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Accessibility analysis in MOOC platforms. A case study: UNED COMA and UAb iMOOC

Francisco Iniesto, Covadonga Rodrigo
Department of Computer Languages & Systems
School of Computer Science, UNED
Madrid, Spain
finiesto@gmail.com, covadonga@lsi.uned.es

António Moreira Teixeira
Universidade Aberta & Centre for Philosophy - University
of Lisbon
Lisbon, Portugal
Antonio.Teixeira@uab.pt

Abstract— This article has come about as a result of joint work between the Universidad Nacional de Educación a Distancia (UNED, Spain) and the Universidade Aberta (Portugal), pioneering universities in the development of MOOC platforms with pedagogical approximations different from the xMOOC and cMOOC models. The work has been centred on the analysis of the degree of accessibility of both platforms from the point of view of the User Centred Design for which tools suitable for this purpose such as eXaminator and aDesigner have been used.

Keywords— Accessibility, MOOC courses, UAb iMOOC, UNED COMA

I. INTRODUCTION

Virtual platforms have given rise to a wide range of educational resources such as the distribution of documentation, audio and video, videoconferences, electronic books and other multimedia resources. Since 2005, initiatives at a global level of learning, helped by mobile and social technologies, have been extended [1] [2]. In this sense the change from closed educational platforms to open learning environments, such as the case of MOOCs (Massive Open Online Courses) have been nothing more than the evolution of open education on the Internet that have made it possible for thousands of people to follow different educational initiatives [3] [4]. However the quality of the education has not been guaranteed by the use of new technologies but that any new teaching methodology through the Internet supposes both a technological change and qualification for all of the participating agents.

Although there exists a recent taxonomy of different types of MOOC [5], several authors [6, 7] clearly differentiate between those which can be considered as 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. G. Siemens [8], 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.

The xMOOCs (extended) are based on already existing university courses and reflect a more traditional training focus [9] in the transmission of information 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 review. The methodology proposes that the monolithic thematic blocks 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 totally necessary for the student to become an active participant when looking for and creating appropriate learning content and to always be 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 said process [10].

In this sense, a basic characteristic of MOOC courses, independently of its type, is the high degree of interactivity that it facilitates and reinforces the bidirectional communication between the students and the mediators. In MOOC courses the figure of the teacher is less present than in classroom training or eLearning, at least in the traditional conception. In effect, in open courses the functions of the "tutor" figure are being permanently updated: reference is made to the pedagogical mediation, to the "mediator", "counselor", "assessor", "facilitator" of the learning processes." Therefore, the academic figure in the MOOCs is likened more to community managers, acting within the communities that come about as content curators or helpers for the acquisition of digital facilitators. This requires a greater commitment from the student in self-learning, research and analysis as well as reflexive capacity together with a high component of personal autonomy.

The following section goes more deeply into the considerations of accessible learning in these types of courses in order to later show the underlying architectures in the two platforms chosen for evaluation. After that, the evaluation process carried out and the main conclusions of the study are detailed.

Fig. 1. Page from the "Estado del course Spain+Francia+Cerca I " course from UNED COMA



II. ACCESSIBLE MOOC LEARNING

A recent study carried out by the *Fundación Vodafone Spain* [11] shows the possibilities that Information and Communications Technologies (ICT) offer people with disabilities to improve their wellbeing and the possibility of their insertion into the work market. Among the main conclusions of the report it is pointed out that 100% consider that the incorporation of ICT into the workplace has increased their work possibilities.

In Europe, the access and integration process for people with functional diversity in the education system is positive and irreversible. In Spain, the number of students with a disability that use support products and/or require adaptations to be able to enjoy the use of higher education resources is increasing every year. There is a growing proportion of these students who have an officially recognised disability who choose distance education universities for their studies (for example, the enrolment at the UNED was 8,068 students in the 2012/2013 academic year, approximately 50% of university students with a disability in Spain). These students look for the so-called permanent learning or lifelong learning paradigm, which integrates education, work and personal life in a continuous process and allows the citizens to be able to access the knowledge and develop it both personally and through work.

