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International MOOC Trends in Citizenship, Participation and Sustainability: Analysis of Technical, Didactic and Content Dimensions

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Abstract: Within globalization and the development of information and communication technologies (ICT), social and civic competence and sustainability take on a relevant role in the international scope. To this end, a theoretical section on citizenship models and the different fingerprints of sustainability is presented. The study is quantitative, with a sample of 161 massive open online courses (MOOCs) from three of the main platforms (Coursera, EdX and MiriadaX) with content on citizenship, citizen participation and/or sustainability. Both data collection and analysis are structured around a system of four categories: Technical dimension, didactic dimension, citizenship and sustainability. An exploratory analysis is carried out, followed by a factorial analysis focused on correlations and reduction of factors that allows us to define a main formative profile of the MOOC in relation to the reference themes. In this way, this research concludes that there is an international trend in MOOCs in citizenship and sustainability, whose predominant training proposals include contents related to the ecological citizenship model, as well as issues such as lack of resources, the need to reduce waste derived from consumption, climate change, or the impact of companies on the local economy and environment.

Keywords: citizenship model; participation model; sustainability; MOOC; technical dimension; didactic dimension; quantitative research; factor reduction; educational trends

1. Introduction

Globalization and glocalization have been developed in response to the increasingly interconnected and interdependent world [1]. Globalization refers to the spread of technology, trade and democracy across the globe [2], while glocalization refers to the global development in a specific area mixed with local culture [3]. Glocalization connects universal and local values, so that "*glocalized learning and teaching refers to the curricular consideration and pedagogical framing of local and global community connectedness in relation to social responsibility, justice and sustainability*" [4] (p. 223). In other words, within globalization and the development of ICT, social and civic competence and sustainability acquire a relevant role in the international scope. MOOCs (Massive Open Online Courses) are distance courses with no limit on participants, which can be accessed online, and where anyone can sign up [5–7]. In addition to videos, readings and questionnaires (typical in traditional courses), MOOCs can make use of interactive user forums that help build a community for students, teachers and teaching assistants.

As per the acronym, MOOCs are *Massive*, as they focus on demands of all users in a world with Internet access; *Open*, as their contents are usually open, that is, they can be shared, and some of them can be modified; *Online*, as they are accessed and developed through the Internet and autonomously; *Course*, as they are structured by passing tests and focusing upon teaching [8–10]. Regarding the MOOC platforms, in 2012, due to the high number of enrolled students, and based on the technology developed at Stanford, Daphne Koller and Andrew Ng created Coursera, a platform supported by numerous prestigious universities such as Yale, Princeton, Michigan or Penn. That same year, the Massachusetts Institute of Technology (MIT) and Harvard announced their joint Edx Project (created from MITx at MIT). Subsequently, other platforms such as MiriadaX have emerged. The expansion of MOOCs and the popularization of the term were reflected in the article "The Year of the MOOC" by the New York Times [11]. In general, the international trend is to consider two basic types of MOOCs: That is, xMOOCs and cMOOCs (Yousef, Chatti, Schroeder, Wosnitza & Jakobs, 2015): The xMOOCs are behaviorism-based courses where the contents are transmitted uni-directionally, assessment is usually based on questions, tests or the delivery of work to the teacher, and dialog between members of the course is not promoted, and cMOOCs are courses based on connectivism that allow users to create virtual learning communities and collaborative projects.

Social and civic competence transcends civility (knowledge of social norms) and constitutionalism (knowledge of the institutions and democratic mechanisms established by the Magna Carta, England, 1215) [12]. It can be learned as an independent subject, integrated in contents of curricular areas such as Social Sciences, Geography and History, or incorporating general skills that permeate all areas. Regardless of the trend adopted, the European Commission's Eurydice report argues that "*Education for citizenship is one of the main means whereby European countries help young people acquire the social and civic skills they will need in their future life*" [13] (p. 97), grouping the objectives in four blocks [14,15]: That is, *development of political culture*, proposed as the knowledge of basic facts and understanding of key concepts and, in some countries, including issues such as knowledge of political institutions, cultural heritage, human rights or citizens' rights and duties; *acquisition of critical thinking and capacity for analysis*, which in some countries includes the knowledge and analysis of information on social and political issues considered relevant; *development of values, attitudes and behaviors* related to respect, tolerance and solidarity, and where content such as respect for cultural plurality or gender equality can be considered; and *encouraging active participation, commitment in the school and the community*, with a practical approach to intervention and transformation of the community. On the other hand, every four years, the United Nations Educational, Scientific and Cultural Organization (UNESCO), receives information from Member States on the measures adopted to implement the 1974 Recommendation in the different stages of formal education, ranging from early childhood education to university. This recommendation is closely related to Goal 4 of sustainable development: "Quality Education" and, within it, to target 4.7 proposed by the United Nations in the Sustainable Development Goals [16]: "*By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights (. . .) and (appreciation) of culture's contribution to sustainable development.*"

The approach is based on the flexible hypothesis that there is a relationship between citizenship and sustainability, acknowledging the importance of ICT in education. In this way, after a brief theoretical review of citizenship models and the different footprints on which sustainability is based, a review of the trends in citizenship and sustainability of MOOCs during 2019 is carried out within the three main platforms (Coursera, EdX and MiriadaX). Likewise, given the complexity of both conceptualizations, and in order to achieve a deeper understanding of the relations between both categories, beyond the measures of central tendency, a factorial analysis based on the correlations between citizenship models and aspects is carried out. Sustainability keys, such as the ability of a natural area to produce resources and absorb waste from the population, greenhouse gases in the manufacture and marketing of products, fresh water consumed in the production and consumption of

goods and services, and the impact of business activity on social welfare, in the local economy and in the environment.

1.1. Citizenship and Citizen Participation Models

Since the 1980s, together with the impulse of globalization, the debate on what citizenship is and how to educate for a democratic citizenship has intensified, with the participation of universities, public institutions and international organizations [17]. Regarding the specific content blocks of this research, the theoretical framework of this research is based on a concept of citizenship that has been defined from multiple perspectives. However, we have limited this plurality to six types of citizenship [18–20]: Liberal, republican, communitarian, cosmopolitan, ecological and radical. Each model implies a different vision of issues, such as rights, responsibilities, the individual, the community, internationalization, natural environment or ideological positions.

