing : how to plan, design, and conduct effective tests, Wiley Pub.
- Sharp, H., Preece, J., & Rogers, Y. (2015). Interaction design: beyond human-computer interaction. 4th ed. John Wiley & Sons.
- Sharp, H., Preece, J., & Rogers, Y. (2019). Interaction design: beyond human-computer interaction. 5th ed. John Wiley & Sons.
- Gvero, I., (2013). Observing the user experience, 2nd edition: a practitioner's guide to user research by Elizabeth Goodman, Mike Kuniavsky, and Andrea Moed. ACM SIGSOFT Software Engineering Notes, 38(2), p.35.
- Johansson, S. (2019). Design for Participation and Inclusion will Follow: Disabled People and the Digital Society. (Doctoral dissertation, KTH Royal Institute of Technology).
- Johansson, S., Gulliksen, J., & Catharina, G. (2019). Survey methods that enhance participation among persons with disabilities.
- Microsoft (2018). Inclusive Design.
<https://www.microsoft.com/design/inclusive/> (Last accessed on 14 October 2020)
- W3C (2013). Stories of Web Users.
<https://www.w3.org/WAI/people-use-web/user-stories/> (Last accessed on 14 October 2020)
- Usability.gov (2020). Personas.
<https://www.usability.gov/how-to-and-tools/methods/personas.html> (Last accessed on 14 October 2020)
- Usability.gov (2015). Recruiting participants.
<https://www.usability.gov/get-involved/blog/2015/07/recruiting-participants.html> (Last accessed on 14 October 2020)

3.4.3 Resources for good practices in teaching and learning

These resources present various materials that can be used in teaching good practices of web accessibility.

- MOOCAP, A pan-European project on providing education on accessible design (2017). A day in the life of ...
https://moocap.gpii.eu/?page_id=33 (Last accessed on 14 October 2020)
- W3C (2020). Web Accessibility Evaluation Tools List
<https://www.w3.org/WAI/ER/tools/> (Last accessed on 14 October 2020)
- University of Cambridge. Inclusive Design Toolkit.
<http://www.inclusivedesigntoolkit.com/> (Last accessed on 14 October 2020)
- User Experience Professionals' Association. Cognitive Walkthrough.
<https://www.usabilitybok.org/cognitive-walkthrough> (Last accessed on 14 October 2020)
- Ideo.org. Design kit.
<https://www.designkit.org/> (Last accessed on 14 October 2020)
- Royal College of Art. Designing with people.
<http://designingwithpeople.rca.ac.uk/> (Last accessed on 14 October 2020)
- Vinnova (2016). Guide to Nova: Tools and methods for norm-creative innovation.
<https://www.vinnova.se/globalassets/mikrosajter/nova/guide-eng.pdf> (Last accessed on 6 November 2020)
- Valtech design (2017). Inclusive design.
<https://medium.com/valtech-design/inclusive-design-dd4e03f82094> (Last accessed on 14 October 2020)

Chapter 4. Teaching Instruments and Methods

This chapter briefly describes basic guidelines that lecturers can follow to make their teaching materials more accessible.

4.1 Accessible learning and teaching materials

The following rules can be applied to produce accessible learning and teaching materials.

1. **Use clear, consistent layouts for presenting content.** This can be achieved in part by consistently using templates in word processing software, presentation software, content management systems and learning management systems.
2. **Use correctly nested headings to structure documents.** Word processing software such as Microsoft Word provides styles for headings. Using these heading styles has several benefits: they allow blind users to navigate the document by jumping from heading to heading, they allow you to automatically generate a table of contents, and they can be used to generate a hierarchical list of bookmarks when you export the document to PDF.
3. **Use descriptive link text for hyperlinks.** Use “[Web Content Accessibility Guidelines 2.1](#)” instead of “[click here](#)” or the document’s URL.
4. **Avoid creating PDF documents.** Use HTML for presenting learning content in a learning management system. HTML is a much more accessible format than PDF and can be much more easily adapted in the browser to fit the learner’s needs or preferences. PDF can be provided as a secondary format, in which case it should still meet accessibility criteria.
5. **Provide text alternatives for images and other non-text content.** A text alternative should serve the same purpose as the non-text content. A short text alternative (e.g. for simple images) can be added as a type of metadata that is not visible to sighted users. Longer text alternatives (for complex images or diagrams) can be provided in text, since they can also benefit sighted users.
6. **Use highly legible fonts and plain backgrounds.** A font size of 12 points or 16 pixels is recommended. Sans-serif fonts that were designed for reading on screens include Verdana, Trebuchet MS and Calibri. Serif fonts designed for reading on screens include Georgia, Cambria and Constantia.
7. **Use high-contrast colour combinations that can be read by people with colour-vision deficiencies.** Colour contrast can be checked using tools such as the [Paciello Group Colour Contrast Analyser](#) (for Microsoft Windows and Mac OS).
8. **Provide closed captions for video and transcripts for audio content.** Closed captions can be switched on and off by viewers. Unlike open captions, they may allow styling options to make them easier to read.
9. **Make sure that all content and functionality can be accessed using the keyboard alone.**

