An investigation into the perspectives of providers and learners on MOOC accessibility

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ABSTRACT

An effective open eLearning environment should consider the target learner's abilities, learning goals, where learning takes place, and which specific device(s) the learner uses. MOOC platforms struggle to take these factors into account and typically are not accessible, inhibiting access to environments that are intended to be open to all. A series of research initiatives are described that are intended to benefit MOOC providers in achieving greater accessibility and disabled learners to improve their lifelong learning and re-skilling. In this paper, we first outline the rationale, the research questions, and the methodology. The research approach includes interviews, online surveys and a MOOC accessibility audit; we also include factors such the risk management of the research programme and ethical considerations when conducting research with vulnerable learners. Preliminary results are presented from interviews with providers and experts and from analysis of surveys of learners. Finally, we outline the future research opportunities. This paper is framed within the context of the Doctoral Consortium organised at the TEEM'17 conference.

CCS CONCEPTS

• **Information Systems** → User/Machine Systems; *human factors; human information processing* • **Information Interfaces and Presentation** → User Interfaces; s*tandardization; prototyping; user-centered design* • **Computers and Education** → Computer Uses in Education: *Collaborative learning; Distance learning* • **Computers and Society Issues** → Social Uses; a*ssistive technologies for persons with disabilities; handicapped persons/special needs*

KEYWORDS

Accessibility, MOOC, mixed-method research, audit, guidelines

1 CONTEXT AND MOTIVATION

Massive open online courses (MOOCs) have emerged as a popular mode of learning that is now being widely-researched as a development in distance education. MOOCs offer materials such as video lessons, readings, peer to peer activities, provide interactive user forums to support community interactions among learners, educators and facilitators.

The need to incorporate greater access in Open Education and MOOCs for those who declare disabilities is a factor being highlighted [1, 2]. There is a growing proportion of disabled learners who choose distance education institutions for their studies [3]. Furthermore, evolution in the enrollment of these learners in distance learning universities demonstrates that these students look for the lifelong learning paradigm, which integrates education, work and personal life in a continuous process and allows them to be able to access the knowledge and develop it both personally and through work [4]. If accessible, MOOCs have the characteristics to provide an appropriate mode of study for disabled learners. However, there is a lack of research about what educators and disabled learners expect from MOOCs [5].

For this doctoral project, we are employing a mixed methods-research programme to understand the complexity of the issues related to disability and MOOCs. In qualitative studies involving interviews, we have explored learner expectations and educators' viewpoints on how MOOCs can be valuable for disabled learners; and quantitative analysis of survey data has provided an understanding of the demographics of disabled learners who take up MOOCs. To assess the current state of MOOC accessibility, we are designing a MOOC accessibility audit to evaluate MOOCs. This mixed methods research approach will yield guidelines for the design of MOOC platforms that meet the needs of disabled learners.

2 STATE OF THE ART: ACCESSIBILITY AND MOOCS

To understand issues in MOOC accessibility, we need to draw on research on accessibility and Open Educational Resources (OERs), since MOOCs have similar qualities in terms of openness adding their own factor of massiveness. There is a consensus that there is a need to address accessibility features of platforms where OERs are deposited, and open educational repositories should be designed with accessibility in mind [6]. A study supported by the Support Centre for Open Resources in Education (SCORE) project [7] identified that accessibility of OERs can be enhanced by relatively simple strategies, such as the use of accessibility features embedded within software packages. European Unified Framework for Accessible Lifelong Learning (EU4ALL) was a major collaborative project [8], which highlighted the importance of adapting online learning resources for all, and stressed the need to make accessible content available. Problems regarding access to LMS (Learning Management Systems) from the registration or login process and difficulties for user interaction with learning resources such as forums and documents have been reported [9, 10].

While conducting the literature review we have observed that there has been limited research focused on the accessibility of MOOCs. The research papers can be clustered into five groups depending on the research methods applied (Table 1):

Table 1: Clusters of papers in the literature review and references

Cluster	References
User-based empirical studies: qualitative methods based on observation.	[11, 12]
Heuristic evaluations: Accessibility evaluation through evaluation tools and experts.	[12 – 16]
Online surveys: quantitative data from surveys.	[17, 18]
Integrating accessibility aspects within the technological infrastructure of MOOCs or adapting the legal framework.	[19 – 25]
MOOCs as an approach to teaching accessibility	[26, 27]

The studies using a qualitative approach tend to use very small samples and apply to just one group of disabilities such as vision impairment. Studies using quantitative methods tend to focus on just one platform. Heuristic evaluations against a set of guidelines or heuristics take the form of technical reports that do not usually include user-based approaches. For a complete understanding of the problems that happen in MOOCs, the methodology should try to include the widest possible set of disabilities and the combination of different methods. The literature also omits studies related to 'learning' interests of learners with disabilities in MOOCs. Studies that focus on current accessibility state in MOOCs are few and don't provide clear guidelines on how the accessibility can be improved.