The liberal citizenship model places emphasis on civil (freedom, right to property and right to justice), political (right to participate in public power) and social (right to a full life) rights of each citizen, based on the work "Citizenship and Social Class" [21] and results from the combination of the principles and dynamics of the three systems that make up post-industrial liberal society: Capitalism, democracy and welfare. In this sense, Marshall's post-industrial society theory is based on capitalism-civil, democracy-politics and social-welfare ideas [22]; implying the defense that the free market (and not civic participation) is an indispensable condition for the creation and sustenance of democracy and individual well-being that makes social welfare possible. The American political philosopher in the liberal tradition, John Rawls (1921–2002), was a significant person in a contemporary liberal approach.

His theory of *justice as fairness* describes a society of free citizens holding equal basic rights and cooperating within an egalitarian economic system. His theory of *political liberalism* delineates the legitimate use of political power in a democracy, and envisions how civic unity might endure, despite the diversity of worldviews that free institutions allow [23].

Thus, in general terms, liberal citizenship is primarily concerned with rights, and there is no expectation that citizens will engage in civic and political participation.

Republican citizenship emphasizes the assumption of responsibilities, shifting from a passive citizenship to an active citizenship. This citizenship model considers that participation may be motivated by the individual or the common good [24]. The liberal and republican traditions of democracy differ in citizen consideration, participation, criteria for decision-making and criteria for the construction of the common good [25]. Thus, republican citizenship emphasizes direct participation based upon the ethics of each person, accepting duality with representative participation. Regarding communitarian citizenship, citizens build common goals based on dialog, making decisions on citizen action to meet community needs, solve socially problematic situations and reduce social gaps. According to this model, citizen status is not provided by individual purchasing power, expertise or interest group, but the experience and ideas of each individual as part of a collective [26]. The main point is the critique of the individualistic focus of liberal thinkers, such as Rawls; moreover, there are communitarian perspectives on the left, right and center of the political spectrum.

Cosmopolitan citizenship or civic cosmopolitanism advocates a global system of universal rights and duties. According to this citizenship model, rights and responsibilities go beyond national borders [27,28]. In the European case, the sovereignty of states has ceased to be absolute, and coexists with supranational decision-making institutions and with a civil society organized in networks and transnational associations; however, the community project faces deep challenges in the face of the rise of nationalisms. Ecological citizenship implies that the individual has the responsibility to exhibit behaviors that include a lifestyle which reduces ecological pressures on nature, and is related to citizens' status, rights and participation processes related to the natural environment [29,30]. Finally, Radical citizenship acknowledges the value of political advocacy, conflict and ideological positions, in

addition to the potential to transform sociopolitical structures [31,32]. In this citizenship model, civil disobedience is considered a symbolic process that [33]:

- "Raises democratic demands to political actors (authorities, parliament, courts of justice) and the general public in situations where elitist projects and abuses of power predominate".
- "Creates a public space for the forming of citizen opinion and will in a process of democratic self-legislation".

Radical citizenship is based on critical theory, and citizen action is considered inseparable from ideological positioning, and conflict is considered a democratic value. In general terms, there is no universally-accepted model of citizenship, so, in an eclectic approach, we could define citizenship as:

> "*A legal status that integrates the knowledge and exercise of rights and the assumption of responsibilities that materialize through active and critical participation in the different areas that make up the world today (society, economy, culture and politics); being able to transcend from the local to the global and being marked by the exercise of individual responsibilities, rights and liberties without limiting the rights of other citizens, as all citizens who assume a responsible citizenship essentially understand that equality, dialog, rejection of situations of social injustice and, ultimately, respect for human rights must be demandable in any democratic State*" [34] (p. II).

The adoption of certain notions of citizenship will condition citizen education in educational environments. In this sense, continuing from the aforementioned eclectic perspective, 'good' citizens could be defined as citizens able "*to critically analyze the interactions that occur in their environment, so that, knowing their rights and duties, they are able to act accordingly, in a competent manner and within an ethical framework (. . .)*" [20] (p. 367). It should be noted that the consideration of a good citizen has a subjective basis. It is necessary to highlight research where it is concluded that teachers committed to civic education are already adopting their own concepts of citizenship, highlighting the need for a formal training plan that allows them to teach students, as citizens, to protect themselves from antidemocratic situations and against the interests of political parties [35]. On the other hand, as there are different models of citizenship, there are also different models of citizen participation, summarized as personally responsible citizen, participatory citizen and justice-oriented citizen [36]. The personally responsible citizen commits to their community by paying taxes and obeying the laws, etc. A participatory citizen assumes leadership positions in established systems and structures. A justice-oriented citizen questions and seeks changes in established systems and structures when they reproduce injustices over time. In general, and in relation to this, a responsible member respects all the rules, collaborates in campaigns, signs proposals, and so on. An active member organizes campaigns, collects signatures for proposals, and performs similar duties; and a critical member considers that it is not enough to act on a problem, analyzing the causes that generate it and acting on those causes.

1.2. Sustainability and Footprints

Sustainability is the achievement of the maximum by using the minimum rate of resources, and consists of multidimensional aspects from environmental, social, and economic points of view, considering the balance between the natural environment and artificial configurations, and combining climatic responsiveness with functional efficiency [37–39]. Over the last few decades, habitat loss, the overexploitation of natural resources and pollution have led to catastrophic decreases in biodiversity [40]. There are four indicators that contribute to the evaluation and improvement of the sustainability of the activities of individuals, communities and companies: Ecological footprint, carbon footprint, water footprint and social footprint. The ecological footprint is the capacity of a natural area necessary to produce resources that a population consumes, and then to absorb waste generated in the process.

In other words, the ecological footprint tells us how many natural resources we use. However, biocapacity—the ability of ecosystems to renew themselves—indicates how many natural resources we have. World Wide Fund for Nature (WWF) Report EU 2019 indicates that there are six subcategories for the ecological footprint calculations [41] (Figure 1):

- "Forest product footprint measures the demand for forests to provide fuel, wood, pulp and timber products."
- "Carbon footprint measures carbon emissions from fossil fuel burning and cement production (. . .). accounts for forests' varying rates of carbon sequestration depending on the degree of human management, the type and age of forests, emissions from forest wildfires and soil build-up and loss."
- "Cropland footprint measures the demand for land for food and fiber, feed for livestock, oil crops and rubber."
- "Grazing land footprint measures the demand for grazing land to raise livestock for meat, dairy, leather and wool products."
- "Built-up land footprint measures the demand for biologically productive areas covered by infrastructure, including roads, housing and industrial structures."
- "Fishing grounds footprint measures the demand for marine and inland water ecosystems needed to restock the harvested seafood and support aquaculture."

