View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Open Research Online

Open Research Online

The Open University's repository of research publications
and other research outputs

A preliminary study for developing accessible MOOC Services

Journal Item

How to cite:

Iniesto, Francisco and Rodrigo, Covadonga (2016). A preliminary study for developing accessible MOOC Services. Journal of Accessibility and Design for All, 6(2) pp. 126–150.

For guidance on citations see FAQs.

© 2016 Journal of Accessibility and Design for All

Version: Version of Record

Link(s) to article on publisher's website:
http://dx.doi.org/doi:10.17411/jacces.v6i1.117

Copyright and Moral Rights for the articles on this site are retained by the individual authors and/or other copyright owners. For more information on Open Research Online's data policy on reuse of materials please consult the policies page.

oro.open.ac.uk

Journal of Accessibility and Design for All

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

A PRELIMINARY STUDY FOR DEVELOPING ACCESSIBLE MOOC SERVICES

Francisco Iniesto[1], Covadonga Rodrigo[2]

[1]Institute of Educational Technology, the Open University, Milton Keynes, UK

[2]Department of Languages and Computer Systems, School of Computer Science, Universidad Nacional de Educación a Distancia (UNED), Madrid, Spain

ORCID: [1]*0000-0003-3946-3056,* [2]*0000-0001-8135-3163*

[1]francisco.iniesto@open.ac.uk, [2]covadonga@lsi.uned.es

Received: 2016-04-21 | Accepted: 2016-11-05 | Published: 2016-11-30

***Abstract*:** The flexibility of the MOOC service allows students to learn at their own time, place and pace, enhancing continuous communication and interaction among all participants in knowledge and community building. This model especially benefits people with disabilities, which can improve therefore their level of employability and social inclusion, reaching a better quality of life. Unfortunately the access to MOOC platforms present severe barriers: there is a lack of accessibility on the learning resources, the communicating tools and personalized user interfaces. All these issues add extra difficulties such as the need to develop specific digital or even social skills for students with functional diversity. In this context, MOOCs are leading a revolutionary computer and mobile-based scenario along with social technologies that will emerge new kinds of learning applications that enhance communication and collaboration processes. For that reason, this paper describes the need for designing an information model and related specifications to support a new strategy for delivering accessible MOOC courses to learners with special needs, in terms of their preferences and context of use based on a particular application profile. This user profile's design is based on standard metadata schemas, data that provides information about other data, regarding the achievement of accessibility from content to user preferences.

Keywords: MOOC, accessibility, employability, standards, metadata, social inclusion.

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Introduction

Massive Open Online Courses (MOOCs) have made open education available to the public domain by offering a free window to the same courseware that students might experience at university and colleges. Higher Education institutions are shifting from closed educational platforms to new open learning environments, demonstrating that the evolution of open education on the internet is enabling thousands of people around the world to follow different educational initiatives. A basic characteristic of MOOC courses, independently of its type, is the high degree of interactivity that facilitates and reinforces the bidirectional communication between the students and the mediators. In MOOC courses the figure of the teacher changes, being less prominent in the traditional conception than it is in classroom training or even traditional eLearning. In open courses the role of the tutor is updated, more close to the idea of pedagogical mediation, playing the role of a content curator, a mediator, counsellor, or facilitator of the learning processes. Therefore, the academic figures inside the MOOCs act more like community managers. As the learning is not faculty-centered but student-centered, it requires a greater commitment from the student side into self-learning, deep research aptitude, and analysis, reflexive capacity along with a high component of personal autonomy.

Downes (2012; 2013) clearly differentiates between basic types of MOOC: cMOOCs and xMOOCs. The cMOOC (connectivist) are based on the principle of forming learning communities with very active users who contribute to re-factorizing the content and building knowledge collaboratively. Siemens (2012), one of the fathers of connectivism, bases his theory, in which learning takes place within a community of users, in which the students can use different digital platforms organized as personal learning environments that allows them to create blogs, wikis, tweets and share this knowledge by means of social networks to form new communities and build knowledge. Siemens insists that this type of course emphasizes creativity, personal autonomy and social learning in the community. While xMOOCs (extended) are based on already existing university courses and reflect a more traditional training focus (Morrison, 2013) in the transmission of information

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

by means of presentations recorded on video and in the carrying out of brief assigned exercises which are evaluated automatically by the platform itself. Thus the evaluation may be carried out through multi-choice examinations/tests or even peer-to-peer review. The methodology proposes that the huge thematic blocks should be divided into bite-sized pieces of learning, which are much easier to digest. Given that it is the student who must develop his/her own knowledge networks, it becomes compulsory for the student to become an active participant when looking for and creating appropriate learning content and being always able to learn something new. The teachers, consequently, instead of reducing their creative capacity to merely transmitting the knowledge, give each student the possibility of becoming co-creators of their own learning through being active participants in the process (Zapata-Ros, 2013).

However, the pedagogical and visual design of MOOCs, their information architecture, usability and interaction design could be having a negative impact on student engagement, retention and completion rates as it has been previously analyzed in adult learning (Tyler-Smith, 2006). The recent addition to this new open and online learning called MOOC, the creation of new educational forms (both from the instructional and technological point of view) can be used to refactor education delivery, also renewing inclusive education that can reach all citizens. Social inclusion can only be reached by embedding inclusive strategies, the importance of targeting and including vulnerable groups in MOOCs, such as people with disabilities is emphasized.

Information and communications technology (ICT) offers great possibilities for people with visual, auditory and mobility disabilities to improve their well-being, promoting their training and therefore their potential for entering the workforce (Pallisera & Bonjoch, 2007; Vila, Pallisera & Fullan, 2007). There are numerous studies looking in depth into both the ease of and difficulties in accessing and using the different types of technology that they come up against, thus giving rise to significant limitations while using ICT (Koon & De la Vega, 2000) and the appearance of the concept of digital divide (Cullen, 2001). The difficulties especially focused on the use of computers and the Internet, rather than the user's devices, which usually

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

are already adapted or personalized via its operating system tools and functionalities.

