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Glossary

Acronym	Meaning
W3C	World Wide Web Consortium
WAI	Web Accessibility Initiative
WCAG	Web Content Accessibility Guidelines
UCD	User-Centred Design
UI	User Interface

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1 Introduction

1.1 Objective of the Task

Nowadays, web services have become an increasingly valuable resource for different aspects of daily life. They are used for work, shopping, health care, interaction, entertainment, etc. Therefore, it is essential for the Web to be accessible and usable in order to provide equal access and equal opportunity to all people including those with disabilities.

In this context, the services provided by the ANIMATE platform allow a company, retired or older worker, young worker or unemployed to interact and exchange their skills, experience, knowledge and expertise from different domains.

As the platform is open and can be used by different people, whatever their physical or mental abilities, we need to define an appropriate design to ensure the usability of the platform and accessibility by everyone, regardless of disability, enabling them the use of the content as well as enabling them to navigate, understand, communicate, interact and use the user interface (UI) successfully.

Usability is one relevant factor of the quality and recognised as a fundamental property for the success of Web applications. Making the website usable and accessible is a difficult task, however using specific guidelines, standards, and techniques, such as the Web Content Accessibility Guidelines (WCAG), makes it easier for website developers.

Evaluation methods need to be used at any stage of the design and development process to verify the usability of the product. This iterative design allows promoting usability throughout the whole web application lifecycle. The cycle of design, evaluation, and redesign must be repeated as often as necessary to correct any error detected during the evaluation activities or accommodating newly emerged requirements. The product will gradually evolve, becoming well defined step by step.

To ensure that the platform meets their expectations, expert evaluators and users have been directly involved in the iterative design and development process of the platform by testing and evaluating the ANIMATE services. The user's evaluation feedback has been gathered through interviews and questionnaires in order to be analysed and used by designers and developers. Moreover, automatic tools are useful, and they have been used to efficiently evaluate the most repetitive tasks.

The aim of this deliverable is to provide a preliminary report on the usability and accessibility of the UI of ANIMATE. Moreover, the ability of the prototype's modules to interface with each other and with other infrastructures (resources and tools) has been tested. The functionalities of modules and services have been evaluated and eventually modified according to the results of analysis of the user's feedback.

2 Accessibility and Usability

Accessibility and usability are closely related, and they are often addressed together in the context of designing and developing web applications. However, some situations require more attention such as for people with disabilities where we need to focus more on specific accessibility and usability standards.

Web usability means the easy use of the web, while web accessibility means that people with disabilities including visual, auditory, physical, speech, cognitive, and neurological disabilities or age-related impairments can access and use the web. This category of users has specific needs, which are often not sufficiently addressed in accessibility and usability practice.

2.1 Accessibility

Accessibility includes technical requirements, which ensure that websites work well in order to provide equal access and equal opportunity to people with diverse abilities. However, accessibility can significantly overlap with other best practices such as mobile web design, multi-modal interaction, usability and design for older users. For example, a usable website with a mouse may represent a good usability practice but remain non-accessible because users with some physical and visual disabilities cannot use a mouse at all. Researchers, designers, and developers need to propose optimised solutions that meet the specific needs of people with disabilities.

As the focus is on a specific category of users with disabilities or age-related impairments, accessibility addresses discriminatory aspects. Indeed, the UN Convention on the Rights of Persons with Disabilities recognizes (Article 9 and 21) access to information and communications technologies, including the web, as a basic human right [1].

Different requirements have to be considered to realise accessible websites, which will have benefits such as better search results, reduced maintenance costs, and increased audience reach. The mission of the World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI) [2] is to remove accessibility barriers that make it difficult or impossible for many people with disabilities to use the web. The WAI acts as the central point for setting accessibility guidelines for the Web. Its work concentrates on the production of Web Content Accessibility Guidelines (WCAG 2.0) [2].

The goal is to lead the Web to its full potential to be accessible for all people including those with disabilities. Therefore, they can participate equally on the web; they can perceive, understand, navigate, interact and contribute. Designing for diversity not only increases the number of people able to access a website but also increases their level of involvement with it. The Barrier-free design is beneficial for all users. Designing for universal access is good social as well as a business practice.

2.2 Usability

Web usability aims to make websites easier to use for the end user, without the need to follow a specific training. The goal of usability is to present information clearly to the users and to ensure the content displays correctly on various devices and browsers. Usability means user-centred design. Thus, both the design and development processes are focussed around the prospective user in order to build products that are efficient, usable by everyone to the greatest extent possible and satisfying the users. Good usability requires an iterative approach to constant testing and refining.