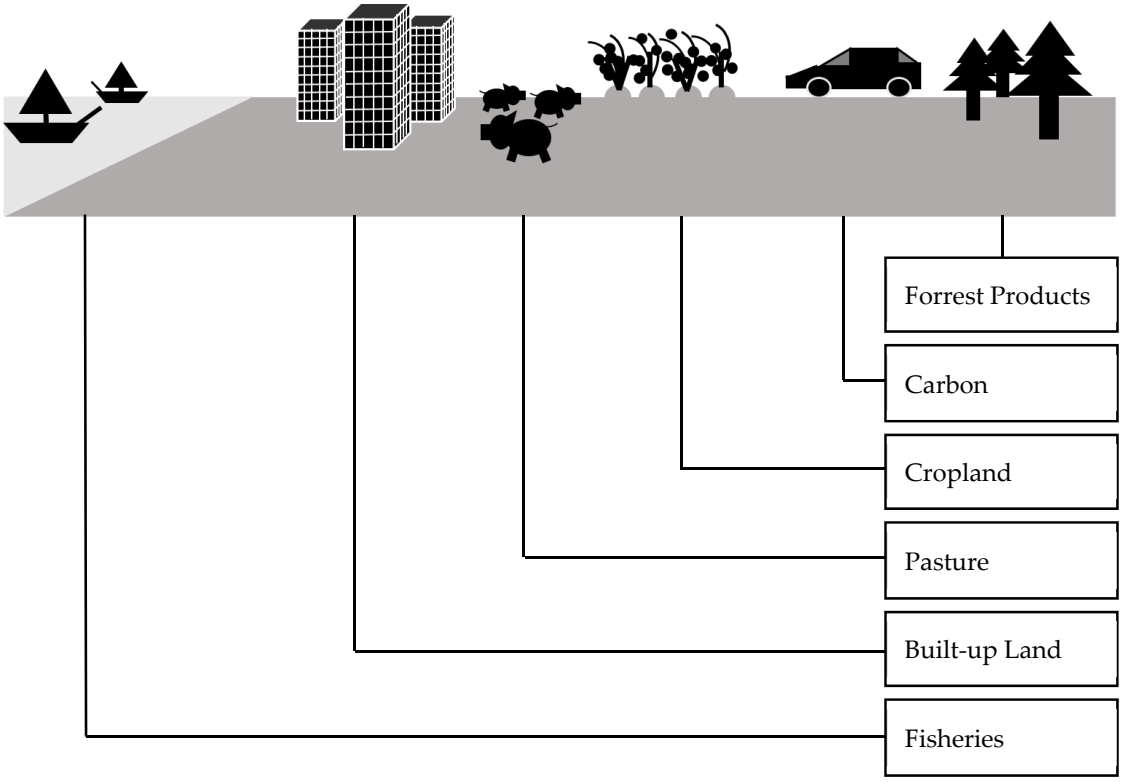

Figure 1. Ecological footprint. Based on [42].

Regarding these subcategories, we will pay special attention to the carbon footprint, which is related to greenhouse gases in the manufacture and marketing of products, and can be defined as a measure of the amount of greenhouse gases that are produced and measured in carbon dioxide units, causing environmental damage due to human activities [43].

Whereas the ecological footprint indicates the area needed to sustain the life of people, the water footprint indicates the necessary water to sustain a population. Regarding this, water footprint was defined as the volume of water needed for the production of the goods and services consumed by the inhabitants of the country [44]. This concept is linked to the virtual water concept, the necessary volume of water to produce a commodity or service. Water footprint includes a geographical and temporal dimension; highlighting three types: Green, blue and gray. *Green water* footprint is water from precipitation, particularly relevant for agricultural, horticultural and forestry products; *blue*

water footprint is the use of evaporated water that has been sourced from surface or groundwater resources, incorporated into the product, returned to another basin, or returned in a period other than extraction, and it is related to irrigated agriculture, industry and domestic water use; and *gray water* footprint is the amount of fresh water required to assimilate pollutants while maintaining water quality standards, including pollution through a pipe or through runoff, leaching from the soil, impervious surfaces, etc. [45,46]. Finally, the social footprint quantifies the social sustainability performance of an organization, and can be defined as the impact of business activity on social welfare, on the local economy and on the environment. Ecological footprint measures a population's use of, and impact upon, natural resources and the Social footprint deals with impacts produced by people on anthropogenic/anthro capitals (human, social and constructed capital), covering sustainability performance in its social, economic and environmental dimensions [47].

Whereas natural or ecological capital is limited, and is related to living within our means, anthro capitals are human-made, and can therefore be produced as needed, creating and maintaining the means to live.

2. Research Design

2.1. Problems and Objectives

Through the main exploratory to factorial approach, we will respond to the following research questions:

- "What is the technical dimension of MOOCs in terms of citizenship and sustainability in Coursera, Edx and MiriadaX?"
- "What is the didactic dimension of MOOCs in terms of citizenship and sustainability in Coursera, Edx and MiriadaX?"
- "What are the main trends of MOOCs regarding the citizenship and sustainability contents?"
- "What are the trends of MOOCs regarding the interaction between citizenship and sustainability?"

These research questions are related to the following research objectives:

- Objective 1: Determine the technical dimension of MOOCs in citizenship and sustainability in the Coursera, Edx and MiriadaX platforms.
- Objective 2: Determine the didactic dimension of MOOCs in citizenship and sustainability in the Coursera, Edx and MiriadaX platforms.
- Objective 3: Access MOOCs trends in citizenship and sustainability contents.
- Objective 4: Understand the MOOCs trends in the relationship between contents in citizenship and sustainability.

2.2. Research Methodology, Sample and Data Collection

The methodological approach of this research is quantitative. The sample consists of the 2019 MOOCs on citizenship and/or sustainability; allowing a selection of 161 MOOCs from Coursera (38), Edx (117) and MiriadaX (6) that can be divided into five macro reference areas (Figure 2): Experimental Sciences (38), Health Sciences (9), Technical Teachings (5), Social and Legal Sciences (85) and Humanities (24). The search bars from the respective platforms were used to define the sample. Keywords for searching were "citizen", "citizenship", "sustainability" and "footprint", in all languages of the European Union (EU).