The flexibility of the learning through MOOC-type courses allows obstacles of time, space and rhythm to be overcome just as in any e-learning context, as well as promoting the continuous communication and interaction between all of the participants of the social and constructivist process. Furthermore, it is precisely the MOOCs that can reach global audiences, and in this context it is essential that they bear in mind that it is the groups of the most vulnerable potential users that may be left behind in the Knowledge Society [12]. These courses may bring the training closer and facilitate it both freely and openly to people with motor or sensorial difficulties and those who have problems in travelling.

However, it must not be forgotten that access to MOOCs may suppose an added difficulty, due, among other reasons, to

the need to develop specific and changing skills. The introduction of audiovisual content and interactive elements (test, self-evaluations, etc.) in these courses adds a new difficulty to the accessibility requirements, since new elements are included which widen the digital breach, and not just for people with a disability.

Therefore, in order to achieve the minimum required level of accessibility in this type of platform, two significant aspects will have to be taken into account:

- Make possible and guarantee access to the content by means of the platforms.
- Produce the content accessible in itself: in this sense, add locutions, alternative content in the form of subtitles, audio description, etc. also aiming to satisfy basic usability aspects both graphical and visual, and respecting the most accessible font types and sizes, optimal levels of contrast, etc.

The analysis of the achievement of these aspects is the objective of this work, which has been circumscribed to the study of some of the MOOC platforms available in Europe [13] offered through the OpenUpEd.eu¹ portal, specifically, those provided by two institutions participating in this research: UNED COMA and UAb iMOOC.

III. THE MOOC PLATFORMS: UNED COMA AND UAB iMOOC

The UNED COMA platform "Fig. 1" is the first free platform of MOOCs in Spanish which allows the creation and management of massive courses in an autonomous, simple and intuitive way and which has its own system of quality [14]. It has been developed on OpenMOOC, an open code platform (Apache 2.0 licence) with the perfect integration of videos, documents and the observations of the teachers. It provides information on the progress through self-evaluation, and the students exchange knowledge by means of debate forums. It also has the possibility of providing follow up to student questions or those of other users. Likewise, the system automatically assigns a series of badges that evaluate the different skills associated to the social behaviour of the students in the forum and are assigned to their karma (or social profile) and can appear on their certificate.

The main characteristics of the UNED COMA architecture are:

- Identity provider. It manages the users. It is based on SimpleSAMLphp.
- Mootools. Is the motor of the platform. This module allows the teachers to create, manage and deliver the courses to the students. It is written in Python/Django.
- Askbot. This is a Q&A component written in Python/Django. It is the main means of communication between teachers and students.

¹ <http://www.openuped.eu/>

Fig. 2. Page from the "As alterações climáticas - or contexto das experiências de vida" course from UAb iMOOC



The Universidade Aberta has developed its UAb iMOOC environment “Fig. 2” through the integration of two software platforms: Moodle (development of on-line courses) and Elgg (training of communities of users). Instead of relying on the personal learning environments of the participants in the social context, the selection has been the use of Elgg, a platform of open source social networks totally integrated with Moodle by means of a single system to begin the session. Moodle (in version 2.4) is used to centralise the main information on the content, the resources, the suggested activities, timetable, etc. and it also houses the discussion forums. Elgg is a platform of open source social network services, which facilitates the training of communities, the work on the network with the exchange of archives and the collection of news via content aggregators. Everything may be shared between users, using access controls and can be catalogued by means of labels. It has a variety of web 2.0 tools and social network functionalities, enriched profiles, micro blogging, blogs, social markers, photo and video editing, recommendation systems, wiki-like pages, etc.