The standard ISO 9241- Article 11 (Ergonomic Requirements for Office Work with Visual Display Terminals) [3] provides guidance on usability, introducing requirements and recommendations to be used during application design and evaluation. According to this standard, usability is defined as “the extent to which a product can be used by specified users to achieve specified goals effectively, efficiently and with satisfaction in a specified context of use". In this definition, effectiveness means “the accuracy and completeness with which users achieve specified goals”, efficiency is “the resources expended in relation to the accuracy and completeness with which users achieve goals”, and satisfaction is described as “the comfort and acceptability of the use of the product”.

Although not components of the ISO definition, other aspects were considered as part of usability by many practitioners:

- **Flexibility:** the extent to which the system can accommodate changes desired by the user beyond those first specified.
- **Efficiency:** the level of attainable productivity, once the user has learned the system.

- **Learnability (also known as ease of learning):** The ease of learning the functionality and the behaviour of the system.
- **Memorability:** the ease of remembering the system functionality, so that the casual user can return to the system after a period of non-use, without needing to learn again how to use it.
- **Safety:** aspects of the system related to protecting the user from dangerous conditions and undesirable situations.
- **Few errors:** the capability of the system to feature a low error rate, to support users making few errors during the use of the system, and in case they make errors, to help them to easy recover.
- **User's satisfaction:** the measure in which the user finds the system pleasant to use.

2.2.1 Keys principles of good website usability

Good usability depends on whether the website is available, clear, credible, learnable, and relevant to the people who actually use it. The following key principles are useful to define good website usability:

2.2.1.1 Availability and Accessibility

The availability and accessibility of the website is the basic aspect of usability. It is essential to invest in good hosting and ensure server uptime for users, to check that there are no broken or dead links on the website and to ensure the mobile responsiveness can handle different screen sizes and slow connections.

2.2.1.2 Clarity

Clarity is the core of usability. A clear and usable design can be achieved through:

- **Simplicity:** focus on what is important for the user.
- **Familiarity:** based on what people already know.
- **Consistency:** try to create a consistent experience for users across the entire website.
- **Guidance:** guide users through the website in order to show them what is offered.
- **Direct feedback:** as feedback is essential to any interaction, users need to have an indication of success or failure of their actions when they interact with the website.
- **Good information architecture:** an understanding of users for structuring the content of the website to meet their expectations.

2.2.1.3 Learnability

The goal is to design intuitive interfaces where instructions are not required. The idea is to use an intuitive design based on what people already know as familiar concepts. For new concepts in design, create something new that is easy to learn and give people 'a hand' (e.g., additional information or instruction) during the initial learning phase.

2.2.1.4 Credibility

Credibility is a crucial aspect of any website. Users need to trust the people/company who made the content of the website. Such information can be found on the "About Us" page with contact details and address.

2.2.1.5 Relevancy

The relevancy contributes to good website usability. In addition to the clarity of the website, the content must also be relevant.

2.3 Usable Accessibility Design

The website needs to be clear but also with relevant content. By interacting and defining users scenarios, designers can understand what kind of content users want to find on the website.

The design and development of accessibility are based on specific guidelines, standards, and techniques, such as the Web Content Accessibility Guidelines, which is the international standard ISO/IEC 40500 [2].

Accessibility standards also have an important role in accessible design. For example, understanding the basic accessibility principles and using the guidelines for developing early prototypes help the development team to provide basic accessibility so that when users do evaluations, they are able to use the prototype enough to provide useful feedback.

Accessibility guidelines, standards, and techniques ensure that the wide range of issues is adequately covered. Understanding the basic principles of accessibility and use of the guidelines is helpful during the development of the prototypes to provide basic accessibility. Therefore, users will be able to evaluate and use this prototype enough and provide useful feedback.

Web designers and developers can use usability processes, methods, and techniques, such as the user-centered design (UCD) process in order to address the user interface component of accessibility. Combining accessibility standards and usability processes with real users ensures that web design is technically and functionally usable by users with disabilities.

To evaluate the web accessibility and usability, we need to involve real users and users with disabilities (e.g., older persons) early and throughout the design and the development processes. Moreover, it is important that individuals working for the web project understand the basics of how people with disabilities use the Web. During the early design stages, the goal of the evaluation is to check the design team understanding of the users' requirements, and to test design choices quickly and informally, thus providing feedback to the design activities. Later on, the evaluation can support the detection of users' difficulties, and the improvement and the upgrading of the website.

2.4 Guidelines for accessibility and usability

2.4.1 Accessibility Guidelines (WCAG 2.0 Guidelines)

The key set of guidelines for assessing the accessibility of websites is the Web Content Accessibility Guidelines developed by the WAI [2]. The WCAG2 guidelines are organised around four accessibility principles:

- Principle 1: Content must be perceivable.
- Principle 2: Interface components in the content must be operable
- Principle 3: Content and controls must be understandable
- Principle 4: Content should be robust enough to work with current and future user agents (including assistive technologies)

Each principle is associated with a list of guidelines addressing the issues around that principle (See Table 1).