Regarding the didactical and technical dimensions of MOOCs, the data collection tool is adapted from the *Questionnaire for the evaluation of teaching, technical and educational aspects of teaching sites* [48] and *Questionnaire* to measure the quality of a MOOC [49]; maintaining, with exceptions, the 'Yes' and 'No' scale. In relation to the specific citizenship and sustainability blocks, items for data collection are related to the theoretical background described above, focusing on main elements of the different types

of citizenship and fingerprints for sustainability; including the following scale: With, "not worked", "indirectly worked", "explicitly worked".

The instrument consists of three items for classification (massive open online course (MOOC) platform, educational institution, macro reference area), followed by a series of items that have been grouped based on a four-part system related to the categories system.

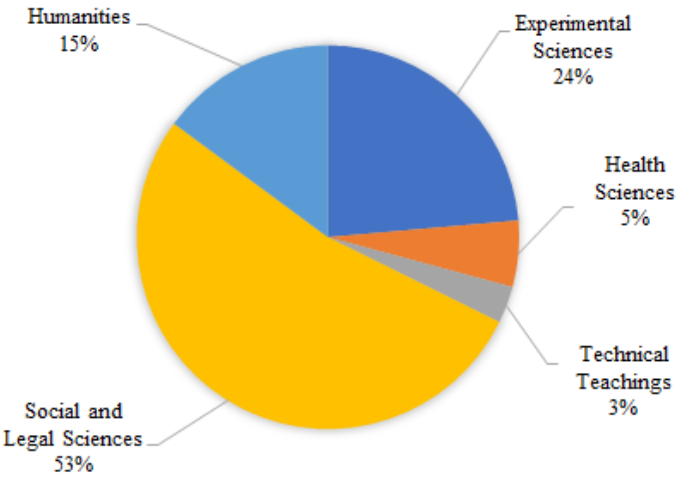

Figure 2. Macro reference areas of MOOCs.

2.3. Categories System and Data Analysis

Once the problem is defined and after the bibliographic review, a system of categories whose specific structure is adapted from several proposals is designed [20,50,51]. This system consists of four categories: Didactic dimension (Table 1), technical dimension (Table 2), citizenship (Table 3) and sustainability (Table 4).

Table 1. Category: Didactic Dimension of MOOC.

Subcategory	Indicator
INITIAL BASIC INFORMATION	DID.BAS.01. Language. DID.BAS.02. Temporalization DID.BAS.03. List of modules. DID.BAS.04. Number of modules DEC.BAS.05. Difficulty level. DID.BAS.06. Previous knowledge required. DID.BAS.07. Teaching team DID.BAS.08. Program. DID.BAS.09. Contact.
OBJECTIVES AND POWERS	DID.OYC.01. Goals. DID.OYC.02. Competencies DID.OYC.03. Linguistic communication competence. DID.OYC.04. Mathematical competence DEC.OYC.05. Digital competence DID.OYC.06. Competence of learning to learn. DID.OYC.07. Social and civic competence. DID.OYC.08. Competence of sense of initiative and entrepreneurial spirit. DID.OYC.09. Competence of conscience and cultural expressions.
CONTENTS	DID.CON.01. Integration of concepts, procedures and attitudes.
METHODOLOGY	DID.MET.01. Description of teaching activity DID.MET.02. Details of student workload. DID.MET.03. Participation in the activities. DID.MET.04. Type of learning DID.MET.05. Degree of complexity.
MEANS	DID.REC.01. Readings DID.REC.02. Videos. DID.REC.03. Quizzes DID.REC.04. Social networks. DID.REC.05. Webs. DID.REC.06. Other applications and resources.
SCHEDULE	DID.CRO.01. Temporary detail for content development. DID.CRO.02. Key dates and deadlines.
EVALUATION	DID.EVA. 01. Evaluation criteria. DID.EVA. 02. When to evaluate DID.EVA. 03. How to evaluate EVID. 04. Self-assessment. DID.EVA. 05. Case Analysis DID.EVA. 06. Participation in forum DID.EVA.07. Work preparation (essay, report, etc.).
BIBLIOGRAPHY	DID.BIB.01 Bibliography

Table 2. Category: Technical Dimension of MOOC.

SUBCATEGORY	INDICATOR
ACCESSIBILITY	TEC.ACC.01. Plugins TEC.ACC.02. Content Access
NAVIGATION	*TEC.NAV.01. Design. TEC.NAV.02. Ease of browsing TEC.NAV.03. Browsing support elements. TEC.NAV.04. Toolbar with links. TEC.NAV.05. Visible links and hypertexts. TEC.NAV.06. Help system for course development. TEC.NAV.07. Content search engine.*
INTERACTIVITY	TEC.INT.01. Facilities or tools for teacher–student interaction. TEC.INT.02. Facilities or tools for student-student interaction (cooperative work). TEC.INT.03. Allows interaction by private message. TEC.INT.04. Allows interaction by chat. TEC.INT.05. Allows interaction by videoconference. TEC.INT.06. Allows interaction through specific communication programs (Adobe Connect, Blackboard, etc.).

Table 3. Specific Block 1: Citizenship.

SUBCATEGORY	INDICATOR
CITIZENSHIP MODELS	CIU. 02. Content about liberal citizenship. CIU. 03. Content on republican citizenship. CIU.04. Content about communitarian citizenship. CIU.05. Content about cosmopolitan citizenship. CIU. 06. Content about ecological citizenship. CIU. 07. Content about radical citizenship.
CITIZEN PARTICIPATION MODELS	CIU.09 Personally responsible citizen. CIU.10 Participatory citizen. CIU.11 Justice-oriented citizen.

Table 4. Specific Block 2: Sustainability.

SUBCATEGORY	INDICATOR
ECOLOGICAL FOOTPRINT	SUS.02. Content on the area of the natural environment necessary to produce the resources consumed by a population. SUS.03. Content on the area of the natural environment necessary to absorb the waste generated by a population.
CARBON FOOTPRINT	SUS.04. Content on greenhouse gases generated by activities such as the manufacture and marketing of products.
WATER FOOTPRINT	SUS.05. Content on the volume of fresh water used for the production and consumption of goods and services.
SOCIAL FOOTPRINT	SUS.06. Content on the impact of business activity on social welfare. SUS.07. Contents about the impact of business activity on the local economy. SUS.08. Content about the impact of business activity on the environment.