3 PROBLEM STATEMENT AND RESEARCH QUESTIONS

The goal of this doctoral research project is to identify the accessibility issues in MOOCs and to derive guidelines to improve their accessibility. Accessible MOOCs have the potential to give the flexibility of learning and benefits to all irrespective of their disability. As Seale [28] argues, we need to understand the multiple viewpoints of stakeholders in accessibility practice, such as those of educators who design materials and facilitate learning, and of technologists who develop and maintain platforms. It is, therefore, essential to identify how these stakeholders can be involved in achieving accessibility in MOOCs.

There is a lack of understanding of what educators and disabled learners expect from MOOCs. Typically, disabled learners can face difficulties in accessing and using the distinct types of technology that they come up against, causing limitations in their usage of information and communication technologies (ICT) [29], which is effectively digital divide, causing them to miss out on opportunities offered by MOOCs [30]. In recent studies, it has been shown the lack of accessibility and the scope for improvement exist in MOOCs [31, 32].

For this programme three main research questions were developed and iterated:

- RQ1. How do MOOC providers cater for disabled learners?
- RQ2. What are the expectations of disabled learners when taking part in MOOCs?
- RQ3. How can MOOCs be made accessible for disabled learners?
    - RQ3 a. What is the current state of accessibility of MOOCs?
    - RQ3 b. Which aspects of accessibility in MOOCs could be improved and adapted?

4 METHODOLOGY

Considering the different reviews of literature in the field of MOOC research, Liyanagunawardena et al. [33] analysed 45 publications from 2008-2012. In most of these studies, online surveys were used to collect data from MOOCs participants; some researchers also reported collecting data via email interviews, focus groups, logs in the platform data, discussion forum data, blogs, and observations. Veletsianos and Shepherdson [34] focus on the most recent literature, 2013-2015, with 183 publications. In their analysis, they comment that researchers favoured a quantitative approach to the conduct of MOOC research, and that survey data and secondary data collected via automated methods dominated the analyses. Very few studies were informed by methods traditionally associated with qualitative research approaches such as interviews, observations, and focus groups – involving direct participation of end-users. Gasevic et al. [30] indicate that use of mixed methods is an optimal approach to research which will recognise the magnitude of complexity of the issues related to MOOCs.

We have considered a mixed method approach in this doctoral project. Mixed methods research is appropriate when a study's purpose and research questions warrant a combination of quantitative and qualitative approaches [35]. In our research design, we have included research methods that require the opinion from stakeholders [28]: those who develop the MOOCs and provide the MOOC platforms, disabled learners and propose to undertake expert evaluation of the platforms. Qualitative studies can help identify learner expectations and establish the position of educators on how MOOCs can be helpful to disabled learners. Quantitative studies are used to understand the demographics, interests and

expectations of learners. The MOOC accessibility audit that we are proposing for 'expert evaluation' can help to detect the main problems and try to find solutions and adaptations that can meet user needs.

Interviews will help to understand the point of view of MOOC providers and disabled learners (RQ1 and RQ2) and the way accessibility could be improved and the resources adapted to their needs (RQ3). Data from online surveys (that we have access to) will help to have a more general understanding of demographics and the learners' expectations (RQ2). Finally, the MOOC accessibility audit will seek to improve understanding of the current state of MOOC platforms and courses and how they may be improved (RQ3). This mapping between research questions and methods is shown in Fig. 1.

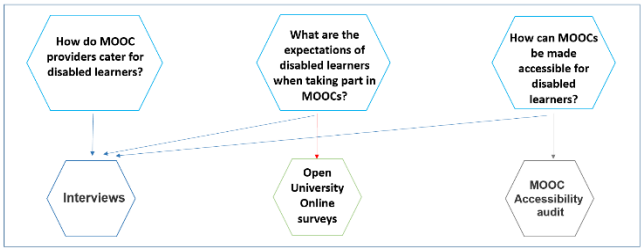

Figure 1: Methods and research questions

We consider the consequences of having different samples when merging quantitative and qualitative methods [36], the combination of methods will allow triangulation, understood as a validity checking and as a way of seeking complementary information.

4.1 Study A: The perspectives of providers

An interview study with 26 participants was conducted to understand the perspectives of MOOC providers on accessibility [37]. Participants in these interviews worked across several roles, including the MOOC producers, who include platform and course providers, and researchers in the MOOC community (as seen in Table 2).