PRINCIPLE	GUIDELINES
1. Perceivable - Information and user interface components must be presentable to users in ways they can perceive	• 1.1 Text Alternatives: Provide text alternatives for any non-text content so that it can be changed into other forms people need, such as large print, braille, speech, symbols or simpler language.
	• 1.2 Time-based Media: Provide alternatives for time-

	based media
	• 1.3 Adaptable: Create content that can be presented in different ways (for example simpler layout) without losing information or structure
	• 1.4 Distinguishable: Make it easier for users to see and hear content including separating foreground from background
2: Operable - User interface components and navigation must be operable	• 2.1 Keyboard Accessible: Make all functionality available from a keyboard
	• 2.2 Enough Time: Provide users enough time to read and use content
	• 2.3 Seizures: Do not design content in a way that is known to cause seizures
	• 2.4 Navigable: Provide ways to help users navigate, find content and determine where they are
	• Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution
3: Understandable - Information and the operation of user interface must be understandable	• 3.1 Readable: Make text content readable and understandable
	• 3.2 Predictable: Make Web pages appear and operate in predictable ways
	• 3.3 Input Assistance: Help users avoid and correct mistakes
4: Robust - Content must be robust enough that it can be interpreted reliably by a wide variety of user agents, including assistive technologies	• 4.1 Compatible: Maximize compatibility with current and future user agents, including assistive technologies
	• 4.2 Ensure that content is accessible or provide an accessible alternative

Table 1 Summary of Web Content Accessibility Guidelines Version 2.0 [2].

As an example, for guideline 1.1 Text Alternatives, the success criteria for all non-text content is ensured if one of the following is true:

- If non-text content presents information or responds to user input, text alternatives serve the same purpose and present the same information as the non-text content. If text alternatives cannot serve the same purpose, then text alternatives at least identify the purpose of the non-text content.
- If non-text content is multimedia; live audio-only or live video-only content; a test or exercise that must use a particular sense; or primarily intended to create a specific sensory experience; then text alternatives at least identify the non-text content with a descriptive text label. (For multimedia, see also Guideline 1.2: Provide synchronized alternatives for multimedia.)
- If the purpose of non-text content is to confirm that content is being operated by a person rather than a computer, different forms are provided to accommodate multiple disabilities.
- If non-text content is pure decoration or used only for visual formatting, or if it is not presented to users, it is implemented such that it can be ignored by assistive technology.

2.4.2 Usability Guidelines and Standards

In a heuristic evaluation, usability experts review the website interface and compare it against accepted usability principles. Nielsen's [4, 5] and Shneiderman [6] Heuristics (See Table 2 and 3) are among the best-known sources of heuristics. Detailed 207 guidelines for web design are also provided produced by the U.S. Government Department of Health and Human Services (HHS) [7].

HEURISTIC	DESCRIPTION
Visibility of system status	• The system should always keep users informed about what is going on, through appropriate feedback within reasonable time
Match between system and the real world	• The system should speak the users' language, with words, phrases, and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order
User control and freedom	• Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo
Consistency and standards	• Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions
Error prevention	• Even better than good error messages is a careful design which prevents a problem from occurring in the first place
Recognition rather than recall	• Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for the use of the system should be visible or easily retrievable whenever appropriate
Flexibility and efficiency of use	• Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions
Aesthetic and minimalist design	• Dialogues should not contain information, which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility
Help users recognize, diagnose, and recover from errors	• Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution
Help and documentation	• Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large

Table 2 The ten Nielsen's heuristics for user interface design and evaluation [5].

HEURISTIC	DESCRIPTION
Strive for consistency	• Consistent sequences of actions should be required in similar situations; identical terminology should be used in prompts, menus, and help screens; and consistent commands should be employed throughout.
Enable frequent users to use shortcuts	• As the frequency of use increases, so do the user's desires to reduce the number of interactions and to increase the pace of interaction. Abbreviations function keys, hidden commands, and macro facilities are very helpful to an expert user.
Offer informative feedback	• For every operator action, there should be some system feedback. For frequent and minor actions, the response can be modest, while for infrequent and major actions, the response should be more substantial.
Design dialogue to yield closure	• Sequences of actions should be organized into groups with a beginning, middle, and end. The informative feedback at the completion of a group of actions gives the operators the satisfaction of accomplishment, a sense of relief, the signal to drop contingency plans and options from their minds, and an indication that the way is clear to prepare for the next group of actions.
Offer simple error handling	• As much as possible, design the system so the user cannot make a serious error. If an error is made, the system should be able to detect the error and offer simple, comprehensible mechanisms for handling the error.
Permit easy reversal of actions	• This feature relieves anxiety since the user knows that errors can be undone; it thus encourages exploration of unfamiliar options. The units of reversibility may be a single action, a data entry, or a complete group of actions.
Support internal locus of control	• Experienced operators strongly desires the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders. Allow users to tailor frequent actions
Reduce short-term memory load	• The limitation of human information processing in short-term memory requires that displays be kept simple, multiple page displays be consolidated, window-motion frequency be reduced, and sufficient training time be allotted for codes, mnemonics, and sequences of actions.