After categorization, prior to the analysis and with the support of the "SPSS" statistical program, the data are entered. Subsequently, descriptive methods (exploratory analysis) are applied for all categories and correlational (factor analysis) for 16 items of the specific categories of citizenship and sustainability that allow us to discover the latent relationships between variables.

3. Results and Discussion

3.1. Technical Dimension of MOOC Platforms

In relation to **Objective 1** of the research, and in response to research question 1, the technical dimension transcends the courses and refers to the possibilities of accessibility, browsing and interactivity offered by the platforms themselves. Coursera, Edx and MiriadaX are platforms which, in technical terms, are very similar, so we will not delve into this category. There are similarities in terms of access to content, consistency in design, ease of navigation, browsing support, existence of toolbars, links and visible hypertexts, help system for course development and content search. There is

the possibility of teacher–student interaction, for example, through private messages, but there is no development of student-student interaction and the use of specific communication tools. Although the importance of social networks and the interaction between students has been put forward as a key factor in MOOCs in previous studies [52], in the courses that we reviewed, social networks and student interaction tools do not have a remarkable relevance. In general terms, after reviewing the technical features of the Coursera, Edx and MiriadaX platforms, the xMOOC approach can be considered a major trend. Considering this international trend in different platforms, a previous research work sets out the following considerations as essential needs in MOOCs [53]: A balance between theory and practical examples, support for interaction and other support, such as technical and learning strategies for students; including communication with other learners and getting feedback from teachers as necessary challenges for the developers of MOOCs in the future.

3.2. Didactic Dimension of MOOCs

This subsection is linked to **Objective 2** and responds to research question 1. In the subcategory INITIAL BASIC INFORMATION, the main language (DID.BAS.01) of citizenship and/or sustainability courses is English with 130 courses, followed by 21 Spanish courses. The temporalization (DID.BAS.02) is quite different, so that 52 courses are longer than eight weeks, followed by 48 courses of six weeks and 38 courses of four weeks. The list of modules (DID.BAS.03) is presented in only 44 courses, while in terms of the number of modules (DID.BAS.04), 60 courses have more than eight modules, 48 courses, six modules, 26 courses, four modules and 22 courses, five modules. The difficulty level (DID.BAS.05) is presented in 135 courses, 49 being for beginners, 42 intermediate level and 42 expert level. Ninety-four courses require prior knowledge (DID.BAS.06); in 160 courses, the teaching team (DID.BAS.07) or person responsible for training is indicated; the program (DID.BAS.08) is presented in 44 courses and the contact (DID.BAS.09) in 135 courses.

In relation to the subcategory OBJECTIVES AND COMPETENCES, the objectives (DID.OYC.01) are presented in 159 of the courses. However, a lack of balance is observed between concepts, procedures and attitudes, as the main type is conceptual.

On the other hand, the competences (DID.OYC.02) are explicit only in 28 courses. Either explicitly or implicitly, competence in linguistic communication (DID.OYC.03) works 51 courses; mathematical competence (DID.OYC.04), in 57 courses; digital competence (DID.OYC.05), in 128 courses; competence of learning to learn (DID.OYC.06), in 74 courses; social and civic competence (DID.OYC.07), in 131 courses; competence of sense of the initiative and entrepreneurial spirit (DID.OYC.08), in 83 courses; competence of conscience and cultural expressions (DID.OYC.09), in 60 courses. In other words, in the courses reviewed, the development of social and civic competence, followed by digital competence, predominates. Within the CONTENTS subcategory, the integration of concepts, procedures and attitudes (DID.CON.01) is present in an eminently declarative manner in 84 courses. As in our results, digital skills development through MOOC has been widely acknowledged in several research works [54]. Due to the conceptual framework of our study (citizenship and sustainability), social and civic competence has a very significant importance in the majority of MOOCs in our research sample. An investigation of didactical elements of MOOCs reflected broad cognitive competencies, emphasizing the importance of critical thinking, evidence-based argumentation and the evaluation of evidence, as well as applying the knowledge in solving problems [55]. Critical thinking is recognized as a trans-disciplinary skill [56], but it needs disciplinary contents to solve problems and build argumentations. Unlike the aforementioned research, and as we will see in the next paragraph, 61% of the courses in the sample are cumulative or comprehensive, and do not include elements that encourage the construction of critical competence.

In the METHODOLOGY subcategory, regarding the description of the teaching activity (DID.MET.01), only in two of the courses did the teacher act actively as a guide. In other words, there is an almost total predominance of a passive teacher and content dispensing. The details of students' workload (DID.MET.02) are present in 160 courses, while the participation in the activities

(DID.MET.03) is individual in 160 courses. The type of learning (DID.MET.04) is predominantly cumulative, with 50 courses, and then compressive, with 49 courses, followed by the critical, with 32 courses, and integrated, with 30 courses (Figure 3). Regarding the degree of complexity (DID.MET.05), it is constant in 82 courses and ascending in 79.

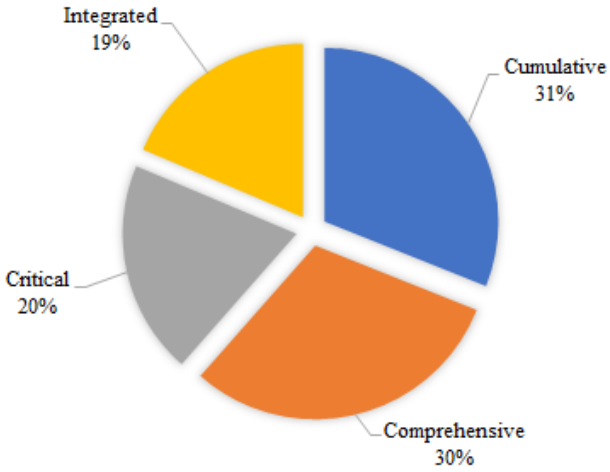

Figure 3. Learning type.

In relation to the RESOURCES subcategory, readings (DID.REC.01), videos (DID.REC.02) and quizzes (DID.REC.03) are present in all MOOCs of the sample, the use of social networks (DID.REC.04) only in one, the use of websites (DID.REC.05) in seven, and other applications and resources (DID.REC.06) in nine. Consistent with our analysis of the technical dimension, we find some lacks in the variety of resources used in a large number of MOOCs in the sample.