The UAb iMOOC architecture is defined in the following points:

- Identity provider. It manages the users.
- Moodle (version 2.4). This is the motor of the platform. It allows the teachers to create, manage and deliver courses. It is written in PHP 5 and is used to centralise the main information (content, resources, suggested activities, timetable, etc.) as well as the discussion forums, where the participants can interact with and debate relevant aspects.
- The Elgg community. This component is written in PHP. It is an open source, social network platform which offers the users their own weblog, archive repository, an on-line profile and an RSS reader. Furthermore, all of the user content can be labelled using key words so that they can connect with other

users with similar interests and create their own personal learning network.

The pedagogical conception of the MOOCs in the UAb is typified as iMOOCs [15] with a focus on individual responsibility, interaction, interpersonal relationships, innovation and inclusion. The model defines a set of pedagogical regulations dedicated to the specific type of educational program or course and although each version has different characteristics, all of them share a common pedagogical identity based on the articulation of the program into four principles: user centred methodology, flexibility, interaction and digital inclusion.

IV. WHAT MUST THE MODEL OF THE ACCESSIBLE MOOC PLATFORM BE?

The objective of guaranteeing the participation of all of the students in the virtual classroom of the MOOC is both a didactic and technical task, which means guaranteeing the following conditions:

- The receiver of the MOOC is a student, therefore it is necessary to evaluate the access conditions, the knowledge and the handling of the technological platforms. In the case of access, it will have to be previously guaranteed that the registering procedure (if there is one) also complies with the minimum accessibility requirements.
- The technological platform. The degree of usability of a series of Web services offered to the student will depend on the design of the user interface, of the interaction with the computer, and even the graphic design of the content.
- The electronic format of the educational resources is determined, as is the way in which the student will download it and whether they are interactive elements or not. The content of the MOOC must be the same for all of the students, although the presentation is different.
- The students must be able to access the content using assistive technologies and adapt their presentation in accordance with the specific needs.
- It is necessary to offer alternative textual descriptions for multimedia content (such as images or videos).
- Assistance must be provided to those students who have encountered problems or barriers to accessibility.

It would be desirable to know the specific needs of the students, according to their functional diversity, since a document may be presented in different formats or the graphic interface of a platform may be adaptable to a visualization device, although they are not all equally accessible. However, the enrolment into an open course itself is usually quite anonymous and there is no access to the said personal information.

V. METHODOLOGY FOR THE ANALYSIS OF ACCESIBILITY

It is decided to follow the methodology for the analysis collected in works and already published guides [16], [17] and [18] for which a selection is made of a set of Web pages as a

representative example of each of the platforms: on the one hand of the "Spain+Francia+Cerca I" course of UNED COMA and "As alterações climáticas - o contexto das experiências de vida" de UAb iMOOC. The evaluation tools used have been:

- eXaminator that carries out the automatic evaluation
- aDesigner that carries out evaluations in terms of simulation to complement the results.

The applicable regulations are the accessibility guidelines for Web WCAG 2.0² content.

A. Evaluation through automatic tools

The WCAG 2.0 guidelines are organised in 4 basic principles for the accessibility of the content: Perceptible, Operable, Understandable and Robust. These principles are important for the carrying out of the automatic validation following the WCAG 2.0 guidelines for which the eXaminator online test has been implemented to all of the selected pages. The eXaminator tool adjudicates a score of between 1 and 10 as a rapid indicator of the accessibility of the pages and at the same time incorporates values in accordance with their impact on a series of user profiles. The individual values serve to obtain a qualification for each of the profiles and the final qualification of the page is obtained from the 5 partial qualifications "Fig. 3" corresponding to the limitations:

- Total limitation in seeing
- Serious limitation in seeing
- Limitation of the higher members
- Limitation in understanding
- Limitations derived from age

Fig. 3. Use of eXaminator in a page from the "As alterações climáticas - o contexto das experiências de vida" course from UAb iMOOC



This tool provided different scales to the set of tests carried out, with those points that have been applied in a correct and regular way being considered as excellent, bad and very bad to those which have accessibility problems according to the guidelines, the final offers a score calculated as a weighted scale. The results can be seen in Table I.

