Digital adult literacy in virtual learning environments*

The case of xMOOCs in energy sustainability

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ABSTRACT

Humanity is currently experiencing constant political, economic, cultural, and social changes, produced by the interaction and use of technology. Adults are adapting to new technologies with certain obstacles and difficulties in their professional context and especially in the area of their learning. Digital literacy for adults allows them to include themselves and take advantage of technology in their daily life. Evaluation instruments have been made to measure the level of digital literacy; however, a study on the impact of the level of digital literacy of adults in the context of learning virtual environments is required, specifically the xMOOC. Therefore, this research focuses on analyzing the digital skills, that affect the completion of xMOOC courses. In addition to setting a reference framework or digital literacy assessment scale to know the skills of the participant in those courses.

CCS CONCEPTS

• **Applied computing~E-learning** • Social and professional topics~Adult education

KEYWORDS

Adult education, distance education, xMOOC, digital literacy, digital literacy framework

1 Context and motivation that drives the dissertation research

Humanity is currently experiencing constant political, economic, cultural, and social changes, produced by the interaction and use of technology. These technological changes are best adopted by children and young people [1] [2] born in the 80s and called digital natives [3]. The inherent use of new technologies (video games, internet, mobile phones), by digital natives, has allowed them to develop innate confidence in the use of these [4].

However, adults are not considered digital natives, but digital immigrants, since they do not know the functioning of the technological means of communication and information, becoming passive consumers of technology [5]. This condition is attributed to the different circumstances and obstacles that adults experience in their daily lives, causing alienation due to the technological changes produced by the appearance of the internet and other information and communication technologies [6].

Nowadays, an adult can be considered a digital illiterate if it does not possess the technical skills or lacks the competence related to the search and use of information [7]. This is why adults, regardless of their experience or background, should reduce the digital divide and acquire the knowledge, skills, and attitudes necessary to achieve personal, economic and social success in the world of the 21st century [6]. The fundamental importance of minimizing the digital divide and increasing digital literacy in adults is, according to some authors such as Jacobs et al. [6] and Jimoyiannis and Gravani [8]; confront the problems of exclusion and marginalization that accompany the growth in the use of ICT-mediated activities in modern life.

2   State of the art

The systematic review of literature focused on the construct: Digital Literacy in the context of adults, in virtual learning environments, specifically in the xMOOCs (Massive Online Open Courses). The search for the research covered ten years (2008-2018). Only articles published in international journals and indexed in databases such as SCOPUS and Web of Science will be reviewed to ensure their quality and relevance. For the systematic literature review, the methodology proposed by Kitchenham [9] was considered, and the results are found in the section on related research.

In the first part of the research, the digital literacy construct and its conceptual evolution are presented. Subsequently, the characteristics of the adult in the digital age and the types of virtual learning environments are described, especially the xMOOCs. Finally, the discussion of researchers on digital literacy is described in detail, presenting the types of theoretical approaches, the applied methodology, the most important findings and the recommendations for future studies on the subject

2.1 Digital Literacy

The influence and impact that digital has on our societies have transformed different dimensions of current life, such as work, human relations, leisure, business, and especially the educational field. Given that literacy is not a set of predetermined, timeless and contextless skills to be acquired, educational policies should be aimed at maintaining and improving their development and at the same time encouraging people to learn new skills [10].

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When speaking about the concept of literacy, the skills of reading and writing are usually evoked. Some authors like Belshaw [11], Christie [12], Gourlay, Hamilton and Lea [13], and Hanemann [10], mention that literacy can usually be defined as a set of skills and practices that include reading, writing and the use of numbers in written materials. However, in recent decades, changes in the economy, the nature of work, the role of technology in the social sphere, have increased the importance of literacy for citizens [10] and its concept has been evolving.

In the eighties, the term digital literacy only referred to the handling of software and hardware [14] [15]. By the end of the 1990s, analog devices were being replaced by digital devices [16]. American technologist Paul Gilster defined literacy in a digital context as: "A set of attitudes and skills to manage and communicate information and knowledge effectively, in a variety of media and formats" [17], coining the term of digital literacy. Although, since then, this definition has been widely transformed.