This is not a new situation, as several studies that consider the point of view of students indicate that MOOCs should create a learning community to increase the interaction among students, student feedback and communication; using a variety of communication tools, both synchronous and asynchronous, and requiring more resources in addition to lecture videos [57–59]. In the SCHEDULE subcategory, the temporal detail for content development (DIC.CRO.01) is present in 160 courses, while key dates and deadlines (DID.CRO.02) appear in 52. In relation to the EVALUATION subcategory, the assessment criteria (DID. EVA.01) are stated in all courses; regarding when to evaluate (DID.EVA.02), in 155 courses, at the end of each module, while only two courses are assessed continuously before, during and at the end; and how to evaluate (DID.EVA.03) is explicitly indicated in 87 of the courses. Self-assessment (DID.EVA.04) is presented in 159 courses, and case analysis (DIC.EVA.05) appears in 42 courses. Other researchers have reported similar findings regarding assessment in several disciplines [55,59]. In a very minor way, participation in the forum (DID.EVA.06), and the elaboration of work (essay, report, etc.) (DID.EVA.07) are used as an evaluation tool in two courses and six courses, respectively. Finally, in relation to the BIBLIOGRAPHY subcategory, it is present in 159 courses, and, in five of them, both a basic and complementary bibliography are included.

3.3. Specific Block 1: Citizenship

The citizenship specific block is related to Objective 3 and responds to the first half of research question 3. In relation to the CITIZENSHIP MODELS subcategory, the role of each model in the course contents is reflected in Table 5. The citizenship models that have less presence in the sample MOOCs are the communitarian model, the radical model and the liberal model. In relation to this, the allusion to the collectivization of citizens (communitarian) is less frequent, which implies a greater respect for the individuality of people. However, the civil, political and social rights of each individual, typical of the liberal model, have a smaller presence (47.8%) than the responsibilities linked to the republican model (82.6%). In other words, beyond rights and considering passive citizens, the importance of

participation is emphasized. However, there is a relatively low presence of the radical model (32.3%), not considering so important the value of political advocacy, conflict, ideological positions or the potential to transform sociopolitical structures.

Table 5. Table of Frequencies and Percentages of Contents Related to Citizenship Models.

	Not Worked		**Indirectly Worked**		**Explicitly Worked**	
	f.	%	f.	%	f.	%
Liberal citizenship (CIU.02)	84	52.2	67	41.6	10	6.2
Republican citizenship (CIU.03)	28	17.4	76	47.2	57	35.4
Communitarian citizenship (CIU.04)	126	78.3	17	10.6	18	11.2
Cosmopolitan citizenship (CIU.05)	64	39.8	41	25.5	56	34.8
Ecological citizenship (CIU.06)	27	16.8	45	28.0	89	55.3
Radical citizenship (CIU.07)	109	67.7	29	18.0	23	14.3

The responsibilities that citizens must assume individually, according to the republican model of citizenship, and the responsibility to exhibit behaviors that include a lifestyle which reduces ecological pressures on nature, typical of the ecological model, have a priority presence in the sample analyzed, with 82.6% and 83.2%, respectively. This is followed by the defense of a global system of the universal rights and duties of civic cosmopolitanism.

As for the CITIZEN PARTICIPATION MODELS, the importance of each of them in the sample of MOOCs reviewed is reflected in Table 6. Citizen participation based on leadership has an important presence (64%), followed by the model of individual responsibility (45.3%). The justice-oriented citizenship model, a critical approach that proposes the need to act from a critical perspective on the causes of the problems, beyond acting on the consequences, has a relatively low presence (30.4%).

Table 6. Table of Frequencies and Percentages of Contents Related to Citizen Participation Models.

Content About Citizen Participation Model ...	**Not Worked**		**Indirectly Worked**		**Explicitly Worked**	
	f.	%	f.	%	f.	%
Personally responsible (CIU.09)	88	54.7	57	35.4	16	9.9
Participatory (CIU.10)	58	36.0	89	55.3	14	8.7
Justice-oriented (CIU.11)	112	69.6	21	13	28	17.4

3.4. Specific Block 2: Sustainability

The sustainability specific block is related to Objective 3 and responds to the second half of research question 3. This category was addressed based on the ecological footprint, the carbon footprint, the water footprint and the social footprint (Table 7). In the MOOCs of the sample, social footprint has a greater presence, highlighting the impact of business activity on the local economy (87%), the environment (85.7%) and social welfare (74.9%). The ecological footprint also has a notable presence, with courses where the area is directly or indirectly worked to produce consumption resources (65.8) and absorb the waste generated (70.8%). The aspects of sustainability with a relatively lower presence in the MOOCs of the sample are the carbon footprint and greenhouse gases (40.4%), and the water footprint and the volume of fresh water needed for the production and consumption of goods and services (27.9%).

Table 7. Table of Frequencies and Percentages of Content Related to Sustainability.

Content About . . .	Not Worked		Indirectly Worked		Explicitly Worked	
	f.	%	f.	%	f.	%
the area of natural environment necessary to produce the resources consumed by a population (SUS.02)	55	34.2	75	46.6	31	19.3
area of natural environment necessary to absorb the waste generated by a population (SUS.03)	47	29.2	85	52.8	29	18.0
greenhouse gases generated by activities such as the manufacture and marketing of products (SUS.04)	96	59.6	47	29.2	18	11.2
the volume of fresh water used for the production and consumption of goods and services (SUS.05)	100	62.1	48	29.8	13	8.1
the impact of business activity on social welfare (SUS.06)	42	26.1	41	25.5	78	48.4
the impact of business activity on the local economy (SUS.07)	21	13.0	62	38.5	78	48.4
the impact of business activity on the environment (SUS.08)	23	14.3	36	22.4	102	63.4

3.5. Relationship Between Citizenship and Sustainability: MOOC Profiles

This subsection is linked to Objective 4 and responds to research question 3. Regarding the factorial analysis of citizenship and sustainability categories, as a first, we have ensured that the sample number (161) is at least five times greater than the number of items that will be part of the factor analysis (17 items, ten on citizenship and seven on sustainability). Then, as shown in Table 8, the Kaiser-Meyer-Olkin sample adequacy index provides an acceptable result (0.662), as it is between 0.500 and 0.750. On the other hand, the Bartlett sphericity test indicates a high statistical significance ($p < 0.005$), and that the factors are correlated. Thus, the factorial model used is suitable to explain the data.