Integrating accessibility standards actively, through metadata (Neville, Cooper, Heath, Rothbergeine & Treviranus, 2005; Green, Jones, Pearson, & Gkatzidou, 2013), into both MOOCs courses and platforms would make them more accessible. Metadata standards could then be incorporated in two separate fields by:

- Incorporating preferences and context information into user's profile definition.
- Adding metadata information to wrap up the educational resources.

The research presented in this article offers major opportunities of modelling user profiles with accessibility metadata standards being able to map the access to educational resources that best suit user's preferences. The main objective of this work is to design a system for recommending MOOCs, being the ranked list of courses adapted to the user needs in order to achieve new professional competences and closed to the learner's preferences.

The structure of the paper is as follows: first, a case study of accessibility in MOOCs is explained, then the different standards that applied are presented, followed by a brief design model for the recommender system and the metadata that would be necessary to integrate. Finally, main conclusions are established.

Accessibility issues in MOOCS

MOOC platforms are web based eLearning engines that provide mechanisms for scheduling academic curriculum, allowing synchronous and asynchronous communication between instructors and students and delivering various modes of assessment.

Most modern LCMS environments claim to achieve good levels of accessibility compliance (Martin et al., 2007), also MOOC platforms. In terms of interface

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

elements, logging in, logging out, navigating in courses and content, MOOC environments have like other LCMS multi layered structures across which users with special needs must be able to navigate by using WAI-ARIA specifications (2014). Managing content in MOOC platforms can include some easy tasks such as editing the names of items, deleting items or setting the sequence of items, but not all of the approaches are necessarily intuitive or quick to use. Old versions of LCMS management functionalities were more accessible in their intrinsic conception: simple drop-down lists or numbered field values being attached to each module or content item within a module and so on. Nowadays MOOC platforms have evolved to more media rich, graphically interactive web applications that greatly increase the interface complexity (Rodrigo & Iniesto, 2015).

Unfortunately, accessibility issues have been reported for years in regular LMS, and the same happens for MOOC platforms. Sanchez-Gordon and Luján-Mora (2013) made a review of five Coursera courses and authors found web accessibility problems in five courses, both regarding the content and navigating into the Coursera platform, limiting access to elderly students. Moreover, Al-mouh, Al-khalifa, and Al-khalifa (2014) did the evaluation of ten Coursera courses on different topics (technology, design, humanities, physics, etc.) aimed to be used by blind or partially sighted people, and none of the courses reached the minimum level of accessibility. Bohnsack and Puhl (2014) proceeded with the evaluation of the accessibility of five MOOC platforms (Udacity, Coursera, edX, OpenCourseWorld, and Iversity) for blind users, the experiment had to be stopped at the point at which an accessibility problem prevented the user from continuing without help. All platforms (except edX) had fatal accessibility problems in the initial stages of the interaction. Finally expert accessibility evaluations were carried out on UNED COMA, UAb iMOOC, COLMENIA and Miriada X platforms, all scored low results, indicating that there is scope for improvement in their accessibility (Iniesto, Rodrigo & Moreira Teixeira, 2014; Iniesto & Rodrigo, 2014a).

It is also important to consider that eLearning materials are often used with a specific technology which can make them less available to people who

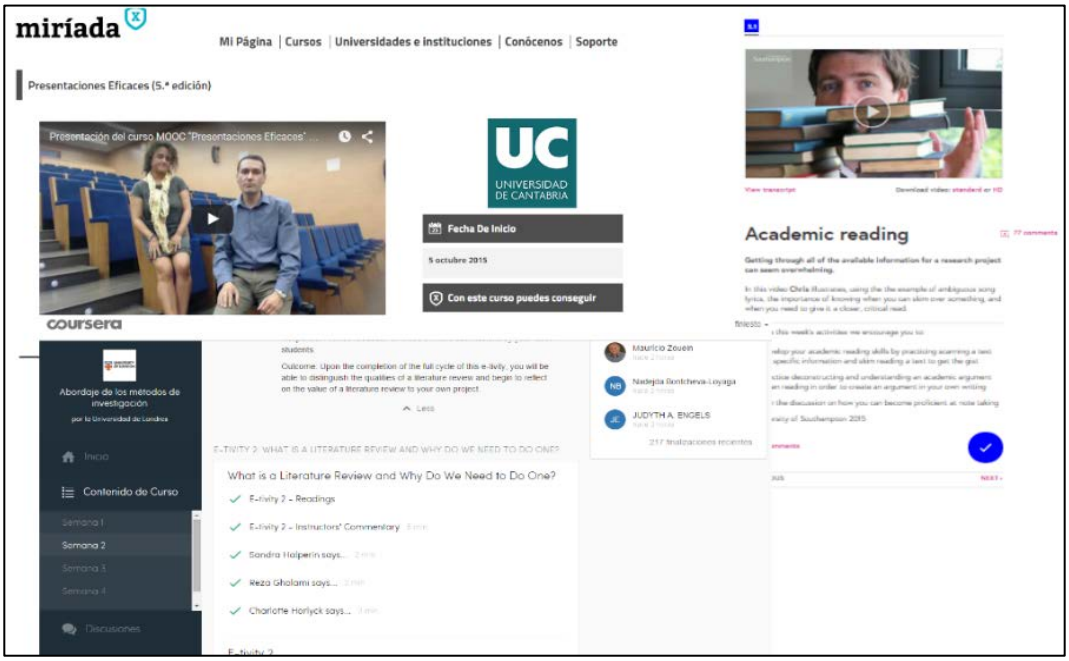
(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

have limited access capabilities or who are using nonstandard computer equipment. Problems regarding accessing the eLearning platform and also great difficulties for user interaction with learning resources have been reported (Iglesias, Moreno, Martínez & Calvo, 2011). Typically, eLearning environments have a variety of interactive components which do not always share a consistency of interface logic or managing interactive elements, such as posting in a forum, making up elements in tests or timed quizzes, embedded videos or a variety of document formats (Figure 1).

Probably one significant issue is precisely the real openness of the content (Jansen & Schuwer, 2015). Many MOOC providers nowadays allow login with Google, Facebook and other open ID providers, which currently have no metadata for users' abilities (Mirri, Salomoni & Prandi, 2011). An effective "open" eLearning environment should take into account each learner's abilities, learning goals, where learning takes place, and which specific devices the learner uses letting user's access the content directly.