Table 2: MOOC provider's sample structure

Technical specialists	• Software developers • Digital designers • Technical program managers
Accessibility specialists	• Accessibility managers • Inclusive Designers
Course teams	• Educators • Instructional designers • Curators • Facilitators
Educational content specialists	• Course editors • Learning media developers
MOOC researchers	• Accessibility • eLearning quality • Learning analytics • Open education • Self-directed and mobile learning • Universal Design for Learning

This set of interviews was designed to elicit the perspectives of MOOC providers on the importance of accessibility in MOOC production [38, 39]. Interviewing individuals involved in the MOOC production helps to understand how they cater for disabled learners (RQ1); their current approaches to the accessibility of MOOCs and the approaches they are using to adapt the content for disabled learners (RQ3). The semi-structured interviews focused on three main topics corresponding to the research questions:

- Data availability and knowledge about disabled learners.
- Accessibility from the perspective of course providers and design of accessible MOOC platforms.
- MOOCs and adaptation - how the content is adapted for disabled learners.

The recruitment process was conducted via email to MOOC providers and experts around the world. This study has been designed in two phases, the first phase of 12 interviews carried out and analysed to understand the problem, consider initial results and identify gaps. The second phase of interviews then sought to more comprehensively understand the MOOC providers' perspectives. These interviews were online (through audio or videoconferencing tools) or face-to-face depending on the interviewee location. All the interviews were audio recorded.

4.2 Study B: The perspectives of learners

The Open University has standardized pre- and post-course surveys in their FutureLearn [1] MOOCs. The surveys include questions related to disabilities and about their educational interests and goals. The second study focused on learners, involving interviews and analysis of online pre- and post-course survey data of FutureLearn MOOCs. This is in progress at the time of writing this paper. Survey data from 14 Open University MOOCs from 2013-2015 in FutureLearn are analysed to provide insights into how MOOCs can help disabled learners that are already participating in MOOCs (RQ2). Table 3 shows the different topics covered in the pre- and post-course survey of interest for this research. These topics also helped to develop a profile for those learners who are being approached for interviews.

Table 3: Topics covered in the pre-and post-course survey

Pre-Course survey	• Areas of interest and expectations (interest in the course, subject areas interested in online courses and MOOC platforms) • Demographic information (gender, age, mother tongue, employment status, disabilities)
Post-Course survey	• Learning outcomes (previous knowledge and knowledge acquired) • Completion • Devices used and location • MOOC structure and interactivity (clarity and activities) • Learning experience • Educators (feedback and support) • Evaluation (rating the experience)

A set of disabled learners who had responded to the survey and were willing to be contacted for research purposes have been approached by us for an interview. These semi-structured interviews are being conducted to understand the expectations of

[1] FutureLearn: https://www.futurelearn.com/

disabled learners from MOOCs (RQ2) and the current barriers they experience in their learning due to 'inaccessible' design of MOOCs and how improvements could be made to improve their learning experience (RQ3).

To develop this set of interview-participants, we have focused only on the survey respondents who have taken MOOCs in 2015, as this is the most recent data that is available to us. We have analysed their pre- and post-course surveys before conducting the interviews with individual participants. In addition, we ask them to fill out a short online pre-questionnaire prior to the interview with some questions elaborating on the survey data – for example, their interest in participating in a MOOC and barriers or challenges in their learning.

With the information gathered via the survey and some concrete questions related to interests and accessibility issues, a profile of the learner is created prior to the interview to help further focus the semi-structured interviews. Interviews with learners are either online with audio recording or through text-based with a written record.

4.3 Study C: MOOC accessibility audit

Study C will follow studies A and B and is currently in the design stage. A MOOC accessibility audit gives the opportunity to assess the accessibility state in MOOCs and their platforms and provide indicators of the accessibility issues that occur and how the educational content may be adapted to learners needs. Therefore, to determine the current state of accessibility in MOOCs (RQ3), we are proposing to develop an audit instrument that will combine expert-based heuristic evaluations focussing on universal design with user-based evaluations [40].