Table 8. Kaiser-Meyer-Olkin (KMO) Sample Adequacy and Bartlett Sphericity Test.

Kaiser-Meyer-Olkin Sampling Adequacy Measure.		0.662
Bartlett's Sphericity Test	Approximate Chi-square	1996.322
	Gl	120
	Sig.	0.000

Each variable (or group of variables) is considered dependent upon a series of components, which in turn are composed of all other variables, so that the choice of factors obeys the criterion of percentage of variance [60]. In Social Sciences, a score of over 60 % is deemed acceptable [61]. As we can see in Table 8 and in the sedimentation graph (Figure 4), the reduction of factors to six explains 82.002% of the variance. In short, applying the analysis of major components, the 16 variables would be grouped into six components or factors (Table 9).

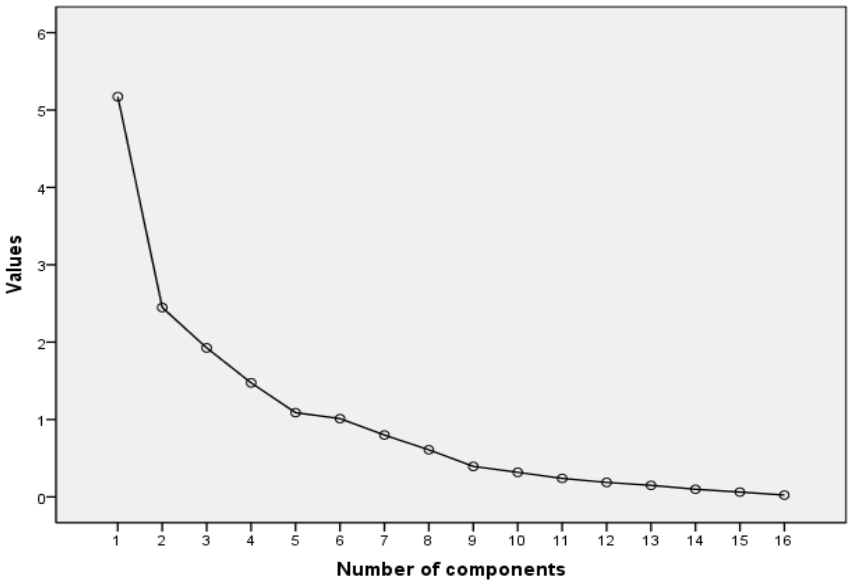

Figure 4. Sedimentation graph.

Table 9. Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	Variance %	Accumulated %	Total	Variance %	Accumulated %
1	5.172	32.327	32.327	5.172	32.327	32.327
2	2.448	15.301	47.628	2.448	15.301	47.628
3	1.926	12.035	59.663	1.926	12.035	59.663
4	1.474	9.212	68.875	1.474	9.212	68.875
5	1.089	6.805	75.679	1.089	6.805	75.679
6	1.012	6.324	82.003	1.012	6.324	82.003

Extraction method: Principal components analysis.

To interpret the components, we transform the factorial matrix into a rotated factorial matrix through a factorial rotation process using the Varimax standardization with Kaiser (Table 10), which makes interpretation easier by achieving high correlations with one group of variables and low with the others [62]. In summary, based on the principal components' analysis extraction method (Table 9), 16 items, nine from the citizenship category (Ciu 2–7, 9–11) and seven from the sustainability category (Sus 2–8) could be reduced to the following six components:

- Component 1: Explains 32.327% of the variance. We designate it socio-ecological citizenship, and it includes ecological citizenship and indicators of the social footprint (impact on social welfare, local economy and the environment)
- Component 2: Explains 15.301% of the variance. We designate it ecological footprint, and it includes the ecological footprint indicators
- Component 3: Explains 12.035% of the variance. We designate it participatory critical citizenship, and it includes radical citizenship and justice-oriented citizen participation
- Component 4: Explains 9.212% of the variance. We designate it responsible community citizenship, and it includes communitarian citizenship, personally responsible participation, and in negative, active participation
- Component 5: Explains 6.805% of the variance. We designate it austere citizenship, and it includes liberal (negative) citizenship, carbon footprint and water footprint
- Component 6: Explains 6.324% of the variance. We designate it glocal responsible citizenship, and it includes republican citizenship, and in negative, cosmopolitan citizenship

Table 10. Rotated Components Matrix (Summarized).

	Component					
	1	**2**	**3**	**4**	**5**	**6**
CIU.06	**0.625**					
SUS.06	**0.819**					
SUS.07	**0.865**					
SUS.08	**0.791**					
SUS.02		**0.939**				
SUS.03		**0.943**				
CIU.07			**0.902**			
CIU.11			**0.920**			
CIU.04				**0.833**		
CIU.09				**0.813**		
CIU.10				**−0.619**		
CIU.02					**−0.592**	
SUS.04					**0.723**	
SUS.05					**0.826**	
CIU.03						**0.813**
CIU.05						**−0.787**

Extraction method: Principal components analysis. Rotation method: Varimax standardization with Kaiser

The Pearson correlation table (not included due to word limit) enables researchers to interpret the degree of relationship between pairs of variables according to the magnitude (absolute value) and direction (sign); these scores may be: Low (0.30), average (0.50), high (0.70) or perfect (1). Figure 4 groups significant correlations, average and high correlations. Moreover, the significance of the correlations was taken into account, marking the significant values at 0.01 with ** (probability of correlation due to chance 1% or less) and the significant values at 0.05 with * (probability of correlation due to chance between 5% and 1%).

Reviewing the high and medium correlations of the items related to citizenship types, civic participation and sustainability, and regarding the sample of 161 revised MOOCs, ecological citizenship (CIU.09) is the model of citizenship with the highest correlations with the items linked to the ecological footprint, the carbon footprint and the impact of business activity on the environment and on the local economy of the social footprint (Figure 5). Despite not being present in the figure, it also has a medium-low correlation (below 0.500), although significant, with the items linked to water footprint and the impact of business activity on the social welfare of the social footprint. This does not mean that ecological citizenship, as a concept, gives less importance to both footprints, but that, without entering into questions of causality, in the courses reviewed, the tendency is to prioritize the ecological footprint in a broad sense and the social footprint in MOOCs where ecological citizenship has an important weight. The definition of this MOOC profile around ecological citizenship and sustainability is analogous to that in another study on ecological citizenship, where it is concluded that citizens who think about ecological citizenship are more likely to behave in an environmentally friendly manner in their day-to-day activities [63].