Figure 1. Different MOOCs examples

Source: Prepared by the authors from Miriada X, Coursera, and Futurelearn.



In this context, it is strategic to describe learner's preferences and user's special needs by means of a specific profile. How the profile information interacts with the eLearning platform interface and the objects containers

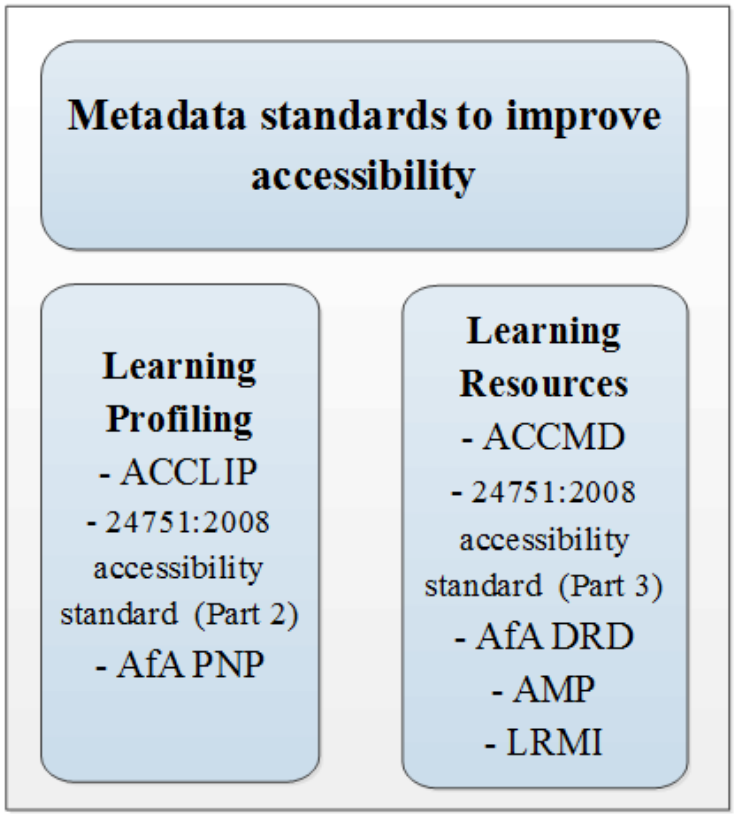
(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

can impact upon the learning experience of users with different capabilities, as it was reflected in the EU4ALL project (European Unified Approach for Accessible Lifelong Learning, 2010). With all these standards, learners can specify which kind of adapted and\or alternative resource they prefer or need. For instance, text may be preferred over visual resources, or audio might be preferred over text or images, etc. For creators of educational content, at the most basic level a standard metadata framework for learning resources means increased interoperability.

Therefore, the strategy presented here relays upon integrating some metadata application profiles, based on standard metadata schemas both for user profiling enrichment and also adding accessibility characteristics to MOOC learning content (as shown in figure 2).

Figure 2. Metadata standards to improve accessibility

Source: Prepared by the authors.



(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Learning profiling standards

Some standards have been defined to profile learner preferences and needs that will help the user to personalize devices and services for students with disabilities. Groups that have been really active in this work are IMS Global Learning Consortium and ISO.

IMS Learner Information Profile (IMS LIP) and IMS Learner Information Package Accessibility for LIP (ACCLIP).

The IMS Global Learning Consortium has developed a specification that attempts to address learner profiling, the IMS Learner Information Profile (IMS LIP, 2001), devoted to describe general learner characteristics, by defining a set of packages that can be used to import data into and extract data from an IMS compliant Learner Information server.

The IMS Learner Information Package Accessibility for LIP (ACCLIP, 2003) is that subset of IMS LIP which lets learners specify accessibility preferences and accommodations in terms of visual, aural or device. This profile provides a means of describing how learners interact with an eLearning environment, by focusing on accessibility requirements, therefore the user's set of preferences can be exploited according to the different contexts of use of the eLearning environment, customizing the visualization of the learning contents, selecting the preferred input or output device, etc. In 2009, a new version of ACCLIP was released, called "Access-For-All Personal Needs and Preferences for Digital Delivery".

Accessibility user preferences in the IMS standards can be grouped as follows:

- **Display information**: this set describes the user preferences to have information displayed or presented. For example, it is possible to define preferences related to text (fonts and colors), video (resolution), mouse (pointer, motion), etc.
- **Control information**: this set defines the user preferences to control the device: keyboard (virtual), zoom preferences, voice recognition.

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

- **Content information**: this set defines the user preferences to visualize learning content.
- **Privacy and data protection information**: each ACCLIP element has meta-data sub-elements related to this information. The privacy and the data integrity is considered very important, since the exchanged information can be closely related to the user's disabilities.

ISO/IEC 24751:2008 accessibility standard (Part 2)

While the IMS standard is focused on defining content characteristics, ISO specifies the senses through which content is accessed. The second part of the ISO/IEC 24751:2008 accessibility standards (Information technology–Individualized adaptability and accessibility in eLearning, education, and training–Part 2: "Access for all" personal needs and preferences for digital delivery, 2008) is devoted to describing the learners' Personal Needs and Preferences (ISO PNP).

IMS Access for All (AfA) Personal Needs and Preferences (PNP) 3.0

According to the standards, learners can explicitly declare only one alternative access mode for each form of learning resource and it does not allow a change: for example, a blind user might prefer audio description but if such alternatives are absent, he/she cannot choose a text description instead. Therefore a new standard IMS Access for All (AfA) Personal Needs and Preferences (PNP, 2012) 3.0 has recently been developed, aiming to solve this type of problems and letting the learner specify multiple adaptation requests for each existing Access Mode. Still, IMS AfA PNP has some restrictions while choosing the size or quality of video and audio resources.

For instance, it is not possible to request a lower version of a video clip or audio file to be adapted to the user's device. Therefore, a specific quality profile for learning resources would be desirable as well as clarification rules to better describe the list of alternative recommendations.