2.1.1 Concepts and approaches to digital literacy

There are multiple definitions of digital literacy; some are similar, complementary, or ambiguous [18], according to the perspective of each author. Within its definition and application, a wide range of research agendas can be observed with trans and interdisciplinary approaches [19]. The first attempts to understand digital literacy focused on the skills and competencies related to information technologies [20], on the ways of reading and writing through the new virtual environments, from editors to text designers [21] mediated by the computer.

The fast evolution of technology has shaped the initial definition of the concept of digital literacy, forming a multidisciplinary term [22]. In 2007, the Council and the European Parliament established a frame of reference for competences for lifelong learning, including digital competence. The following definitions are broad and varied. For example, the concept of digital literacy for the British non-profit organization Joint Information Systems Committee (JISC), is defined as the skills needed to live, learn and work in a digital society, this includes knowing how to use the devices, digital applications, and services [23].

On the one hand, the state and national education standards of the United States associate digital literacy with phrases such as computer use, critical reading of web pages and understanding when viewing or reading digital images [24]. On the other hand, the United Nations Organization for Education, Science and Culture (UNESCO) defines digital literacy as: "The ability to access, manage, understand, integrate, communicate, evaluate and create information in a safe and appropriate way through digital technologies, for employment, jobs and entrepreneurship; including competition to which several refer as computer literacy, ICT literacy, information literacy, and multimedia literacy " [25].

For Martin [26], digital literacy is the awareness, attitude and ability of people to effectively use digital tools and facilitate their identification, access, administration, integration, evaluation, analysis and synthesis of digital resources, also, to create, express and communicate with others. Some other authors, such as Ferrari [27], have conceptualized digital literacy with more comprehensive and multiple perspectives, including various skills such as information technology, computer science, and information technology.

Digital literacy has been studied by the academy from different perspectives [14]. Studies have tried to identify Internet access profiles and mastery of a series of digital tools [28] [29] [30], approach to the subject of infoxication [31] [32], the abundance and diet of information in the network [33] [34] [35], as well as the need for digital skills in the face of changes in consumer habits. informative [36] [37]. The perspective of privacy and online behavior has also been studied [38].

The different conceptual approaches of digital literacy suggest that it will expand continuously in order to face the challenges of changing technology in digital societies [13] [39]. According to a search exercise by O'Brien and Scharber [24] of the term digital literacy, they found a series of concepts similar to digital literacy such as new literacies, literacy in digital media, new literacy studies. However, the conceptual debate on the emergence of new variants of the meaning of digital literacy will not be delved further.

Given the extent and variety of the mentioned definitions of literacy in a digital environment, it is essential to underline that since the creation of the concept of digital literacy by Gilster [17], a set of skills, abilities or competencies to operate in the digital domain field was generalized. Nevertheless, in no way did the author specify which ones and how many are [22] and much less in which virtual environment corresponded according to each context, formal, non-formal, or professional.

2.1.2 Models to evaluate digital literacy

To measure or assess digital literacy, academics have developed models or frames of reference. For example, the group of experts in digital literacy in the European Union proposed in 2007 concrete measures to evaluate and promote digital literacy, through the development of appropriate evaluation frameworks that include socio-economic variables, motivation, critical thinking and usability [40]. Some examples of frames or reference models of digital literacy are from: Beetham and Sharpe [41], Belshaw [11], Chetty et al. [22], Eshet [42] and Eshet-Alkalai [43], Ng [44] and Law et al. [25], among others. The characteristics, indicators, or competences of each of the models are briefly explained below.

The digital literacy model of Ng [44] groups three main dimensions: technical, cognitive and socio-emotional; Covering these dimensions, people will have the possibility of exercising critical thinking and evaluating the internet information they can use, as well as being ethical and responsible when communicating with others. For author Doug Belshaw [11], there are eight essential elements identified for digital literacy, divided into cultural, cognitive, constructive, communicative, confidence, creativity, critical, and civic [11].

