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Storie della crisi ecologica.
L'ambiente tra immaginazione, creatività e linguaggi



Redefining higher education for sustainability. Strategies, barriers and practices

Silvia Aru¹, Cristina Capineri¹, Angelo Riccaboni²

Abstract

Education for Sustainable Development (ESD), in the form of higher education (HE), plays a pivotal role both in the achievement of sustainable development goals and in the implementation of Agenda 2030 (UNESCO, 2012, 2014). Academia has always been the cradle of innovation, theoretical debates and practical experimentation. However, its mission is also to discern truth, impart knowledge, skills and values and prepare responsible citizens and competent workers who will contribute to an improving world. Recently, colleges, universities and networks of different kinds (e.g. SDSN, IAU, WEEC, etc.) have developed educational initiatives which represent a wealth of sources of innovation in sustainability. The paper aims to identify methodologies, tools and learning processes in order to highlight the strengths and weaknesses of the ongoing initiatives taken into consideration. The paper highlights evidence, practices and policies by investigating recent literature on the topic (literature review and state of the art) and subjects and methods used in HE sustainability education in face-to-face traditional classroom environment (trends in HE sustainability education) and in an open online environment, namely MOOCs (Massive Online Open Courses). The outcomes of the paper will contribute to the suggestion of future scenarios for the improvement of sustainability in HE and for the educational transformation that is required in order to create a sustainable future.

Keywords: Education for Sustainable Development; Higher education; SDG4; Classes in Sustainability; Learning processes; MOOCs.

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Ripensando l'educazione superiore allo sviluppo sostenibile. Strategie, barriere, pratiche

Riassunto

L'educazione allo sviluppo sostenibile (ESD), in particolar modo quella superiore, svolge un ruolo fondamentale per il raggiungimento della sostenibilità e per la concreta attuazione dell'Agenda 2030 (UNESCO, 2012, 2014). L'accademia è sempre stata la culla dell'innovazione, di dibattiti teorici, così come di sperimentazione pratica. La sua missione è però anche quella di discernere la verità, di impartire conoscenze, competenze e valori e di preparare cittadini responsabili e lavoratori competenti che, con le loro azioni, contribuiranno a migliorare il mondo. Recentemente, università e differenti network (ad esempio SDSN) hanno sviluppato numerose iniziative educative che rappresentano importanti fonti di innovazione nell'ambito della sostenibilità. L'articolo intende individuare le metodologie, gli strumenti e i processi di apprendimento utilizzati nell'ambito di queste iniziative, per evidenziarne i punti di forza e di debolezze. Il lavoro presenta tali pratiche attraverso la revisione della letteratura e lo stato dell'arte sul tema ed analizzando argomenti e metodi utilizzati nell'educazione alla sostenibilità sia durante le tradizionali lezioni in compresenza che nell'ambito dei corsi online (in particolare i MOOC - Massive Online Open Courses). I risultati dell'analisi presentata contribuiscono alla definizione di possibili scenari futuri, utili per il miglioramento della sostenibilità nell'istruzione superiore e dei processi didattici entrambi condizioni necessarie per creare un futuro sostenibile.

Parole chiave: *educazione allo sviluppo sostenibile, istruzione superiore, SDG4, corsi sulla sostenibilità, processi di apprendimento, MOOC.*

■ Introduction

Education is a strategic resource for building resilient and sustainable societies (UNESCO, 2012), because it plays a central role in changing attitudes and behaviour, creating conditions for active and aware citizenship (from an early age) that will lead to sustainable and inclusive growth. Furthermore, education is an essential tool for contrasting negative phenomena such as poverty, child mortality, unemployment, low education levels and lack of opportunities for the younger generation, and can also help to reduce the environmental fatalities, inequalities and social inclusion (UNESCO, 2016a). At international

level, the UN 2030 Agenda for Sustainable Development identifies education as a standalone goal (SDG4) for its pivotal role as a key enabler of sustainable development. In this context education needs to be shaped and transformed to ensure a positive impact (*Ibidem*, p. 11). In the last decades, the transformation of higher education to adapt to sustainable development requirements is a pressing concern for educators and policymakers in order to prepare students for life after graduation and generally to contribute for an active and aware civil society. Different educational strategies, practices and tools have been developed at a global level but the field of ESD is very complex and in “a considerable state of flux” (Wortham-Galvin *et al.*, 2017, p. 365).

This paper aims to analyse the inclusion of sustainability in HE curricula and classrooms by identifying trends, methodologies, approaches and criticalities in order to better understand the present scenario; it also suggests specific policies for its improvement. The paper is structured as follows: after drawing attention to the background and actors of ESD, it examines the inclusion of sustainability in HE teaching activities and the role of the MOOCs – Massive Online Open Courses - in determining new learning opportunities. Finally, the paper identifies some current barriers to ESD and suggests specific actions for the improvement of sustainability in HE. From a methodological point of view, the paper highlights evidence, practices and policies by investigating recent literature on the topic (literature review and state of the art) and subjects and methods used in HE sustainability education both in face-to-face traditional classroom environment (trends in HE sustainability education) and in an open online environment.³

■ Milestones and actors in Education for Sustainable Development

In the last decades, there has been growing international recognition of ESD as an integral element of sustainable development. However, ESD, in the form of higher education (HE), has a long history as an international priority (fig. 1). In 1987 the Brundtland Report by the World Commission on Environment and Development introduced ‘sustainability education’ for the first time and in 1992 the concept was taken up and emphasised in Agenda 21 from the Earth Summit of the United Nations Conference on Environment and Development (Zahan *et al.*, 2015). In particular education was one of many paths to sustainability mentioned in the 40 chapters of Agenda 21 which also emphasized that the best starting point for the achievement of sustainable development is at the local level. This was a relevant step to think