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Learning resources standards

At the time of using the Internet as a mean of communication to publish multimedia content in audio-visual format, it is necessary to take different aspects into account:

- **Technological**: the user agents that must make possible access the information, the technology to develop and edit the resources, authoring tools to facilitate the production of accessible materials or the adaptation of those already produced.
- **Adapted Devices**: when a user accesses a resource available on the Internet, it can be accessed directly or a device would have to be used specifically: screen reader, specialized mouse, virtual keyboard, magnifying glass, etc.
- **Existing Inclusive Methodologies and Educational Standards**: here the XML markup languages have to be mentioned, together with the use of metadata that provides the adaptability of the content according to the user profile.

IMS Access-For-All Metadata (ACCMD)

In order to improve the accessibility of eLearning content, the Access-For-All Metadata (ACCMD) specification was developed by IMS in 2004. It describes learning content by identifying which types of resource are available in a Learning Object, which can be used to present the same content to a given learner, but by means of different media. Metadata can then be used to describe the types and the relationships between an original resource and its available adapted formats. Interpreting user profiles for choosing the appropriate content, ACCMD metadata can be exploited to describe textual alternatives that are available for images, audio descriptions for videos, transcripts or captioning for audio tracks, visual alternatives for text, and a variety of other potential alternative formats matching user's preferences. Based on ACCMD, these appropriate alternative media resources can be retrieved and presented to the user. A visually-impaired learner, for instance, viewing a video that had entered an ACCLIP profile previously, will

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

automatically receive that video with audio descriptions, while a hearing-impaired learner will receive the same video but with captioning included in the presentation.

ACCMD and ACCLIP have been incorporated at the ISO/IEC Standard 24751 "Individualized Adaptability and Accessibility in e-Learning, Education and Training".

ISO/IEC 24751:2008 accessibility standard (Part 3).

Furthermore, the third part of the ISO/IEC 24751:2008 accessibility standards (Information technology–Individualized adaptability and accessibility in eLearning, Education and training–Part 3: "Access-for-all" digital resource description, 2009) is devoted to describing the resources which make up an eLearning content (ISO DRD), with an approach which is similar to the IMS ACCMD, both standards having the same aim: providing information on alternatives to original resources. Then, any resource presented in an e-learning content can be identified as having an original form and one or more adapted forms, depending on its media type.

IMS Access for All (AfA) Digital Resource Description (DRD) 3.0

A limitation to these standards arises whenever eLearning content authors want to provide alternatives both to the whole original content and to each single part that makes up the entire resource (images included in a document, formatted texts, etc.).

According to these standards, it is neither possible to declare those pieces of formatted text as original resources if they are not in separated files, nor can a subset of adapted resources be declared as an alternative to a single resource. For example, a sequence of audio files cannot be identified as a single auditory resource, a video with sign language cannot be defined as an alternative to it, and a sequence of images cannot be declared as an alternative to a video.

The IMS Access for All (AfA) Digital Resource Description (DRD) 3.0 aims to solve these problems by radically changing the point of view: now it is possible to declare one or more access modes for each resource, define

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

existing accessible adaptations and whether they come from the specific original resource.

IMS Accessibility Metadata Project

The Accessibility Metadata Project (AMP, 2014) is a metadata subset that emerged with the idea to define a set of accessibility metadata to enable the search and discovery of Web resources that would suit user's needs and preferences. It tries to find a solution to the lack of properties to identify the accessible nature of resources being useful to define semantics that describes resources in ways that will facilitate their discovery by suitability.

Is a subset of the standard IMS Access for All Digital Resource Description focused in matching of the characteristics of resources where they might not be suitable for all types of users.

The Accessibility Metadata Project has developed a common metadata framework for describing or "tagging" the accessibility attributes and alternatives on the web, with the contribution of Benetech Corporation, IMS Global's Access for All and the Learning Resource Metadata Initiative (LRMI) groups and funding from the Gates Foundation. Once a critical mass of content has been tagged to a universal framework, it becomes much easier to parse and filter that content, opening up tremendous possibilities for search and delivery, as well as easily discovery of other accessible adaptations. The Accessibility Metadata Project is the byproduct of LRMI initiative and the accessibility working group within IMS Global, called Access for All that has been working on a framework for specifying both digital resource information and personal preferences. This accessibility metadata project brought a subset of the most important attributes of Access for All into a proposal for broad adoption within the schema.org framework, called A11Y Metadata proposal, with the hope that this will enable rapid adoption. Incorporated into Schema.org can become the de facto standard for tagging accessibility information for educational resources and other content on the web.

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

*Learning Resource Metadata Initiative **(LRMI)***

Learning Resource Metadata Initiative (LRMI) is an initiative promoted by the Association of Educational Publishers (AEP) and Creative Commons that has worked to facilitate to publish, discover, and deliver educational resources on the web, having developed a common metadata framework for describing learning resources. It is focused to benefit: search engines so they can return richer results, educators and learners to discover learning materials pertinent to their immediate learning situation.

Aside from improved search, the LRMI also has the potential to:

- Facilitate personalized learning—the right content at the right time
- Decrease production costs through industry standardization
- Address demands of states for standardized description of learning resources.

LRMI, which has been adopted into schema.org, had considered accessibility metadata as part of their charter, increasing the scope of their effort to be even more ambitious.

Adaptive model for delivering accessible MOOC services

The objective of a model for delivering accessible MOOC services is supported by the functional diversity scenario illustrated by Rodriguez-Ascaso and Boticario (2015), in the development of accessible services a reference is the previously mentioned EU4ALL project to be used ideally in any eLearning platform (Boticario et al., 2012), in modelling MOOCs for accessibility purposes Sanchez-Gordon and Luján-Mora (2015) propose a three-layer architecture to extend the MOOCs platform Open edX to enhance course content accessibility for users with disabilities. Finally Salomoni, Mirri, Ferretti and Roccetti (2007) strongly encourage the use of accessibility standards to profile learners in their practical approach.

Adaptive model architecture

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

The model of educational services we propose is useful for people with special needs to find MOOCs courses whose platforms and content are as accessible as possible taking into account users' disabilities. The recommender system has to establish a relationship within the level of accessibility required and take into account the assistive technologies more commonly used by the user, having the following characteristics:

- The ability to help these vulnerable users to find the MOOCs courses that are more accessible regarding their disability.
- Requires accessibility analysis of both: the MOOC platform and the educational content.
- Offers personalization of the app: GUI adaptation to each assistive technology.
- Adjustment of the rated list of recommended MOOCs that best fit accessibility requirements.