The most important standards for accessible content are the European standard EN 301 549, published by ETSI and the W3C WCAG 2.1. For detailed guidance on creating accessible learning materials, see the Section 4.4. Resources for Further Reading.

Presenting information in multiple formats can also be helpful, e.g. as text, audio or video. For example, Microsoft Word documents can be well structured and contain a lot of extra information (or accessibility metadata) that can be preserved when converting to other formats using appropriate tools. Accessible Microsoft Word Documents can be converted into accessible PDF documents using Word's built-in PDF export function or Adobe Acrobat's plug-in for Word. Similarly, LibreOffice Writer can export ODF (Open Document Format) files to tagged PDF. ("Tagged PDF" is an informal name for PDF files that use PDF accessibility features, which are described in the standard ISO 14289-1.) However, not all conversion methods and tools preserve a source document's accessibility features in the exported format. This is usually the case with "Print to File" or "Print to PDF" features, since these tend to flatten the file.

Microsoft Word documents can also be converted into ebooks in ePub format, e.g. using the Daisy Consortium's WordToEPUB tool.

When lecturers use their authoring tools' accessibility features and appropriate conversion tools, the institution's student support unit does not need to retrospectively rework and reformat digital resources, which slows down the process of providing digital learning materials to students with disabilities. Providing accessible learning materials also benefits students who learn remotely, e.g. due to reduced mobility or because of mobility restrictions imposed during an epidemic.

4.2 Accessible instructional methods

This section is about teaching in an inclusive way, regardless of subject matter. This includes Universal Design for Learning (UDL). The advice in this chapter would also apply to teaching other subjects.

Accessibility is essential for Universal Design for Learning but there are more issues covered in the concept of UDL. Accessibility is captured in the first principle of UDL, which recommends multiple representations of information ("If you can't reach them, you can't teach them").

Below are a number of tips for teaching an accessible course. These tips come from a variety of resources, including DO-IT's "20 Tips for Teaching an Accessible Online Course" (see the first resource in the Section 4.4.2):

1. Make sure that course participants can see you well, especially your face and upper body. Adapt the lighting if necessary.
2. Make sure that course participants can hear you well. In a big classroom or a lecture theatre, the sound system needs to be adequate.
3. When presenting visual information such as diagrams, graphs and flow charts, do so in such a way that course participants with vision impairments get all the visual information.
4. Make sure the content is presented in multiple ways. For example, when using a video, make sure it is captioned. A transcript is nice, but when we write, we present content differently than when presenting it in a video.

5. Acronyms and jargon should be defined (or avoided).
6. Instructions and expectations should be clear.
7. Make sure that examples and assignments are relevant to a diverse audience. (Older students, male vs female, from different disciplines.)
8. Make sure that outlines and other scaffolding tools are provided.
9. Make sure to provide adequate opportunities for practice. (Sometimes optional extra materials for students who want to do a little bit more.)
10. Provide adequate time for activities, projects and tests. (For example, you can ask the program manager to open the class one week before it starts, so students can get ahead, in case they get too busy later.)
11. Provide feedback on parts of an assignment (if it's a bigger assignment).
12. Provide options for communicating or collaborating.
13. Provide options for demonstrating learning. (Sometimes there are options for the same task, sometimes a multiple-choice test, sometimes creating a video.)
14. Consider recording the lecture, so that students can listen to it again later.