Accessibility of websites can be assessed through several methods such as conformance reviews, user testing, subjective assessments and screening techniques [41]. As different accessibility evaluation methods (AEM) lead to diverse types of results that reveal various levels of quality, we are planning to employ complementary methods. The proposed audit will combine the methods of conformance reviews, screening techniques and user evaluations [42]:

- **Evaluation through accessibility tools.** The audit includes automated checking of conformance to guidelines or standards (tools for automated accessibility checking) [40]. It is important to consider the weaknesses automated accessibility tools have [43]; therefore, a combination of several ones is significant to enhance their strengths and to overcome the weaknesses.
- **Evaluation of usability and user experience via heuristics.** The evaluation criteria will include usability and user experience characteristics alongside accessibility of the user interface design (heuristic evaluation) [40, 44].
- **Educational content evaluation**. It is important to consider the accessibility of conceptual content of the educational resources within a MOOC based on learners' profiles and disabilities while considering, the pedagogical objectives of the resources and accessibility characteristics of the pedagogical design. Therefore, we will include in this evaluation the Universal Design for learning guidelines and checklist [45].

The accessibility audit will consist of guidelines that will address the accessibility state of MOOC platforms and their courses (RQ3a). The outcome of the MOOC accessibility audit will provide recommendations for improvement and adaptations of MOOCs for disabled learners (RQ3b).

4.4 Risk Management and ethical considerations

While designing the overall methodology, risks that should be considered include the lack of commitment in MOOC learners [46]; and that MOOCs need to be understood as open resources where learners have the right to remain anonymous. This makes it difficult to know the real proportions of learners taking part into MOOCs [47]. Further, in research that involves vulnerable participants, the recruitment can require considerable time [48]. There are ethical considerations that are particularly significant when conducting research with disabled learners: for example, to make the research methods accessible to a range of needs, providing accessible documents and accessible online resources to the learners.

Esposito [49] indicates the evolving principles of online research ethics, within which it is worth locating an ethical decision-making process focussed on e-learning, and more specifically in open educational environments and MOOCs [50]. In this project, we are following BERA ethical guidelines [51]. Ethical approval for research using human participants has been granted by the Open University Human Research Ethics Committee.

5 RESULTS TO DATE

We have so far conducted study A and partially Study B. We will to carrying out study C in the next few months. Preliminary results from the research are explained in this section.

5.1 Study A: The perspectives of providers

As explained in the previous section we have conducted a set of interviews including accessibility content managers of MOOC platform providers, platform software developers/designers, educators and those with a range of expertise in the MOOC community. Some of these are results are available in [52].

The semi-structured nature of the interviews enabled us to expand on the interviewee's comments during the interview. An inductive approach for coding the interviews was followed on the complete transcripts of the interviews [53]. The transcripts were read and annotated using the six-phase methodology by Braun and Clarke [54].

In the analysis of the first set of interviews, we identified a lack of data about disabled learners, either via building profiles of their needs or asking for information during registration processes. The potential use of this data, if it existed, has previously been identified [55]. The interview-analysis indicates that MOOCs are not an exception. It is a matter of concern that the concept of learning design was not commonly raised in the discussion on meeting accessibility needs, even though there is legislation around this commitment.

After the first set of interviews, we have conducted 14 more interviews to fill the gaps discovered during the analysis of the first set. These interviews have involved: educators or content creators who are responsible for thinking about accessible content and formats; domain experts in the areas of learning analytics, the self-directed learning and eLearning quality, and stakeholders who influence the design, development and evaluation of MOOCs. All

data have been transcribed and the resultant codes from the thematic analysis are shown in Table 4. The results have been collated using NVIVO[2] qualitative analysis software. There are six key themes:

- **Organisational accessibility processes.** Structural processes of the organization: how to work the barriers to learning, testing, production of the materials, improvements, training and protocols
- **Legislation and Standardisation.** International legislation and standardisation of accessibility
- **Stakeholders.** All the bodies that are part in the management of MOOCs
- **MOOC educational enablers.** The educational bits and external factors that enable the learning through MOOCs
- **Disabled Learners and MOOCs.** Benefits for disabled learners and data got from the MOOC providers
- **MOOC learning processes.** The processes that include pedagogical and educational approaches which affect the learning in MOOCs

Table 4: Themes derived from thematic analysis of the data

Theme	Sub-themes
Organisational accessibility processes	1. Accessibility protocols and UX guidelines 2. Improvement of barriers to learning 3. Accessibility testing, audits and current state 4. Content adaptation, learner profiling and recommendation 5. Production of educational materials 6. Inform accessibility state to learners 7. Accessibility training 8. Report and feedback on barriers to learning 9. Analytics and Quality assurance
Legislation and Standardisation	1. Standardisation 2. Legislation
Stakeholders	1. Platform Providers 2. Course team 3. Learners 4. Course Providers 5. Educational content 6. Specialists 7. Accessibility and technical specialists
MOOC educational enablers	1. Lessons (Video, Podcast and Text) 2. Files 3. Third party software 4. Images 5. Platform design 6. Activities (Forums, Quizzes, P2P activities) 7. Internet connection
Disabled Learners and MOOCs	1. Understanding of learners 2. Value added
MOOC learning processes	1. Learning and pedagogical design 2. Openness 3. Learner experience and effective learning 4. Cultural diversity, language and digital literacy 5. Massiveness 6. Certification 7. Self-directed learning