The system will have the following distinguishable parts where we have focused the work (Figure 3):

- Enriched user profile. User's device personalization: the preferences or needed assistive technologies and the technical needs regarding user's functional diversity.
- Accessible MOOCs. Accessibility evaluation on MOOC platforms and their educational resources, offering an automated recommendation list adapted to the user's functional diversity to be used in the user's profile.

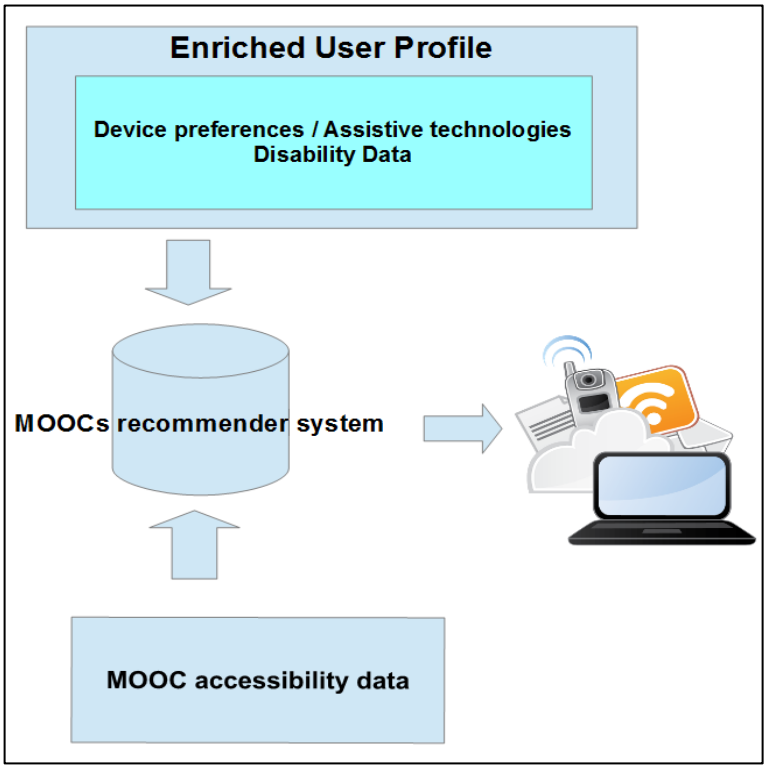
In the Development of an accessibility evaluation of MOOC platforms and courses to achieve a map of accessible MOOCs versus functional diversities, we have taken into account the level of accessibility involving, therefore, an assessment of the web content of MOOCs courses and the educational resources by themselves. Automatic tools and user experience are used for this task of accessibility assessment so we can get a holistic evaluation methodology. This methodology has previously been explained and tested in

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

published works by the authors (Iniesto et al., 2014; Iniesto & Rodrigo, 2014a; Iniesto & Rodrigo, 2014b).

Figure 3. MOOCs recommender system characteristics.

Source: Prepared by the authors.



- Evaluation through automatic accessibility tools:
    - WCAG Accessibility Validation
    - Disability Simulators
- Usability and User Experience (UX)
    - Testing Tools
- User evaluation
    - Educational content evaluation.

Enriched user profile

To define and model the user profile we focus on the most recent and most comprehensive IMS standards relatives to Access for All (AfA) and its aspects

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

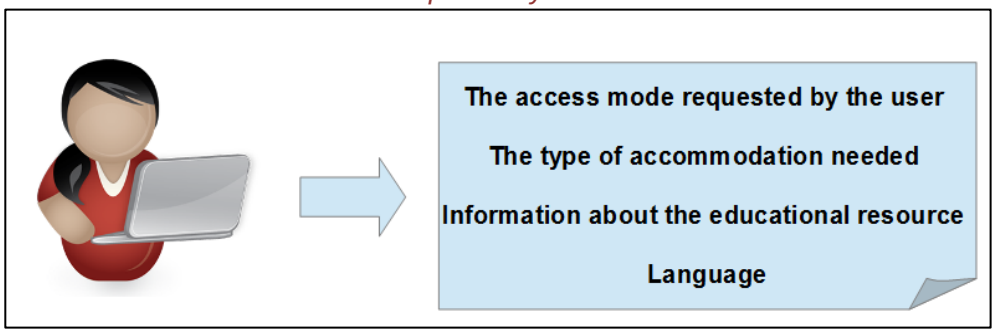
PNP and DRD, as it has been done for example in the METALL project, because they allow us to define collections rather than a single value for each case (multiplicity) (Centelles Velilla, Vázquez Guzmán, Ribera & Pérez Pineda, 2014).

This is a preliminary study, in the future may be interesting to introduce other standards such as AMP or LRMI that could complement the functionality offered in this first selection. Below are detailed the selected metadata to model the learning and educational profiling, the criteria has been to select those that define the access mode requested by the user, the type of accommodation needed, those which deal with information about the educational resource and finally those related to language. The selection takes into account the approach used in the design of the recommender system (Figure 4).

- **Access Mode**. Access mode the user seeks either an adapted or an original resource as a replacement for a different access mode.
- **Accommodation type**. Nature or genre of the adaptation required as a replacement for a specific access mode.
- **Educational resources**. A preference for a resource that is simplified or enriched relative to another resource that presents the same intellectual content.
- **Language**. Language of the intellectual content of the resource or the interface.

Figure 4. Learning and educational profiling

Source: Prepared by the authors.