Although UNESCO establishes a link between sustainability and cosmopolitan citizenship [64], in the sample MOOCs the correlations between both aspects are very low, so the presence of both is not even a majority or defining profile in training through MOOCs. Radical citizenship (CIU.07) and justice-oriented citizen participation (CIU.11), both supported in a critical approach, have a strong correlation (0.870). Correlations between the different elements of sustainability and radical citizenship, and justice-oriented citizen participation, respectively, are relatively low (the majority between 0.250 and 0.400). However, almost all of these correlations are significant at the 0.01 level. Thus, MOOCs related to radical citizenship, justice-oriented participation and the social footprint of sustainability,

with special emphasis on the impact of business activity on social welfare, local economy and the environment, can be considered an emerging trend.

As expected, due to the relationship between area to produce resources and area to absorb waste in the conceptualization of the ecological footprint, the link between both items is almost perfect (0.939). This data is consistent with component 2, due to the reduction of factors. There is an average correlation between the area necessary to produce the resources consumed by the population (within the ecological footprint) and the carbon footprint. This result is consistent with the conceptualization of the ecological footprint that includes the carbon footprint itself [40].

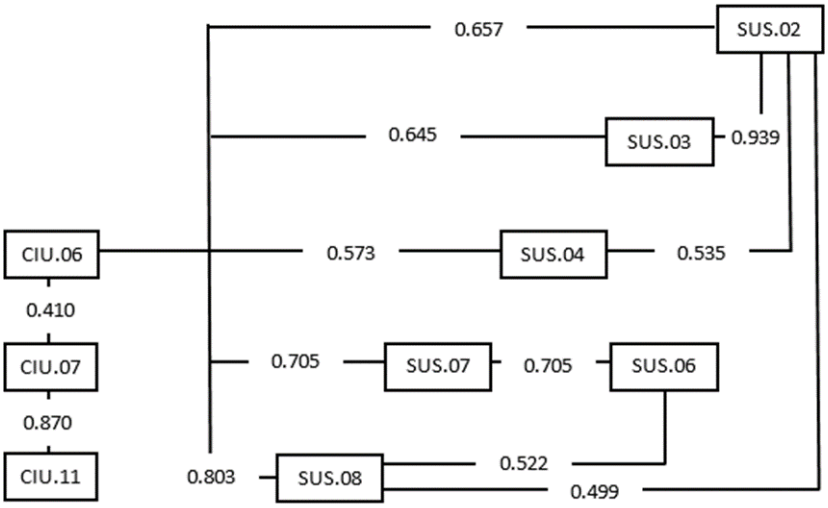

Figure 5. Correlations between ecological citizenship and sustainability.

4. Conclusions

The Coursera, Edx and MiriadaX platforms have similar technical features in terms of access to content, consistency in design, ease of navigation, browsing support, existence of toolbars, links and visible hypertexts, a help system for course development and content search. The main approach in this platform is through xMOOCs. Difficulty in promoting cMOOCs may be due to the massive nature of MOOCs and the effort involved in teacher management on these courses. To this end, recognition by universities and other prestigious institutions and student autonomy are some of the main features in revised MOOCs. Digital skills development through the MOOC has been widely recognized in several research works [45], and due to the conceptual framework of our study (citizenship and sustainability), social and civic competence has a very significant importance in the majority of MOOCs in our research sample. In coherence with xMOOCs features, there is a predominance of a passive teacher approach, content dispensing and individual participation in learning activities. The learning type is predominantly cumulative and compressive, and about one third of them encourage the construction of critical competence.

Regarding the resources, the readings, videos and quizzes are present in all MOOCs in the sample. The usual evaluation process is based upon self-assessment, and takes place at the end of each module.

From the Industrial Revolution, environmental problems have increased in a process of liberalization [64,65] and the capitalist economic system [66]. Some environmental problems arising from social activity are due to the fact that liberal democracy does not encourage citizens to be more sensitive to the environment; moreover, the capitalist economic system favors production and consumption over sustainability [67]. The pressure on our natural resources will increase due to a growing population, economy and increasingly unsustainable patterns of production and consumption [68]. In order to tackle these problems, universities, public institutions and international organizations have participated in the search for an improvement in the democratic quality and quality of life of people in different countries, including the promotion of citizen awareness and

environmental responsibility. As a result of this situation, the *2030 Agenda for Sustainable Development* was developed and published, which included 17 universal sustainable development goals [11]: No poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequality; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; strong peace and justice institutions; and partnerships to achieve the goal. Cosmopolitan citizenship has a greater presence in the sample MOOCs after ecological citizenship and republican citizenship. Nevertheless, the correlations between this citizenship model and the different elements of sustainability are not statistically significant. In other words, despite the political and social importance of globalization, in this sample, courses where cosmopolitan citizenship and sustainability is worked, nowadays, are not a trend. This is especially relevant if we consider that "*Students should not only be offered knowledge but also be empowered to see themselves as glocal citizens who are able to make a difference in the local and global community and thus contribute to a peaceful and sustainable future (. . .) focusing on action as much as on knowledge and beliefs*" [1] (p. 16). MOOCs related to radical citizenship, justice-oriented participation and the social footprint of sustainability, with special emphasis on the impact of business activity on social welfare, local economy and the environment, are not a main tendency, but they can be considered as an emerging trend.

Universal sustainable development goals must be understood in an interconnected manner, highlighting the hope that education becomes a fundamental pillar for the promotion of awareness [69], the fostering of values and the development of the necessary competencies for citizen participation and the critical conservation of heritage. Connected with this approach, the research concludes that there is currently a marked trend in MOOCs where citizenship and sustainability contents are worked, so that the predominant training proposals include contents related to the ecological citizenship model, as well as issues such as the lack of resources, the need to reduce waste derived from consumption, climate change, or the impact of companies on the local economy and the environment. Despite the political and social debate around the socio-environmental problems facing humanity, MOOCs where sustainability and global citizenship are working are not a current trend. However, in relation to the need for a critical citizenship and with the support of the results obtained, MOOCs focused on radical citizenship, justice-oriented participation and sustainability, could become a major trend in coming years.

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