When teaching online, there are a few additional tips and recommendations to bear in mind:

- Online tools, such as learning management systems, web conferencing software and chat services, must meet accessibility requirements. In a learning management system, the accessibility of a course may be affected by the template chosen for it.
- All course participants should know how to mute themselves and unmute themselves only when they need to speak. Teachers and lecturers should know how to mute or unmute all course participants.
- When a screen reader user is speaking, other participants should refrain from writing chat messages. Such messages would be spoken out loud by the screen reader, thus distracting the speaker. Depending on the sound setup on the blind user's computer, the synthesised chat messages may even be fed back to the user participants, thereby distracting all of them.
- If one of the course participants has a motor impairment affecting the upper limbs, they may need more time to mute or unmute themselves or to type a message.

4.3 Good practices for teaching accessibility

When teaching accessibility, there are a number of things lecturers can do to improve learning. These recommendations deal not only with content but also with ways to increase motivation:

- Demonstrate the relevance of accessibility in the outside world. Relevance can be explained by referring to disability statistics, demographic changes, legislation and benefits to the wider population (i.e. without disabilities). Awareness of the relevance of accessibility can also be increased by, for example, inviting a person

with a disability for a guest lecture, visiting a disability support centre and showing recent examples of job advertisements requiring accessibility knowledge and skills.

- Introduce hands-on activities. For example, let students create a short video and caption it. This can be done fairly early in a course. Let students discover the accessibility features and assistive technologies that are built into the operating systems they are using and have them find out what it is like to fulfil specific tasks using, for example, only the keyboard, with a screen magnifier or a screen reader.
- Another hands-on activity is the evaluation of a website for accessibility using an evaluation method based on WCAG. This type of exercise provides another view on accessibility than information that is based on different types of disabilities. It is worthwhile to let students do this before they get exposed to automated evaluation tools, so they can better understand the strengths and weaknesses of such tools.
- Provide alternate methods of learning besides lectures. For example, let students give team presentations about specific topics. This may be combined with peer feedback. (If students have little or no experience with giving peer feedback, it will be advisable to provide some guidelines for how to do this.)
- Some higher-education institutions offer web accessibility instruction as part of a broader course such as Human Computer Interactions or even as a course on its own. However, when teaching software engineering students, it can be effective to teach accessibility through programming and technical problems. This requires teaching materials that are programming focused in addition to the design-focused materials that lecturers may already have (El-Glaly, 2020).
- Use polls and surveys to quickly engage students. Such polls can be organised using external tools such as <https://www.sli.do/> or using features built into learning management systems or web conferencing software (e.g. BigBlueButton).
- Use short group breakout sessions to allow students to discuss a question with each other. This can work very well for open-ended questions

4.4 Resources for further reading

4.4.1 Resources for accessible learning and teaching materials

- World Wide Web Consortium (W3C): Web Content Accessibility Guidelines (WCAG) 2.1 - W3C Recommendation 05 June 2018: <https://www.w3.org/TR/WCAG21/> (Last accessed on 14 October 2020) the language of this standard is very technical and requires competent “interpretation” before it can be applied to web-based or other content.
- ETSI (European Telecommunications Standards Institute): EN 301 549: Accessibility requirements for ICT products and services. Version 3.1.1 (November 2019): https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.01.01_60/en_301549v030101p.pdf (Last accessed on 14 October 2020) Like WCAG, this is also a very technical standard. Chapter 10 covers non-web documents; the requirements in this chapter reference WCAG 2.1 success criteria when these are applicable.
- Accessible Digital Office Document (ADOD) Project. <https://adod.idrc.ocadu.ca/index.html> (Last accessed on 14 October 2020) This website provides guidance for a variety of office suites, including Microsoft Office and

LibreOffice. The guidance has not been updated since 2013, but most of it is still translatable to current office software.