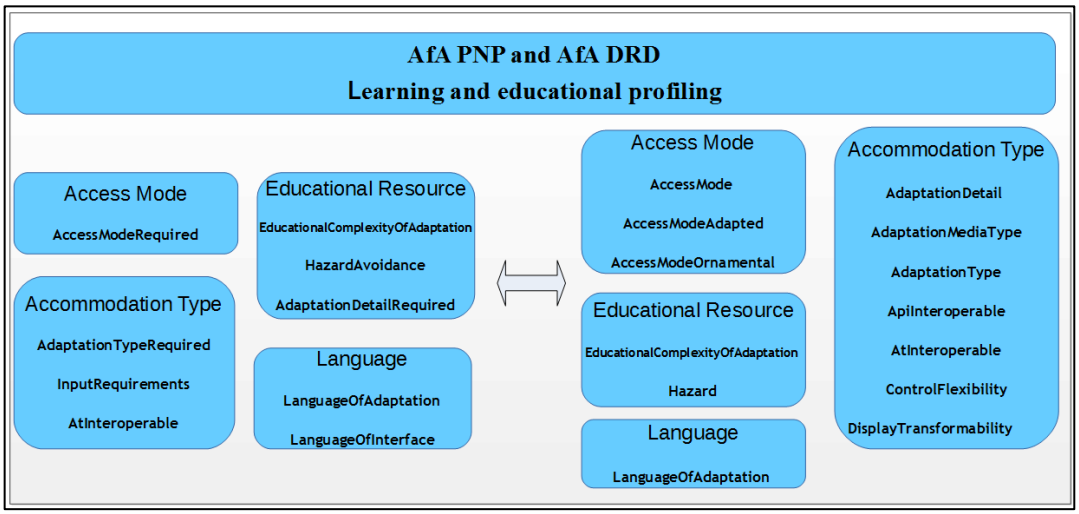


(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

We have chosen nine from twelve elements that have to do with the educational aspects of the profile and thirteen from nineteen elements relating to the educational aspects of the resource as shown in figure 5, the detailed metadata description can be reviewed in the appendix.

Figure 5. Access for All (AfA PNP and DRD) user profile and preferences

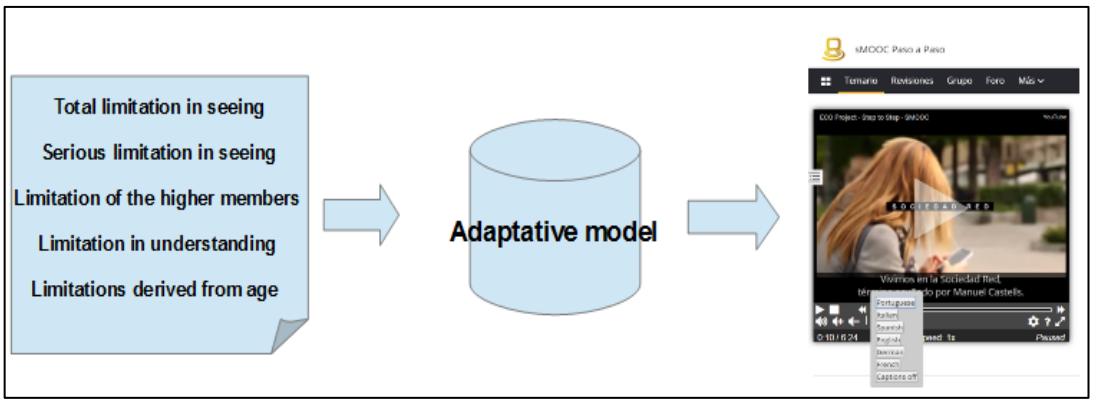
Source: Prepared by the authors.



Depending on the limitation the user might have, providing the information from the user and the resource the system can select the proper adaptation required (Figure 6).

Figure 6. Adapting the resources depending on user's limitation

Source: Prepared by the authors, image from ECO eLearnign project.



(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Conclusions

How eLearning systems are designed, how their interfaces function, how communication is handled, how assessments take place and what form the learning content takes, all impact on the accessibility of these systems by students with disabilities. In MOOCs, the learning activities used had been originally designed neither for specific MOOC platforms nor for a specific learning scenario. Therefore, educational resources that are being delivered present some problems for certain target groups, such as people with special needs. As a result, the level of usability and accessibility of these resources is often lower than desired. This is a clear setback if they are to be used at a greater scale for inclusive learning.

MOOC platforms should be compliant with accessibility standards, not only related to the Web interface, it is important in an eLearning environment like MOOCs take into account learner's abilities and learning goals. It is necessary to describe learner's preferences and needs by means of a profile and how this profile interacts with the eLearning platform interface and the learning resources. Access for All (AfA) in its aspects PNP and DRD standards offer the possibility to learners so they can specify which kind of adapted and/or alternative resource they prefer or need. We should not forget that most of these standards are devoted to technical accessibility aspects of learning materials while less attention is given to the cognitive and didactical issues (Catarci, De Giovanni, Gabrielli, Kimani & Mirabella, 2008).

In designing the recommender system the following steps are to refine the user profile modelling to finally be crossed with a vector of accessibility features from the different MOOC courses, therefore continuing to develop a holistic approach.

Acknowledgments

We would like to thank the Research Chair on "Technology and Accessibility" UNED - Fundación Vodafone España as well as the Global OER Graduate Network (GO-GN) for their support. Francisco's work is supported by a

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Leverhulme Trust Doctoral Scholarship in Open World Learning based in the Centre for Research in Education and Educational Technology (CREET) at The Open University UK.

References

[1] Al-Mouh N. A., Al-Khalifa A. S., & Al-Khalifa H. S. (2014). A first look into MOOCs accessibility: The case of coursera. Lecture Notes in Computer Science (including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 8547 LNCS (PART 1), 145–152. http://doi.org/10.1007/978-3-319-08596-8_22

[2] Bohnsack, M., & Puhl, S. (2014). Accessibility of MOOCs. Computers Helping People with Special Needs, 141–144. http://doi.org/10.1007/978-3-319-08596-8_21

[3] Boticario, J. G., Rodriguez-Ascaso, A., Santos, O. C., Raffenne, E., Montandon, L., Roldán, D., & Buendía, F. (2012). Accessible Lifelong Learning at Higher Education: Outcomes and Lessons Learned at two Different Pilot Sites in the EU4ALL Project. JUCS - Journal of Universal Computer Science, 18(1), 62–85. http://doi.org/10.3217/jucs-018-01-0062

[4] Catarci, T., De Giovanni, L., Gabrielli, S., Kimani, S., & Mirabella, V. (2008). Scaffolding the design of accessible eLearning content: a user-centered approach and cognitive perspective. Cognitive Processing, 9(3), 209-216.