Table 3 The Shneiderman's eight golden principles of good interface design [6].

3 Methods for Usability and Accessibility Evaluation

The main goals of evaluation are to assess the application functionality, to verify the effect of its interface on the user and to identify any specific problem with the web application. In the context of web applications, evaluation consists of verifying if the application design allows users to

easily retrieve and browse content and invoke available services and operations. This will guarantee that appropriate content and services are available in the application and easily reachable by users through appropriate hypertexts.

According to the development phase, two categories of evaluation are defined. Formative evaluation during the design, and summative evaluation after the website has been developed or any prototype version is ready. Within these two broad categories, there are different methods that can be used at different stages of the product development.

The most commonly adopted are evaluation with users; evaluation conducted by specialists/experts, web usage analysis and automated checking of conformance to guidelines and standards. These methods are used for studying user behaviours through the computation of access statistics and the reconstruction of user navigation on the basis of web access logs [6,7].

3.1 Evaluation with users

The goal of user evaluation is to observe the behaviours of some representative of real users when they perform a set of tasks. Experimenter observes users behaviours and collects empirical data (e.g., user execution time, the number of errors, and user satisfaction) about the way users execute the assigned tasks. After the test completion, the collected data are interpreted and used to ameliorate the level of the application usability.

3.2 Evaluation conducted by specialists/experts

This evaluation refers to a set of evaluation techniques that are used by developers to predict accessibility/usability problems that could be detected through users testing. Based on these methods, evaluators examine accessibility/usability related aspects of an application, trying to detect violations of established accessibility/usability principles, and then provide feedback to designers about possible design improvements. The experts can use guidelines, or they can work through task scenarios that represent what users would typically do with a web application.

Different methods can be used for inspecting an application. Among them, the most commonly used are heuristic evaluation, in which usability specialists judge whether the application properties conform to established usability principles, and cognitive walkthrough, which uses detailed procedures for simulating users' problem-solving processes, trying to see if the functions provided by the application are efficient for users, and lead them to the next correct actions.

3.3 Web Usage Analysis

Web usage analysis can be employed after the web applications are deployed to analyse how users exploit and browse the information provided by the website. Very often, weblogs are analysed with the aim of calculating traffic statistics. Such a type of analysis can help identify the most accessed pages and content, and may, therefore highlight some user preferences, not detected at design time.

3.4 Automated evaluation

This evaluation is conducted when initial prototypes or initial versions of full implementations are available. The goal is to ensure that initial prototypes meet appropriate guidelines and standards and do not contain basic accessibility and usability problems.

3.4.1 Automatic Tools Supporting Evaluation

Automatic tools can efficiently treat the most repetitive evaluation tasks, without requiring much time and skills by human resources.

There are three main categories of Web evaluation tools [8, 9], which cover a large set of tests for usability and accessibility:

3.4.1.1 Tools for accessibility analysis

The development of WCAG provided a considerable interest in creating tools to check whether websites and pages conform with the guidelines automatically.

The list of these tools is maintained on the WAI website [10]. The metrics implemented by such tools (e.g., Webaim [11], Accessibility Services [12], Automated Accessibility Testing Tool (AATT) [13]) correspond to official accessibility criteria (such as those prescribed by W3C), and refer to properties of the HTML page coding, such as browser compatibility, use of safe colours, appropriate colour contrast, etc.

Moreover, powerful browser plugins such as Accessibility Developer Tools [14], WAVE Evaluation Tool [15], aXe [16] and Web Accessibility Audit [17] (See Figure 1) are proposed for automating the testing of all the content including what is restricted to logged in users. This is because the evaluation takes place directly in the browser rather than sending the URL to a remote server. Other Chrome extensions such as Color Contrast Analyzer [18] is useful for reviewing colour contrast and testing how the pages look with various visual impairments.

However, many WCAG Checkpoints cannot be checked automatically, and particular care needs to be taken in interpreting what it means when an automatic checking tool returns no failures for a particular WCAG Checkpoint.