The model of Beetham and Sharpe [41] includes a series of levels that the student must master to possess adequate digital literacy.

The authors Law et al. [25] designed for UNESCO a reference framework for digital literacy, with the description of competences for its evaluation. The Eshet model establishes six digital skills that each person can have, but the intensity or magnitude depends on each situation and differs from one person to another [42]. Together, these skills allow people to navigate and find quality information, as well as synthesize, understand and analyze it to create an original work [15].

2.2 Adults in the digital age

Adult education presents challenges and opportunities for educational institutions. For Watkins and Marsick [45], educating adults is often a complex and multifaceted task; especially when you live in a digital age. In comparison with the education of children and young people, adult education depends on the student's biographical influence, since adults have developed their learning style and competences [46], through their educational experiences and technological changes that they experienced throughout their academic life.

Nowadays, adults can be identified and grouped by their social, historical, and technological characteristics during the development of the history of humanity. Each of these groups has been described by Strauss and Howe [47], naming them as Boomers, Generation X and Millennials. The Boomers are idealistic and rebellious individuals [48] born between 1946 and 1964, named by the growing demographic explosion in the world at that time and where the cutting-edge technology was color television [47].

Generation X is formed by adults who were born between 1965 and 1976, many of them living the divorces from their parents [48] and being part of a disintegration of the family as the nucleus of society. Also, they witnessed the birth of video games, the personal computer, and color television [47]. Finally, there are adults named Millennials, individuals born between 1977 and 1993, this generation was born together with technology and have been living with it as part of their lives, showing different patterns of thinking and behavior compared to the last generations [49].

Therefore, it can be said that the adult has particular characteristics from the generation in which it was born. The adult as a student also demonstrates unique characteristics; according to Halpern and Tucker [50] adults are usually motivated and ready to learn, they want their life experience to be recognized, they are also self-directed in their learning process, and they require their lessons to be useful and applicable in their lives daily. These characteristics were described in the decade of the '80s through the concept of andragogy when the field of education in adults had acquired an identity [45].

2.3 Virtual learning environments

The educational institutions are implementing a series of adaptations in their teaching-learning process mediated by technology. Web-based education systems are being used by a growing number of universities, schools, and companies that incorporate technology in their subjects to complement their traditional classroom courses [51]. Virtual learning environments are technological applications capable of integrating and sharing content, images, audios, and videos for online learning, where students can also be followed up, communicated and collaborating with their tutors [52].

The virtual learning environments are characterized by implementing educational spaces on the web, which consist of a set of software tools that allow the development of flexible and autonomous learning models [53]. Other features, according to Dayag [54], are that in virtual learning environments students can communicate, collaborate, download learning materials, upload tasks, answer online exams or request advice from tutors. According to Gros and García-Peñalvo [55], these learning environments are too centered on content and overlook interaction.

Whether adults choose on their own or are required to enroll in online courses, they must have some necessary technical skills to benefit from online learning [56]. Many adults still have limited control over the use of digital tools, which is why many teachers who teach online are not familiar with the challenges and obstacles that adults present, such as the use of virtual learning platforms [57].

3   Problem statement

3.1 History of the problem

Being immersed in a technologically digitalized society does not mean that the population, especially adults and seniors, possess the digital competences [5] necessary to face the challenges of access, processing, information management, and digital content production. Undoubtedly, young people who have grown up with the use of computers, mobile phones, and the internet do not fear technology and are willing to experiment; In contrast, the learning habits of adults, their attitudes, barriers and difficulties in using technology are different [8].

The use of the computer requires diverse and complex prior knowledge since it introduces the individual to new digital contexts that require new mental and intellectual abilities [40]. In the field of education, the lack of physical presence and face-to-face interaction in MOOCs have challenged educators to design environments that provide rigorous academic experiences and promote student academic success.