[5] Centelles Velilla, M., Vázquez Guzmán, C., Ribera, M., & Pérez Pineda, I. (2014). Asignación de metadatos de accesibilidad a vídeos docentes, INNOVADOC (Documents d'Innovació Docent) Retrieved from http://diposit.ub.edu/dspace/handle/2445/60425

[6] Cullen, R. (2001). Addressing the digital divide. Online information review, 25(5), 311-320.

[7] Downes, S. (2012). Connectivism and Connective Knowledge: essays on meaning and learning networks. National Research Council Canada, Retrieved from: http://www.downes.ca/files/books/Connective_Knowledge-19May2012.pdf

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

[8] Downes, S. (2013). What the "x"in "xMOOC"stands for. Retrieved from: https://plus.google.com/+StephenDownes/posts/LEwaKxL2MaM

[9] EU4ALL (2010). Retrieved from: https://adenu.ia.uned.es/web/es/projects/eu4all

[10] Green, S., Jones, R., Pearson, E., & Gkatzidou, S. (2013). Accessibility and adaptability of learning objects: responding to metadata, learning patterns and profiles of needs and preferences. ALT-J, 14(1), 117-129.

[11] Jansen, D., & Schuwer, R. (2015). Institutional MOOC strategies in Europe. Status report based on a mapping survey conducted in October - December 2014 EADTU, ISBN 978-90-79730-15-5. Retrieved from: http://eadtu.eu/documents/Publications/OEenM/Institutional_MOOC_strategies_in_Europe.pdf

[12] Iglesias, A., Moreno, L., Martínez, P., & Calvo, R. (2014). Evaluating the accessibility of three open-source learning content management systems: A comparative study. Computer Applications in Engineering Education, 22(2), 320–328. http://doi.org/10.1002/cae.20557

[13] IMS AccessForAll Metadata. Information Model. (2004). Retrieved from: http://www.imsglobal.org/accessibility/accmdv1p0/imsaccmd_infov1p0.html

[14] IMS Global Access For All (AfA) Digital Resource Description (DRD) Specification Information Model. (2012). Retrieved from: https://www.imsglobal.org/accessibility/accdrdv2p0/html/ISO_ACCDRDv2p0_InfoModelv1.html

[15] IMS Global Access For All (AfA) Personal Needs & Preferences (PNP) Specification Information Model. Version 3.0 Specification (2012). Retrieved from: http://www.imsglobal.org/accessibility/afav3p0pd/AfA3p0_PNPinfoModel_v1p0pd.html

[16] IMS Global's Accessibility Metadata Project. (2014). Retrieved from: http://a11ymetadata.imsglobal.org/

[17] IMS Learner Information Package Accessibility for LIP Information Model (2003). Retrieved from: http://www.imsglobal.org/accessibility/acclipv1p0/imsacclip_infov1p0.html

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

[18] IMS Learner Information Package Specification (2001). Retrieved from: http://www.imsglobal.org/profiles/index.html

[19] Information technology -- Individualized adaptability and accessibility in e-learning, education and training -- Part 2: "Access for all" personal needs and preferences for digital delivery. (2008). Retrieved from: http://www.iso.org/iso/catalogue_detail?csnumber=43603

[20] Iniesto, F., Rodrigo, C., & Moreira Teixeira, A. (2014). Accessibility analysis in MOOC platforms. A case study : UNED COMA and UAb iMOOC. In V Congreso Internacional sobre Calidad y Accesibilidad de la Formación Virtual (CAFVIR 2014) 545–550. Retrieved from: http://oro.open.ac.uk/45192/

[21] Iniesto, F.; & Rodrigo, C., Accessibility assessment of MOOC platforms in Spanish: UNED COMA, COLMENIA and Miriada X. (2014). Computers in Education (SIIE), 2014 International Symposium on vol., no., pp.169, 172, 12-14
doi: http://dx.doi.org/10.1109/SIIE.2014.7017724

[22] Iniesto, F., & Rodrigo, C. (2014). Pautas para la evaluación de la accesibilidad en las plataformas MOOC. In VI Congreso Internacional sobre Aplicación de Tecnologías de la Información y Comunicaciones Avanzadas (ATICA2014) 57–64. Retrieved from: http://oro.open.ac.uk/45191/

[23] ISO/IEC e-learning standard will help match user needs with the right resources (2009). Retrieved from: http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1217

[24] Koon, R., & De la Vega, M. E. (2000). El impacto tecnológico en las personas con discapacidad. In II Congreso Iberoamericano de Informática Educativa Especial, Córdoba.

[25] Learning Resource Metadata Initiative (2014). Retrieved from: http://lrmi.dublincore.net/

[26] Martin, L., Gutiérrez y Restrepo, E., Barrera, C., Rodríguez Ascaso, A., Santos, O. C., & Boticario, J. G. (2007). Usability and Accessibility Evaluations Along the eLearning Cycle. Web Information Systems Engineering – WISE 2007 Workshops, 453–458. http://doi.org/10.1007/978-3-540-77010-7_44

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

[27] Metadata-enabled Tools for Assistive Living and Learning (METALL). Retrieved from: https://access.ecs.soton.ac.uk/projects/metall

[28] Mirri, S., Salomoni, P., & Prandi, C. (2011). Augment browsing and standard profiling for enhancing web accessibility. In Proceedings of the International Cross-Disciplinary Conference on Web Accessibility (p. 5). ACM.

[29] Morrison, D. (2013). The ultimate student guide to xMOOCs and CMOOCs. MOOC News and Reviews. Retrieved from: http://moocnewsandreviews.com/ultimate-guide-to-xmoocs-and-cmoocso

[30] Neville, L., Cooper, M., Heath, A., Rothbergeine, M., & Treviranus, J. (2005). Learner-centred Accessibility for Interoperable Web-based Educational Systems. In: International World Wide Web Conference (WWW2005), 10-14 May 2005, Chiba, Japan.