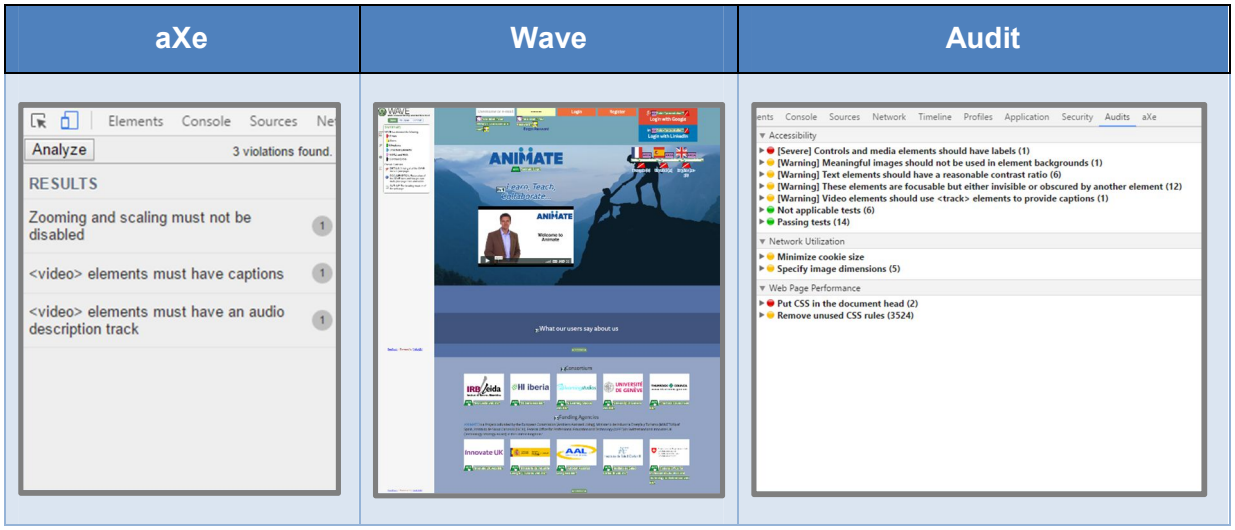

Figure 1 Automatic evaluation of accessibility of ANIMATE home page by using aXe, Wave and Audits automated tools.

3.4.1.2 Tools for usability analysis

The automated tools [19] are used for conformance with basic usability guidelines. As an example, Web Static Analyzer Tool (WebSAT) [20] and WebCriteria proposed by IBM [21] analyse site design for verifying usability guidelines. They mostly operate at the presentation layer, with the aim of discovering problems such as the consistency of contents presentation and navigation commands (e.g., link labels, colour consistency, etc.).

Although these tools are useful for screening for basic problems, they only test a very limited scope of usability issues. Therefore, the accessibility evaluation of ANIMATE is based mainly on end-users feedbacks.

3.4.1.3 Tools for Web usage analysis

These tools allow calculating statistics about site activities, and mining data about user behavior. The majority of the commercial tools such as WebLog [22] are traffic analyzers. Their functionality is limited to producing:

- Site traffic reports, such as total number of visits, average number of hits, average view time, etc.
- Diagnostic statistics, such as server errors and pages not found.
- Referrer statistics, such as search engines accessing the application.
- User statistics, such as top geographical regions.
- Client statistics, such as users' web browsers and operating systems.

Automatic tools constitute a valuable support for reducing the efforts required to evaluators for analysing “by hand” the whole application with respect to all the possible usability issues. However, they are not able to verify usability issues exhaustively. In particular, they cannot assess all those properties that require judgments by human specialists (e.g. usage of natural and concise language). Also, automated tools cannot provide answers about the nature of a discovered problem and the design revision that can solve it.

Automatic tools are therefore very useful when their use complements the activity of human specialists since they can execute repetitive evaluation tasks for inspecting the application and highlighting critical features that are worth to be later inspected by evaluators.

4 Evaluation of Usability and Accessibility in ANIMATE

The evaluations of ANIMATE functionalities and design have been carried out during the different development phases. The trials included elderly users, corresponding to persons early retired and newly retired. However, illiterate people and persons with mental or physical illness that prevents them the correct development of tasks were not involved. The feedback of end users from UK and Spain were collected through questionnaires and face-to-face interviews. The evaluation results were qualitatively and quantitatively analysed and considered for the improvement of the ANIMATE Platform.

Despite that the presented guidelines and standards were not totally considered, Usability and Accessibility evaluations were conducted during the design phase and user testing and validation stage, in order to experiment with the different prototypes achieved during the project (e.g., i.e. first and second prototype) and compare user experience with user requirements. The outcomes of user testing fed the solutions design cycle, in order to refine the use of different software and technologies [23].

In addition to collect general opinion about the platform and the design, the objective of the qualitative analysis is to obtain the end users opinions about feelings and satisfaction, usability and the utility of the platform as well as information about user acceptance and user credibility [23].

4.1 Evaluation based on end-users feedbacks

Table 4 presents an example of questions addressed to end-users for the registration page of ANIMATE.