- Resources by Microsoft:
 - “Accessible authoring tips and updates in Office 365”:
<https://www.youtube.com/watch?v=qa2eUWsUvLs>. (Last accessed on 14 October 2020) This is a basic, four-minute introduction to accessibility features in PowerPoint and Word
 - Microsoft’s Accessibility video training: <https://support.microsoft.com/en-us/office/accessibility-video-training-71572a1d-5656-4e01-8fce-53e35c3caaf4>. (Last accessed on 14 October 2020)
- Arran Smith: “Microsoft Accessibility: Office 365 Online”:
<https://www.youtube.com/watch?v=QphgBc131o0> (Last accessed on 14 October 2020) This is a recording of 53-minute webinar from May 2019.
- OERs from the MOOCAP course “Accessible Documents”:
https://moocap.gpii.eu/?page_id=889 (Creative Commons Licence: CC-BY 4.0). (Last accessed on 14 October 2020)
- OERs from the MOOCAP course “Inclusive Learning and Teaching Environments”, see especially the following resources:
 - “Multiple formats” ([video](#) and associated [Word document](#) that introduces the video) (Last accessed on 14 October 2020)
 - “Institutional benefits of multiple formats ([video](#))”
 - “Checking for the key points to producing multiple formats” ([video](#) and associated [Word document](#)) (Last accessed on 14 October 2020)

4.4.2 Resources for accessible instructional methods

- DO-IT (Disabilities, Opportunities, Internetworking, and Technology, University of Washington): “20 Tips for Teaching an Accessible Online Course”:
<https://www.washington.edu/doit/20-tips-teaching-accessible-online-course>
- W3C Education and Outreach Working Group: “How to Make Your Presentations Accessible to All”: <https://www.w3.org/WAI/teach-advocate/accessible-presentations/>. (Last accessed on 14 October 2020)

See also the Open Educational Resources (OERs) from the MOOC “Inclusive Learning and Teaching Environments” created by the University of Southampton as part of the ERASMUS+ project MOOCAP: https://moocap.gpii.eu/?page_id=886. These resources are all available under the terms of the Creative Commons Attribution 4.0 International licence (CC-BY 4.0). For each video from this course, a captions file and a transcript are also available. See especially the following resources (last accessed on 14 October 2020):

- “The pros and cons of shared learning activities” ([video](#) and associated [Word document](#) introducing the video)
- “[Social and learning technologies, now and in the future](#)” (Word document)
- “Technology power user” ([video](#) and associated [Word document](#) introducing the video)
- “[Can we use mobile technology to support collaboration?](#)” (Word document)
- “Creating inclusive assessments” ([video](#) and [Word document](#))

- “Technology for creativity and planning” ([video](#) and associated [Word document](#) introducing the video)
- “Using multimedia for complex subjects” ([video](#) and associated [Word document](#) introducing the video)
- “[Inclusion a buzzword or priority?](#)” (Word document)
- “Using cloud technology” ([video](#) and associated [Word document](#) introducing the video)

4.4.3 Resources for teaching accessibility

- University of -Southampton (2019) Teaching Accessibility - How is digital accessibility taught and learned? <https://teachingaccessibility.ac.uk/> (Last accessed on 14 October 2020) This is a four-year research study (May 2019 - April 2023) in the UK.
- DO-IT (2020) : What and How to Teach about Accessibility: <https://www.washington.edu/doi/webinars/?webinar=sigcse>. (Last accessed on 14 October 2020)
- El-Glaly, Y.(2020) "Teaching Accessibility to Software Engineering Students", *SIGCSE '20: The 51st ACM Technical Symposium on Computer Science Education*.
- Putnam, C., Dahman, M., Rose, E., Cheng, J., Bradford, G. (2016). “Best Practices for Teaching Accessibility in University Classrooms: Cultivating Awareness, Understanding, and Appreciation for Diverse Users” Article No.: 13, *ACM Transactions on Accessible Computing*, <https://doi.org/10.1145/2831424>. (Last accessed on 14 October 2020)
- Gay, Gregory R.; Djafarova, Naza; Zefi, Leonora: "Teaching Accessibility to the Masses", *W4A 2017*, April 02 - 04, 2017, Perth, Western Australia, Australia, <https://DOI: 10.1145/3058555.3058563> (Last accessed on 14 October 2020)
- Kawas, Saba; Vonessen, Laura; Ko, Andrew J.: “Teaching Accessibility: A Design Exploration of Faculty Professional Development at Scale”, *SIGCSE '19: Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, February 2019, pages 983–989. <https://doi.org/10.1145/3287324.3287399> (Last accessed on 14 October 2020)