[31] Pallisera, M., & Bonjoch, M. (2007). ¿Y después del trabajo, qué?: más allá de la integración laboral de las personas con discapacidad. Revista de Educación, (342), 329–348. Revista acreditada por la FECYT

[32] Rodrigo C., & Iniesto F. (2015). Holistic vision for creating accessible services based on MOOCs. Open Education Global Conference. 22-24 April 2015. Banff, Alberta, Canada. Retrieved from http://conference.oeconsortium.org/2015/wp-content/uploads/2015/02/oeglobal2015_submission_49.pdf

[33] Rodríguez-Ascaso, A., & Boticario, J. G. (2015). Accesibilidad y MOOC: Hacia una perspectiva integral. RIED. Revista Iberoamericana de Educación a Distancia, 18 (2), 61-85. doi: http://dx.doi.org/10.5944/ried.18.2.13670

[34] Salomoni, P., Mirri, S., Ferretti, S., & Roccetti, M. (2007). Profiling learners with special needs for custom e-learning experiences, a closed case?. In Proceedings of the 2007 international cross-disciplinary conference on Web accessibility (W4A) (pp. 84-92). ACM.

[35] Sanchez-Gordon, S., & Luján-Mora, S. (2013). Web accessibility of MOOCs for elderly students. 2013 12th International Conference on Information Technology Based Higher Education and Training, ITHET 2013, 1–6. http://doi.org/10.1109/ITHET.2013.6671024

[36] Sanchez-gordon, S., & Luján-mora, S. (2015). Adaptive Content Presentation Extension for Open edX Enhancing MOOCs Accessibility for

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

Users with Disabilities. The Eighth International Conference on Advances in Computer-Human Interactions Adaptive, (c), 181–183.

[37] Siemens, G. (2012). MOOCs are really a platform. ELearnspace, Retrieved from: http://www.elearnspace.org/blog/2012/07/25/moocs-are-really-a-platform.

[38] Tyler-Smith, K. (2006). Early attrition among first time eLearners: A review of factors that contribute to drop-out, withdrawal and non-completion rates of adult learners undertaking eLearning programmes. Journal of Online Learning and Teaching, 2(2), 73–85.

[39] Vilà, M., Pallisera, M., & Fullana, J. (2007). Work integration of people with disabilities in the regular labour market: What can we do to improve these processes? Journal of Intellectual and Developmental Disability, 32(1), 10–18.

[40] WAI-ARIA. (2014). Retrieved from: https://www.w3.org/WAI/intro/aria

[41] Zapata-Ros, M. (2013). MOOCs, una visión crítica y una alternativa complementaria: La individualización del aprendizaje y de la ayuda pedagógica. Campus Virtuales | Revista Cientifica de Tecnología Educativa, 2(1), 20–38. Retrieved from http://www.revistacampusvirtuales.es/index.php/es/revistaes/numerosanteriores/29-voliinum1/67-voliinum1-art2

Appendix. Detailed metadata

Metadata related with educational aspects of the profile:

- **AccessModeRequired**, access mode the user seeks either an adapted or an original resource as a replacement for a different access mode, it is allowed using the attribute "existingAccessMode" that defines the existing access, for example "visual" and by "adaptationRequest" attribute indicating the access mode the user prefers, for example " textual".

- **AdaptationTypeRequired**, nature or genre of the adaptation required as a replacement for a specific access mode, has the same attributes to allow access being equally "visual" the example to an access mode

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

and an adaptation type that the user prefers could be for example "audio description".

- **AtInteroperable**, denotes that the user does not require assistive technologies support, in compliance with WCAG 2.0.
- **EducationalComplexityOfAdaptation**, a preference for a resource that is simplified or enriched relative to another resource that presents the same intellectual content.
- **HazardAvoidance**, resources having such a characteristic should not be delivered to a user with this preference, for example "flashing visuals".
- **InputRequirements**, single input system that is sufficient to control a resource, for example if we want resources that are fully usable with a keyboard.
- **LanguageOfAdaptation**, preference for the language of the adaptation for the educacional resources.
- **LanguageOfInterface**, preference for the language of the user interface.
- **AdaptationDetailRequired**, detail of one or more required adaptation types, it also contains "existingAccessMode", could be "auditory", and allows using "adaptationRequest" to express the alternative desired if exist, for example "verbatim".

Metadata relating to the educational aspects of the resource:

- **AccessMode** access mode through which the intellectual content of a described resource or adaptation is communicated, for example "visually".
- **AccessModeAdapted**, access mode of the intellectual content of the resource that is being adapted, for example "visual".

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

- **AccessModeOrnamental**, ornamental content of the described resource or adaptation is communicated
- **AdaptationDetail**, fine detail of one or more adaptation type values, for example if the object is recorded with human voice instead of synthesized speech.
- **AdaptationMediaType**, identifies the media type of the described resource.
- **AdaptationType**, nature or genre of the adaptation, for example "alternative Text"
- **ApiInteroperable**, indicates that the resource is compatible with the referenced accessibility API, for example "ARIAv1".
- **AtInteroperable**, the resource is compatible with assistive technologies, in compliance with WCAG 2.0.
- **ControlFlexibility**, identifies a single input method that is sufficient to control the described resource, could be as an example fully usable with keyboard control.
- **DisplayTransformability**, identifies a characteristic of display of the described resource that can be programmatically modified, if it permits its font size to be adjusted on user request can be an example.
- **EducationalComplexityOfAdaptation**, identifies if the resource is simplified or enriched relative to another resource that presents the same intellectual content.
- **Hazard**, a characteristic of the described resource that must not be delivered to some users, for example "flashing".
- **LanguageOfAdaptation**, language of the intellectual content of the resource.

(CC) JACCES, 2016 - 6(2): 125-150. ISSN: 2013-7087 DOI: 10.17411/jacces.v6i1.117

- ©© Journal of Accessibility and Design for All, 2016 (www.jacces.org)
- 
- Article's contents are provided on an Attribution-Non Commercial 4.0 International Creative commons license. Readers are allowed to copy, distribute and communicate article's contents, provided the author's and Journal of Accessibility and Design for All's names are included. It must not be used for commercial purposes. To see the complete license contents, please visit http://creativecommons.org/licenses/by-nc/4.0/.
- JACCES is committed to providing accessible publication to all, regardless of technology or ability. Present document grants strong accessibility since it applies to WCAG 2.0 and PDF/UA recommendations. Evaluation tool used has been Adobe Acrobat® Accessibility Checker. If you encounter problems accessing content of this document, you can contact us at jacces@catac.upc.edu.