These themes suggest that the responsibility of creating accessible content falls on the design and development teams. Accessibility is not always included in the routine design and development decisions for the content of MOOC. Legislation and standards play a predominant role in the development of accessible MOOCs rather than the requirements of disabled learners although the interviewees do acknowledge that MOOCs can be valuable for disabled learners if they are accessible.

5.2 Study B: The perspective of learners

Data from the existing surveys provide insights into the disabled learners who are participating in MOOCs, the subjects they prefer, and their state of satisfaction with the MOOCs. As reported in [56], we have explored data from 8 MOOCs (from the total of 14). The MOOCs selected are from 2015 (the most recent ones in the sample) and cover a range of subjects. In the pre-course survey, we analysed these questions:

- Interest in the MOOC from the response to 'Why are you interested in studying this course?
- Subject areas of interest from the response to 'Which of the following subject areas are you interested in?'
- Previous experience with online courses from response to 'What sort of online course have you taken?

Preliminary analysis shows that the proportions of disabled learners that take part in MOOCs and respond to these surveys are lower than the disabled population. In comparison with other learners, disabled learners are particularly interested in taking up MOOCs to determine if they can study at a higher educational level, or to link the knowledge acquired during the MOOC to voluntary work (Fig. 2). Disabled learners tend to have greater previous experience in online courses that allow them to get university credit, which appears related to their interest in studying at a higher educational level.

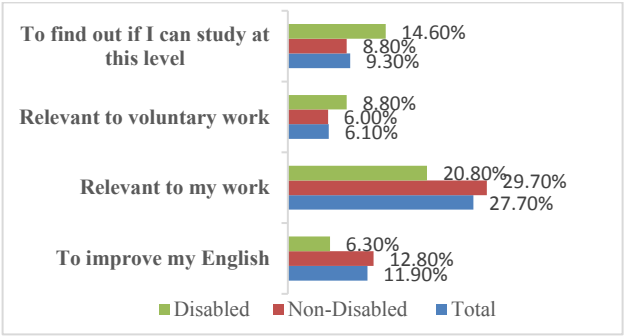

Figure 2: Interests of disabled and non-disabled learners in MOOCs

Learners declaring a disability have less experience of participating in online courses for continuing professional development when compared to the rest of the survey population. In the same context, disabled learners have more previous experience using OERs than MOOCs (Fig. 3).

At the time of writing this paper, the follow-up study of interviews is under way and a total of 8 semi-structured interviews with disabled learners have been conducted around these key areas:

- Accessibility and daily work, current state and improvements

[2] NVIVO: http://www.qsrinternational.com/nvivo-product

- Accessibility issues faced
- Barriers to learning issues
- Solutions and proactivity

- The expectations of disabled learners when taking part in a MOOC
- MOOCs and adaptation, how to show MOOC content to a disabled learner

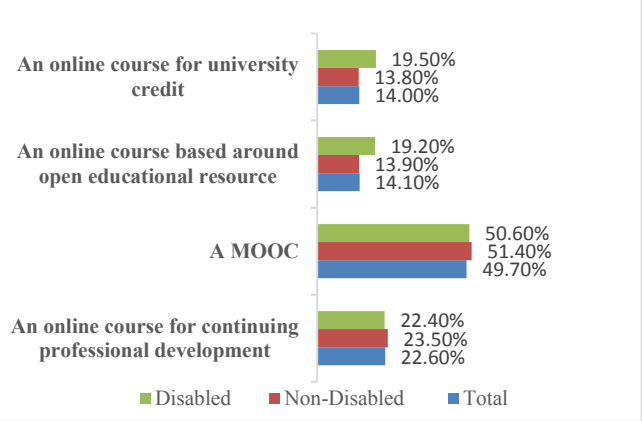

Figure 3: Previous experience with online

Further interviews are planned by the end of this year, to capture a broad range of perspectives prior to analysis.

6 CURRENT AND EXPECTED CONTRIBUTIONS

The combination of qualitative studies through interviews with MOOC providers and learners and the quantitative information provided by the MOOC survey data is providing a deeper and multi-faceted insight into learner accessibility needs when participating in MOOCs. As shown in a recent study [57] assessing the overall accessibility of content in online courses, the value of an automated process can help quantify the issues that need to be addressed. The MOOC accessibility audit will help to assess the accessibility of MOOCs early in the design and development process and before the MOOCs are launched by the providers [58].