MOOCs attract thousands of participants with distinctive characteristics, objectives, and backgrounds. According to García-Peñalvo et al. [58] between 2,000 and 60,000 students can enroll in the same course, and the number of enrolled learners, for some courses representing hundreds of thousands of people [59]. Thus, the massification and heterogeneity of the participants registered are the two most identifying characteristics of MOOCs [58]. Therefore, each of the participants, especially adult participants, have a different level of digital literacy that helps them finishing a course.

3.2 Problem statement

An adult can be considered digitally illiterate if it does not possess the technical skills or lacks the skills that help it in the search and use of information [7]. Therefore, in order to relate to digital culture, digital competences are inherently necessary [14]. However, the concept of adult literacy has not been considered a priority issue by researchers in recent years, and few investigations have been published.

Moreover, several reference models or frameworks have been developed to evaluate adult literacy, such as Beetham and Sharpe [41]; Belshaw [11]; Chetty et al. [22]; Eshet [42]; Eshet-Alkalai [43]; Ng [44] and Law et al. [25], but a framework of reference focused on virtual learning environments, in particular, MOOCs, has not yet been determined in order to assess the necessary digital skills or competencies of the participants and how these influence the academic performance of the participants, especially adults and seniors.

According to the literature review, the evaluation of digital literacy still requires a large amount of research, as mentioned by Varis [40]. According to Jimoyiannis and Gravani [8], there are still many parameters to be identified regarding the difficulties and practices that adult students have in this digital age. This is why the present investigation is focused on answering the following research questions:

1. How can the level of digital literacy of adults be evaluated in xMOOC courses on energy sustainability?
1.1 What are the digital skills that facilitate or impede the learning of adults in xMOOC courses on energy sustainability?
1.2 How does the digital literacy level of adults affect the completion of xMOOC courses on energy sustainability?

4   Research objectives/goals

The main objective of this research is:
General objective:
1. Design an evaluation model to measure the level of digital literacy of participants in xMOOC courses of energy sustainability. With the intention of having a frame of reference for the xMOOC courses of the energy project.
Specific objectives:

1.1 Determine the level of digital literacy of the participants in xMOOC courses of energy sustainability through the evaluation model proposed in the research.

1.2 Explain how the digital literacy level of adults affects the completion of xMOOC courses on energy sustainability. In order to help explain the low completion rates of courses.

4.1 Justification of the investigation

Adult education presents challenges and opportunities for educational institutions. For Watkins and Marsick [45], educating adults is often a complex and multifaceted task; especially when you live in a digital age. In comparison with the education of children and young people, adult education depends on the student's biographical influence, since adults have developed their learning style and competences [46], through their educational experiences and technological changes that they experienced throughout their academic life.

Many adults still do not master the use of digital tools, which is why teachers who teach online are not familiar with the challenges and obstacles that adults present, such as the use of virtual learning platforms [56]. After analyzing the results of the literature review on digital literacy and Adults, researchers Jimoyiannis and Gravani [8] state that, for future research, there are parameters that must be identified concerning how adult students perceive digital literacy, its practices or difficulties when using the computer properly.

On the other hand, Martínez-Bravo et al. [14] suggest evaluating other types of virtual communities, less formal or digital spaces such as MOOC or videogames, that favor the development of digital skills. Finally, Mohammadyari and Singh [15] suggest future studies on distance education focused on a type or stage of distance education, to identify differences in digital literacy and how this influences the decision to accept or continue using distance education.

Therefore, the evaluation of digital literacy through the initial proposal of a frame of reference for xMOOC courses, the level of digital adult literacy and its influence on the academic results within the xMOOC courses, is considered relevant research and current to determine the characteristics, obstacles, and challenges of adults in virtual learning environments.

4.2 Limitations and delimitations

The research will be limited to the xMOOC of energy sustainability that has a specific instructional design, which can limit the observation and measurement of digital skills exclusive to this type of course and not be able to observe any other digital competence required in another type of xMOOC. Another limitation is the gender of the sample of participants, given that the issues of energy sustainability and those interested in it are mostly men with some degree of engineering and few women would be evaluated in order to see the differences between gender.

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