Questionnaire for ANIMATE registration page
1. What do the flags mean?
2. What do you do for joining in? How to do it?
3. What would happen if someone uses your Google account? (What does Gmail mean?)
4. What to do if you do not remember your password?
5. Where do you have to go after logging in?
6. How would you go to the bottom of the page?
7. How would you start the video?
8. How would you put subtitles?
9. What do you think about the institutional logos?
10. Do they inspire trust to you?
11. Do you think the page is attractive?

Table 4 Questionnaire for ANIMATE registration page.

The analysis of the results gave us some indications about the assessment of usability and accessibility [23]. For example:

Negative feedbacks
• It would be necessary to get the design more attractive
• The users aged >70 have lot of problems to use the platform
• Improve the login page. The registration method should look like Facebook
• To many options to log in which confused some end users
• All interviewees believe necessary to increase the font size
• Minority requested text to voice option and ability to change the colour of the screen
• Some opinions of elderly end users (62-80 years): "They don't use web pages", "Main Menu must be bigger", "It is generally too small, only the big titles can be well-read", "Too much text is very small", "It looks small; the pictures section is too large; the logos are not seen with the naked eye (put them on top of the image with flags)"
• Most of the users do not like that it is mandatory to describe the uploaded documents. At the same time, when we tested the users for the need analysis, they said to put this description
• In qualifications, when clicking on it, it sends to you to the year 1800. It's so far!!!! It would be better to send to the year 1950 for example
• The end-users have so many doubts about the value of credits. We suggest adding a message emerging in the screen explaining this value. For example: ….Congratulations, you have 30 credits to waste on ……some example
• There are some Spanish translations problems, and the user's manual is not translated, and sometimes it is a problem for us
• User Manual is large and not small hints directed at the point they have a problem
• Seen with the naked eye (PUT THEM on top of the image with flags) "
• Login page was too long. Was unsure they were required to scroll down
• Was unable to change background colour for sensory disability

Table 5 Negative feedbacks of end-users.

Positive feedbacks
• The proposal of this platform is easy to understand and easy to operate
• End Users liked the layout of the platform and thought the colour contrast allowed the wording to be easily read
• Generic symbols that were easy to understand such as messages (envelope sign)
• The users aged <50, the platform is suitable and intuitive at all. Majority of this age group were able to navigate around the site with minimal assistance
• All end users interviewee's least inexperienced informal caregivers provide a rather positive feedback on the model of the ANIMATE platform
• The video files are now a YouTube link directly. This is a good option
• End Users liked that the designers had listened and responded to their options
• I like the option to choose which notifications you want to receive and which not. Also, we like to have the option to choose between personal mail and ANIMATE mail
• Accessibility: Young people consider easy and quickly access using Gmail, and older people have problems because they do not have an e-mail account (it takes a long time to register and to read everything).
• The concept of the platform was enjoyable
• Previous feedback had been listened to, and changes had been made

Table 6 Positive feedbacks of end-users.

These end-user's recommendations were considered for the next step of the developments. Moreover, end-users partners from UK and Spain used the guidelines and standards presented in this deliverable to extract relevant information which was useful for the improvement of Usability and Accessibility of the ANIMATE platform.

As an example, improvements based on end-users feedbacks were performed on the ANIMATE platform functionalities. For some features, the analysis of end-users feedback from the 1st to 3rd prototype (23) showed the progress realised on the ANIMATE platform.

Web Page Section: Feature	Comment/Suggestions before improvement	Comment/Suggestions after improvement
Home Page: Layout	Video ICON Could be smaller	Like colour and picture/ Layout
Home Page: Funding Agencies	No HYPERLINK at present. Could be added?	Ok
Create Account Screen: Experience URL	Not sure of what this was till help button	better explanation that last
Create account Screen: Layout	In theme of the homepage. All ok	Like new layout visually
Create Account Screen: Allow Contact	Meaning not clear? Could a pop-up note be added?	All Ok
Jobs: Position Level	Not sure if this is required	All OK
Skills: Expertise Level	Concerns on the use of the subjective term "Expert"	Easier to understand than previous
Interests: Expertise Level	Concerns on the use of the subjective term "Expert"	Easier to understand than previous
Qualifications: Title	Unsure why it says role?	All OK
Content: URL	Unsure what was but help	All OK

	guided people?	
Content: Name	Unsure of name and subject?	All OK
Messages: Inbox	Cannot write compile message from Messages	Easy to see messages- who they are from and how to read and delete
Messages: Outbox	No email notification	Easy to see what messages have been sent. Unsure how to create message in this tab
Groups: Create Group	500 message	All OK
Organisations All Organisations	/	Single end users unsure of this - Once explained all ok
Challenges: All Challenges	/	End Users do not understand this

Table 7 End-users feedbacks from the 1st to the 3rd prototype.