These different studies will then help to develop guidelines and checklists to make MOOCs more accessible in developing the content and MOOC platforms, and how the content of MOOCs can be adapted for specific profiles of disabled learners [59, 60]. A recently published inclusive teaching and learning in higher education report [61] encourages higher education providers to care and offer support and develop an optimal environment for disabled learners. Therefore, MOOC and other educational providers will benefit from the outcomes from this research to help disabled learners who potentially can benefit from MOOCs and other open educational environments.

Moreover, this research includes the value of considering both provider and learner opinions. From the analysis of the MOOC providers' interviews, we have already identified some improvements that could help the processes of MOOC development such as the need to increase the effort in developing the skills of the course teams to create accessible content. Further, for development of accessible educational resources, clear accessibility policies are required in organisations. It is also important to have a focus on learners, as their preferences and requirements in learning design need to be included in practices, rather than aiming only to follow the minimum legal requirements.

The next steps of this research programme are to continue with the analysis of online surveys from Open University courses in FutureLearn. This will include a larger number of MOOC presentations, and disaggregate the data by the category of disability, and through demographics. Interviewing more MOOC learners, and developing the MOOC accessibility audit, are the next steps in the completion of the project.

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REFERENCES

[1] US Department of Justice. 2015. Justice Department Reaches Settlement with edX Inc. Retrieved August 2017, from http://www.justice.gov/usao-ma/pr/united-states-reaches-settlement-provider-massive-open-online-courses-make-its-content

[2] Inside Higher Ed. 2016. University May Remove Online Content to Avoid Disability Law. U.S. Retrieved August 2017, from https://www.insidehighered.com/news/2016/09/20/berkeley-may-remove-free-online-content-rather-complying-disability-law

[3] Kop, R. and Bouchard, P. 2011. The role of adult educators in the age of social media. In *Digital education* (pp. 61-80). Palgrave Macmillan US.

[4] Bühler, C. and Fisseler, B. 2007. Accessible e-learning and educational technology-extending learning opportunities for people with disabilities. In *Conference ICL2007, September 26-28, 2007,* pp. 11. Kassel University Press.

[5] Sanchez-Gordon, S., & Luján-Mora, S. 2017. Research challenges in accessible MOOCs: a systematic literature review 2008–2016. *Universal Access in the Information Society*, 1-15.

[6] Law, P., Perryman, L.-A., and Law, A., 2013. Open educational resources for all? Comparing user motivations and characteristics across The Open University's iTunes U channel and OpenLearn platform

[7] Gruszczynska, A.K. 2012. OER-related accessibility issues and their relevance to practices of repurposing/reuse: SCORE Fellowship Final Report. , (May), pp.1–7.

[8] McAndrew, P., Farrow, R., & Cooper, M. 2012. Adapting online learning resources for all: Planning for professionalism in accessibility. *Research in Learning Technology*, *20*, 345–361

[9] 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.

[10] 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.

[11] Al-Mouh, N. A., Al-Khalifa, A. S., and Al-Khalifa, H. S. 2014. A First look into MOOCs Accessibility. In *Computers Helping People with Special Needs*. Springer International Publishing. pp. 145-152

[12] Bohnsack, M. and Puhl, S. 2014. Accessibility of MOOCs. *Computers Helping People with Special Needs*, pp.141–144

[13] Sanchez-Gordon, S. and 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*, pp.1–6.

[14] Calle Jimenez, T., Sanchez Gordon, S. and Luján Mora, S. 2014. Web Accessibility Evaluation of Massive Open Online Courses on Geographical Information Systems. *IEEE Global Engineering Education Conference (EDUCON 2014)*, (April), pp.680–686.

[15] Sanchez-Gordon, S. and Luján-Mora, S. 2016. How Could MOOCs Become Accessible? The Case of edX and the Future of Inclusive Online Learning. *Journal of Universal Computer Science*, vol. 22, no. 1 (2016), pp. 55-81

[16] Martín J. L., Amado Salvatierra H. R., & Hilera J. R. 2016 MOOCs for all: Evaluating the accessibility of top MOOC platforms, *IJEE*, vol. 32, no. 5(B), pp. 2374–2383.

[17] Rizzardini, R. H., Chang, V., Gütl, C., and Amado-Salvatierra, H. 2013. An Open Online Course with Accessibility Features. *Proceedings of World*

Conference on Educational Multimedia, Hypermedia and Telecommunications, pp. 635–643

[18] Liyanagunawardena T.R., and Williams, S. A. 2016. Elderly Learners and Massive Open Online Courses: A *Review. Interact, J Med Res*.