It is seen that both platforms have a large number of very bad or critical errors which leads to them obtaining a lower

score. In some cases, it is the home page of the course that suffers from critical accessibility problems. These pages are compulsory for any student to access and should be, conceptually, the first to be accessible.

TABLE I. AUTOMATIC VALIDATION RESULTS

UNED COMA	Excelent	Regular	Bad	Very Bad	Score	Compliance
Beginning UNED COMA	7	1	3	2	6,6	53,8%
Methodology	7	2	0	1	7,7	70%
FAQ	7	0	3	2	6,8	58,3%
Communiques	7	2	2	2	6,7	53,8%
Course Beginning	7	1	4	3	5,9	46,6%
Debates	6	2	4	1	6,2	46,1%
Average Value					6,6	54,7%
UAb iMOOC	Excelent	Regular	Bad	Very Bad	Score	Compliance
Beginning UAb iMOOC	7	6	4	5	4,8	31,8%
Courses	8	3	1	4	5,8	50%
Activity	8	3	1	5	6,1	47%
FAQ	9	4	2	4	5,8	47,3%
Blogs	9	4	2	4	5,9	47,3%
Favorites	9	4	2	4	5,9	47,3%
Files	9	4	2	4	5,9	47,3%
Groups	9	3	3	3	6	50%
Members	9	3	2	3	6,2	52,9%
Average Value					5,8	41,5%

On closely observing the positive results obtained, it must be highlighted that both applications share many points such as:

- There are link elements for surfing.
- Heading elements and attributes are used.
- Elements to control the visual presentation are not used.
- The main language of the page is identified with the code "en".
- The page has a "title" element.
- The forms have a send button.
- The images have a textual alternative.

As regards the negative results some similarities can be found such as:

- There are links with the same text but different destinations.
- There are "iframe" without "title" elements.
- The first link of the page does not take you to the main content of the page.
- Absolute values are specified for the font size.

However, there are more differences in relation to other errors that appear as a general rule in the pages analysed. Thus, in the case of UNED COMA:

- There are images without textual alternatives.
- There are no links to leap blocks of content.

² World Wide Web Consortium W3C, Web Content Accessibility Guidelines (WCAG) 2.0, 2008

And in the case of UAb iMOOC some of these problems appear assiduously:

- There are form controls without associated labels or a "title" attribute.
- Text justified in the CSS is used.
- The headings are not added correctly.

The particular evaluations obtained in both platforms with the eXaminator tool are presented in "Table II", detailing every profile analysed.

TABLE II. RESULTS DIFFERENTIATED BY FUNCTIONAL LIMITATION.

UNED COMA	totally blind	difficulty in seeing	members	Understanding	age
Beginning UNED COMA	7,2	6,4	6,9	5,7	6,5
Methodology	7,8	7,7	6,9	8,1	8,5
FAQ	7,4	6,5	6,5	6,5	7,1
Communicues	7,1	6,6	6,9	6,2	6,5
Course Beginning	6,5	5,7	5,8	5,3	6,0
Debates	6	6,5	6,6	5,8	6,1
UAb iMOOC					
Beginning UAb iMOOC	5	4,9	4,9	4,3	5
Courses	5,8	6,1	5,3	5,6	6,1
Activity	5,8	6,6	5,9	5,9	6,3
FAQ	5,7	6,1	5,9	5,4	5,9
Blogs	5,8	6,2	6,0	5,5	6,0
Favorites	5,8	6,2	6,0	5,5	6,0
Files	5,8	6,2	6,0	5,5	6,0
Groups	5,9	6,3	6,1	5,6	6,1
Inicio UAb iMOOC	6,2	6,5	6,1	5,8	6,3

It can be proven that both in UNED COMA and in UAB iMOOC the lowest scores are related to the limitation in understanding, the most determinant problems being found in the UAb iMOOC platform related to the total limitation in seeing (blind users).