Finally, an evaluation of the final prototype was carried out to assess the realized improvements based on the end-users feedbacks.
Table 8 presents an example of questions addressed to end-users to evaluate the registration page of the final prototype:

Instructions and tasks to do
1. Be registered to the ANIMATE platform with a new profile (https://animate.hi-iberia.es:4550/es/) through the GRECS organization (it means to access as you are part of GRECS)
2. Put the subtitles on the presentation's video
3. Edit your profile: Upload a picture and fill the sections: Skills, interested in learning and your description and location. Upload a pdf and a YouTube video
4. Add at least one course and one place of work in the pertinent section
5. Configure your profile without receiving weekly notifications by e-mail
6. Configure your profile to receive comments, groups' activities and contacts by the ANIMATE platform
Write your results/difficulties to do the following tasks
1. Search one person/user and ask him for friendship. Accept a friendship
2. Read a message and notification. After, delete a notification and send a message
3. Look the section "My tasks" with tasks have you finalized and with the one you have not. Do you have rewards?
4. What would you do to see the information about how to accomplish a task? Give a reward. Do you think the page is attractive?
5. Create your own group (You must fill all the fields)
6. Give your opinion about ANIMATE platform
7. Plan a Video call

Table 8 Questionnaire for ANIMATE registration page of the final prototype.

The evaluation of the final prototype was conducted with 20 end-users. Table 9 presents the analysis of the results.

Analysis of the end-users feedbacks
• All end users understood how to arrive at ANIMATE platform and the different ways of registration.
• 70 % of the end users watched the promotional video at first step, before register to the ANIMATE web page.
• Approximately three-quarters of them were able to complete the basic profile with appropriate information either independently or with prompts in less than ten minutes.
• 67 % of the end users were able to upload a picture without problem in an average time of three minutes. The main problems were with the uploading process (so much time to complete the uploading process).
• The main problems were with the uploading process (so much time to complete the uploading process).
• The end users upload the picture correctly after asking a question to the moderator. Then we can say that they do it in a right way in the second attempt.
• 80% of the end users had to find “Content” section, and 76% did not know how to select the link box to upload the video. Some users could upload a video with five attempts, and after this period, they ask for help. In total, the time wasted by these users was ten minutes.
• 73 % of the end users were able to upload a pdf document in an average time of 2 minutes. Rest of users in the second attempt.
• 85 % were able to configure their profile to receive notifications, group activities, comments and contacts in the first attempt with an average time of 2:30 minutes.
• 50 % of the end-users had problems to send or accept a friendship request. The rest of users ended with one attempt. The average time were two minutes.
• 62% of the end users had problems to send a message because they were mandatory to fill the fields “Subject and message” so if they did not fill a field it just appears in red color but this message does not say the type of error or where the problem is.
• 86% of the end users were able to give rewards to their connections with an average time of two minutes. The rest of them could not see where the rewards box was or don’t understand the meaning of the question.
• 80% of the end-users were able to create a group between two to five minutes. They need as maximum two attempts.

Table 9 Analysis of the end-users feedbacks for the final prototype.

4.2 Automated evaluation of ANIMATE accessibility

The main pages of ANIMATE were evaluated by using the automatic tools Axe and Audits. Apart from the minors’ errors (e.g., contrast), the results are generally satisfactory as presented in Table 10.

Home	aXe	Audits
Home	1. Elements must have sufficient colour contrast 1violations 2. Zooming and scaling must not be disabled 1 violations 3. <video> elements must	1. [Severe] Controls and media elements should have labels (1) [Warning] Text elements should have a reasonable contrast ratio (7) 2. [Warning] Video elements should use <track> elements to provide captions

	have captions 1 violations 4. <video> elements must have an audio description track	(1)
Content	1. Images must have alternate text	1. [Warning] Images should have a text alternative or presentational role (1) 2. [Warning] Text elements should have a reasonable contrast ratio (13) 3. [Warning] These elements are focusable but either invisible or obscured by another element (3) 4. Not applicable tests (9) 5. Passing tests (13)
Content Upload	1. Elements must have sufficient colour contrast 13 violations 2. Form elements must have labels	1. [Warning] Meaningful images should not be used in element backgrounds 2. [Warning] Text elements should have a reasonable contrast ratio 3. [Warning] These elements are focusable but either invisible or obscured by another element
Message	1. Images must have alternate text	1. [Warning] Text elements should have a reasonable contrast ratio (15) 2. [Warning] These elements are focusable but either invisible or obscured by another element (5)
Compose Message	1. Elements must have sufficient colour contrast	1. [Warning] Meaningful images should not be used in element backgrounds (1) 2. [Warning] Text elements should have a reasonable contrast ratio (16) 3. [Warning] These elements are focusable but either invisible or obscured by another element (2)
Connection	1. Elements must have sufficient colour contrast 2. Headings must not be empty	1. [Warning] Text elements should have a reasonable contrast ratio (14) 2. [Warning] These elements are focusable but either invisible or obscured by another element (5)
Chat Connection	1. Elements must have sufficient color contrast 2. Form elements must have labels	1. [Severe] Controls and media elements should have labels (1) 2. [Warning] Text elements should have a reasonable contrast ratio (15) 3. [Warning] These elements are focusable but either invisible or obscured by another element (4)
Groups	1. Congratulations! No accessibility violations found.	1. [Warning] Text elements should have a reasonable contrast ratio (13) 2. [Warning] These elements are focusable but either invisible or