[19] Singleton, K., and Clark, K. 2013. Re-Defining Accessibility When It Comes to MOOCs. *George Mason University*.

[20] Sanchez Gordon, S. and Luján Mora, S. 2013. Accessibility Considerations of Massive Online Open Courses as Creditable Courses in Engineering Programs. *Proceedings of the 6th International Conference on Education, Research and Innovation (ICERI, 2013)*, (November), pp.5853–5862

[21] Sanchez-Gordon, S., and Luján-Mora, S. 2014. Web Accessibility Requirements for Massive Open Online Courses Can MOOCs be really universal and open to anyone? *Actas Del V Congreso Internacional Sobre Calidad Y Accesibilidad de La Formación Virtual (CAFVIR 2014)*, pp. 530–535.

[22] Sanchez-Gordon, S. and Lujan-Mora, S. 2015. Accessible blended learning for non-native speakers using MOOCs. *2015 International Conference on Interactive Collaborative and Blended Learning (ICBL)*, (May), pp.19–24.

[23] Sanchez-Gordon, S. and Luján-Mora, S. 2015. Adaptive Content Presentation Extension for Open edX Enhancing MOOCs Accessibility for Users with Disabilities. *The Eighth International Conference on Advances in Computer-Human Interactions Adaptive*, (c), pp.181–183.

[24] Rodrigo, C., Accessibility in Language MOOCs. 2015. Martín-Monje, E., & Bárcena, E. (Eds.). (2015). *Language MOOCs: Providing Learning, Transcending Boundaries*. Walter de Gruyter GmbH & Co KG.

[25] Rodriguez-Ascaso, A., and Boticario, J. G. 2015. Accessibility and MOOC: Towards a holistic perspective. *RIED. Revista Iberoamericana de Educación a Distancia*, *18*(2).

[26] Draffan, E. A., Wald, M., Dickens, K., Zimmermann, G., Kelle, S., Miesenberger, K., and Petz, A. 2015. Stepwise Approach to Accessible MOOC Development. *Studies in Health Technology and Informatics*, *217*, pp. 227.

[27] Kelle, S., Henka, A. and Zimmermann, G. 2015. A Persona-based Extension for Massive Open Online Courses in Accessible Design. *Procedia Manufacturing*, 3, pp.3663–3668.

[28] Seale J. 2014. E-learning and disability in higher education: accessibility research and practice. *Routledge*.

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

[30] Gasevic, D., Kovanovic, V., Joksimovic, S. and Siemens, G., 2014. Where is research on massive open online courses headed? A data analysis of the MOOC Research Initiative. *The International Review of Research in Open and Distributed Learning*, *15*(5).

[31] Iniesto, F., Rodrigo, C. and 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)*. pp. 545–550.

[32] Iniesto, F., and Rodrigo, C. 2014. Accessibility assessment of MOOC platforms in Spanish: UNED COMA, COLMENIA and Miriada X. *Computers in Education (SIIE), 2014 International Symposium on vol*., no., pp.169, 172, 12-14

[33] Liyanagunawardena, T. R., Adams, A. A. and Williams, S. A. 2013 MOOCs: a systematic study of the published literature 2008-2012. *International Review of Research in Open and Distance Learning*, 14 (3). pp. 202-227. ISSN 1492-3831

[34] Veletsianos, G., and Shepherdson, P. 2016. A Systematic Analysis and Synthesis of the Empirical MOOC Literature Published in 2013–2015. *The International Review of Research in Open and Distributed Learning*, *17*(2).

[35] Creswell, Plano Clark and Garrett. 2008. Methodological Issues in Conducting Mixed Methods Research Designs, *in Manfred Max Bergman (ed.), SAGE Publications Ltd, London*, pp. 66-84

[36] Hammersley, M. 2008, Troubles with Triangulation, *in Manfred Max Bergman (ed.), SAGE Publications Ltd, London*, pp. 22-37, viewed 20 May 2016

[37] Bloor, M, and Wood, F. 2006. Keywords in Qualitative Methods, *SAGE Publications Ltd, London, England*, pp. 158

[38] Ayres, L. 2008. Semi-Structured Interviews, *in Paul J. Lavrakas (ed.), Sage Publications, Inc*., Thousand Oaks

[39] Hammersley, M., and Atkinson, P. 2007. Ethnography: Principles in practice. *Routledge*

[40] Petrie, H., and Bevan, N. 2009. The evaluation of accessibility, usability and user experience. *The Universal Access Handbook*, pp. 299–315

[41] Brajnik, G. 2009. Validity and reliability of web accessibility guidelines. In *Proc. of the 11th international ACM SIGACCESS conference on Computers and accessibility* (pp. 131-138). ACM.