B. Evaluation through a simulator

aDesigner has been used in order to carry out this evaluation simulating disabilities as it is a disability simulator which helps the designers to guarantee that the content and the applications are accessible and usable to people with a visual disability. Simulations were made in the different pages following two simulation options "Fig. 4":

- Blind person simulator.
- Simulator for people with reduced vision.

In carrying out the tests for the blind person simulator, the tool itself advises whether the majority of pages comply with the necessary guidelines carrying out some modifications and that the structure of the page is good enough to be operated by blind users. Of the problems encountered, some of them have already been detected by the automatic tool. In the case of UNED COMA, problems are:

- Images without the "alt" attribute.
- The page has several "body/html" elements.

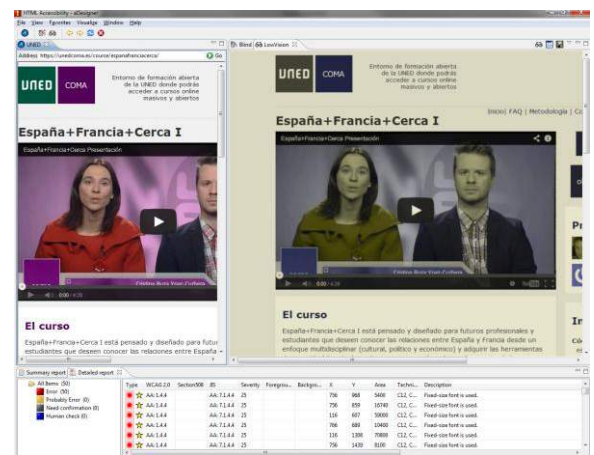
For UAb iMOOC mainly:

- Lack of attribute or label to identify the form.
- Avoid the use of implicit labels.

Found in common on both platforms:

- "iframe" element without title.
- Use of redundant textual information.

Fig. 4. Use of aDesigner in a page from the "Spain+Francia+Cerca I" course from UNED COMA



The automatic simulator of people with reduced vision details that there are problems in the distinction of colours. In this case, both MOOCs platforms converge in the detected errors which are mainly:

- The combination of background and text colours is difficult to distinguish.
- Too small fonts and with a fixed size.

Due to all of this, some recommendations can be made to improve the accessibility in both environments which are difficult to achieve:

- Improve the combination of colours and avoid the use of fixed fonts.
- Avoid the redundancy of information in the texts and links with the same text but different destinations.
- Correct the abundant existence of "iframe" elements without "title".

VI. RESULTS AND CONCLUSIONS

The importance of MOOC courses lies in the possibility of bringing close and facilitating a free and training which is open to global collectives of people, at the same time offering quality of training in a learning environment which supports

the intensive use of ICT. UNED COMA and UAb iMOOC are two innovative MOOC platforms in their respective countries in the area of this new type of learning which offers great possibilities to university teaching and to many vulnerable collectives of students such as people with a functional diversity.

Unfortunately, the preliminary analyses shown in this work demonstrate that serious problems have been found in this collective accessing the education facilitated in this type of platform. Observing the last column of "Table I", it can be seen that both platforms obtain average results of between 6 and 7 which are very improvable.

Likewise, it is interesting to observe the percentage of compliance with the guidelines for WCAG 2.0 accessibility calculated on the number of hits (Excellent) on the total number of tests carried out. Both platforms have different average values but none of them achieve values that could be considered reasonable (higher than 60%) and that the lowest results on both platforms derive from the difficulties in the limitation tests on understanding the written texts and in general the navigation. The UNED COMA platform seems to be the best prepared for the students with vision difficulties.

With the aim of overcoming these barriers, it is necessary to continue with the digital literacy of these collectives and achieve a follow up of the scope of the MOOCs among others. Europe has a long tradition in the establishment and evaluation of related indicators and the new OpenUpEd.eu portal in which the courses evaluated in this article are inscribed will be able to provide additional indicators, as well as measuring the success rate of the students belonging to vulnerable groups.

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