		obscured by another element (4)
Create Group	1. Elements must have sufficient colour contrast 9 violations 2. Form elements must have labels	1. [Warning] Meaningful images should not be used in element backgrounds (1) 2. [Warning] Text elements should have a reasonable contrast ratio (14) 3. [Warning] These elements are focusable but either invisible or obscured by another element (2)
Request/Invitation Group	1. All the element and elements with role=column header/row header must data cells which it describes	1. [Warning] Text elements should have a reasonable contrast ratio (13) 2. [Warning] These elements are focusable but either invisible or obscured by another element (1)
Edit Group	1. Congratulations! No accessibility violations found.	1. [Warning] Text elements should have a reasonable contrast ratio (13) 2. [Warning] These elements are focusable but either invisible or obscured by another element (5)
Group Chat	1. Elements must have sufficient colour contrast 1 violations 2. Form elements must have labels	1. [Severe] Controls and media elements should have labels (1) 2. [Warning] Text elements should have a reasonable contrast ratio (13) 3. [Warning] These elements are focusable but either invisible or obscured by another element (5)
Organisations	1. Elements must have sufficient colour contrast	1. [Warning] Text elements should have a reasonable contrast ratio (14) 2. [Warning] These elements are focusable but either invisible or obscured by another element (3)
All challenges	1. Congratulations! No accessibility violations found.	1. [Warning] Text elements should have a reasonable contrast ratio (14) 2. [Warning] The purpose of each link should be clear from the link text (1) 3. [Warning] These elements are focusable but either invisible or obscured by another element (4)
Create challenge	1. Elements must have sufficient colour contrast 2. id attribute value must be unique 3. Form elements must have labels	1. [Severe] An element's ID must be unique in the DOM (2) 2. [Severe] Controls and media elements should have labels (1) 3. [Warning] Meaningful images should not be used in element backgrounds (1) 4. [Warning] Text elements should have a reasonable contrast ratio (29) 5. [Warning] These elements are

		focusable but either invisible or obscured by another element (2)
Conferences	1. id attribute value must be unique	1. Severe] An element's ID must be unique in the DOM (4) 2. [Warning] Text elements should have a reasonable contrast ratio (26) 3. [Warning] These elements are focusable but either invisible or obscured by another element
Online-Conference	1. Elements must have sufficient color contrast 1 violations 2. Form elements must have labels 1 violations 3. <video> elements must have captions 1 violations 4. <video> elements must have an audio description track	1. [Severe] Controls and media elements should have labels (2) 2. [Warning] Text elements should have a reasonable contrast ratio (11) 3. [Warning] These elements are focusable but either invisible or obscured by another element (3) 4. [Warning] Video elements should use <track> elements to provide captions (1)
Planned Conference	1. id attribute value must be unique	1. [Severe] An element's ID must be unique in the DOM (4) 2. [Warning] Text elements should have a reasonable contrast ratio (26) 3. [Warning] These elements are focusable but either invisible or obscured by another element (9)

Table 10 Accessibility Evaluation of the ANIMATE main pages by using automated tools aXe and Audits.

5 Conclusion

This deliverable defines the usability and accessibility in the User Interface that have been considered for ANIMATE platform. Moreover, evaluation methods and tools, which assist designers/developers in the creation of accessible and usable web applications are presented. The goal is to assess the functionalities of modules and services to verify the effect of its interface on the end-user and to identify any specific problems according to the end-users' feedback for eventual modifications and improvements.

First evaluations of the Usability and Accessibility were performed during the design phase and user testing and validation stage and the result were considered to improve the ANIMATE platform. End-users partners from UK and Spain have analysed the recommendations presented in this deliverable for an effective evaluation of Usability and Accessibility. Moreover, evaluation based on automatic tools were conducted during the development phases.

Designers and developers have incorporated accessibility and usability techniques to improve 'usable accessibility' and to make their designs work better for more people in more situations. Addressing accessibility and usability together can more effectively lead to a more accessible and usable web for everyone.

Given the positive feedbacks of end-users during the pilot trials and the results of the automated tools, the evaluation of ANIMATE usability and accessibility are satisfactory. Moreover, the usability and accessibility guidelines are mostly satisfied.