[42] Brajnik, G. 2008. A comparative test of web accessibility evaluation methods. In *Proc. of the 10th international ACM SIGACCESS conference on Computers and accessibility* (pp. 113-120). ACM

[43] Vigo, M., Brown, J., & Conway, V. 2013. Benchmarking web accessibility evaluation tools: measuring the harm of sole reliance on automated tests. In *Proc. of the 10th International Cross-Disciplinary Conference on Web Accessibility* (p. 1). ACM

[44] Xiao, J., Jiang, B., Xu, Z., & Wang, M. 2014. The usability research of learning resource design for MOOCs *Proc. of IEEE International Conference on Teaching, Assessment and Learning for Engineering: Learning for the Future Now, TALE 2014*, (December), pp.277–282.

[45] Rose, D. H. R., & Gordon, D. 2014. *Universal design for* learning*: Theory and practice*. CAST Professional Publishing.

[46] Christensen, G., Steinmetz, A., Alcorn, B., Bennett, A., Woods, D., and Emanuel, E. J. 2013. The MOOC phenomenon: who takes massive open online courses and why?

[47] Guo, P.J. and Reinecke, K. 2014. Demographic Differences in How Students Navigate Through MOOCs. *Proceedings of the first ACM conference on Learning@ scale conference* (21-30). ACM

[48] Britten, L. 2014. The Enhanced Critical Incident Technique: Using Semi-Structured Interviews to Work with Vulnerable and Marginalized Populations, *SAGE Publications, Ltd., London, United Kingdom*

[49] Esposito, A. 2012. Research ethics in emerging forms of online learning: Issues arising from a hypothetical study on a MOOC. *Electronic Journal of e-Learning*, 10(3), pp.315–325.

[50] Farrow, R. 2016. A Framework for the Ethics of Open Education. *Open Praxis, 8(2), pp. 93-109.*

[51] BERA ethical guidelines 2011. Retrieved August 2017 from https://www.bera.ac.uk/wp-content/uploads/2014/02/BERA-Ethical-Guidelines-2011.pdf?noredirect=1

[52] Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. 2016. Accessibility of MOOCs: Understanding the Provider Perspective. *Journal of Interactive Media in Education*, *2016*(1).

[53] Lapadat, J.C. 2010 Thematic Analysis. *In the Encyclopedia of Case Study Research, Albert J. Mills and Gabrielle Durepos and Elden Wlebe, SAGE Publications*

[54] Braun, V. and Clarke, V. 2006 Using thematic coding in psychology. *Qualitative research in Psychology.* 3 (2) pp. 77-101. ISSN 1478-0887

[55] Porter, J. 2015. *Understanding and Responding to the Experience of Disability*. Routledge: London and New York

[56] Iniesto, F., McAndrew, P., Minocha, S., & Coughlan, T. 2017. What are the expectations of disabled learners when participating in a MOOC? *L@S '17: Proc. of the Fourth ACM Conference on Learning @ Scale*, ACM

[57] Inside Higher Ed. 2017. 'Glacial Progress' on Digital Accessibility. Retrieved August 2017, from https://www.insidehighered.com/news/2017/05/18/data-show-small-improvements-accessibility-course-materials

[58] Iniesto, F.; McAndrew, P.; Minocha, S. & Coughlan, T. 2016. The current state of accessibility of MOOCs: What are the next steps? In: *Open Education Global Conference 2016*, 12-14 April 2016, Krakow, Poland

[59] Sein-Echaluce, M. L., Fidalgo-Blanco, Á., & García-Peñalvo, F. J. 2017. Adaptive and cooperative model of knowledge management in MOOCs. In P. Zaphiris & A. Ioannou (Eds.), *Learning and Collaboration Technologies. Technology in Education. 4th International conference, LCT 2017. Held as Part of HCI International 2017*, Vancouver, BC, Canada, July 9–14. Proceedings, Part I (pp. 273-284). Switzerland: Springer International Publishing

[60] Iniesto, F., and Rodrigo, C. 2016. A preliminary study for developing accessible MOOC Services. *Journal of accessibility and design for all,* 6(2), 126-150

[61] Department of Education. 2017. Inclusive teaching and learning in higher education. *Access to higher education and Higher education participation*. Independent report. Retrieved August 2017, from https://www.gov.uk/government/publications/inclusive-teaching-and-learning-in-higher-education