³ The survey is still open at <http://www.sdsn-mediterranean.unisi.it/survey-higher-education-to-foster-sustainable-development/>

about educational paths which are both locally relevant and addressing global issues as well. Indeed sustainable development is a global goal which needs to be locally declined to be really effective. Along this line the UN Decade of Education for Sustainable Development (2005-2014) sought to mobilize the educational resources of the world and to integrate the principles, values and practices of sustainable development into all aspects of education and learning. More recently, in 2013 the *Global Action Program* (GAP) on Sustainable Development Education was approved and, in 2014, UNESCO⁴ published the '*Roadmap for Implementing the Global Action Programme on Education for Sustainable Development*' to mobilise the community of stakeholders in Education for Sustainable Development towards urgent action to further strengthen it and scale it up.

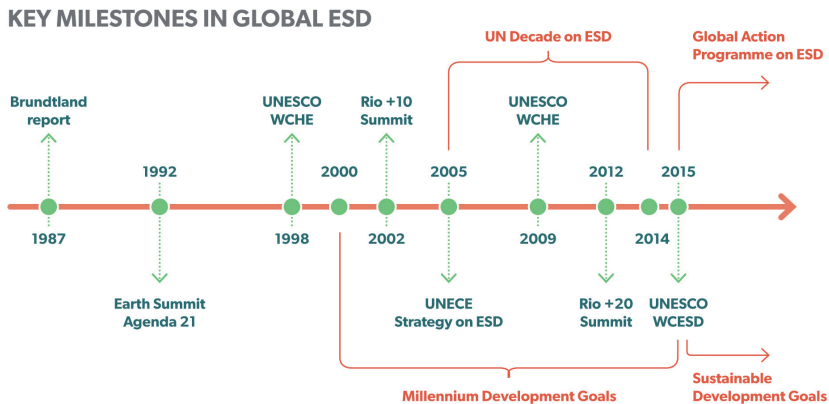


Fig. 1. Timeline of the progress of ESD global efforts with an impact on HE in the UNECE region. Source: UE4SD (Kapitulčinová *et al.*, 2015, p. 22)

The GAP suggests a two-fold approach to scale up ESD action: (a) integrating sustainable development into education and (b) integrating education into sustainable development (UNESCO, 2014): sustainable development and education for sustainable development are therefore two sides of the same coin⁵. More recently, *The Kurashiki Declaration*, which was signed during the G7 Kurashiki Education Ministers' Meeting on 14 May 2016 in Japan, emphasizes this principle, placing strong focus on education as a “basic human right [...] essential for the development of peaceful, prosperous and sustainable societies” (Kurashiki Declaration, p. 3)⁶.

⁴ UNESCO also monitored and evaluated progress during the UN Decade of Education for Sustainable Development (DESD, 2005-2014), publishing three reports in 2009, 2012 and 2014.

⁵ See Vladimirova and Le Blanc (2015).

⁶ Cf. http://www.mext.go.jp/component/a_menu/other/detail/_icsFiles/afieldfile/2016/06/17/1370953_2_3.pdf.

The growing centrality of education in sustainable development is demonstrated by the increasing number of courses and publications produced on the subject. In this regard, the UE4SD (University Educators for Sustainable Development) mapped the National Sustainable Education Development policies adopted by the 32 member states in Europe in 2014. The Final Report shows that 85% of countries (27 out of 32) referred to the adoption of ESD strategies in HE at local level (Kapitulčinová *et al.*, 2015). This local turn is demonstrated by an increasing number of the workplace-based programmes called TVET (*Technical Vocational Education and Training*) which include ESD in their programmes. The “GEM Report” (*Global Entrepreneurship Monitor*) showed that about 20% of youth from 12 countries had participated in TVET (UNESCO, 2016a). These courses are directly linked to the labour market and employer requirements, and they generally involve work placements as part of their programmes.

The implementation of ESD is carried out by the major intergovernmental institutions active in the field of education (e.g. UNESCO, UNECE) whose task is to provide a global framework for HE strategies (Kapitulčinová *et al.*, 2015) which is then locally tuned by universities and research centres (UNESCO-UNEVOC, 2014, p. 7). A growing number of working groups, associations of universities, programmes and partnerships have started working on the development of multidisciplinary forms of education to find practical solutions to the different problems linked to SD: e.g. SDSN, SDG Academy, IAU-HESD, UE4SD, GUPES, WEEC, etc. Each has a different focus, for example, ISCN aims at promoting sustainability within universities; SDSN works as an interface between academia and society (2017 – Educating for Sustainability Report) but they share the mission of enabling international cooperation and sharing of skills, experiences, tools and materials. Within this complex framework of different actors, Universities play a central role in education for sustainable development, as well as in networking, and often play a leading role in relation to local populations (Tilbury, 2011; Dlouhá *et al.*, 2013; Spiteri *et al.*, 2017). There are three main strategies currently in use for achieving these goals and integrating sustainability concerns into university activities:

1. *Classes in Sustainability*. Integration of Sustainability thinking and practice into disciplinary and interdisciplinary courses; specific programmes: Master; PhDs and so on.
2. *Research on Sustainability*. Integration of Sustainability into disciplinary and interdisciplinary research activities related to Sustainable Development Goals.
3. *Green campus*. Most universities are engaged in the sustainable management of their campus buildings, promoting initiatives such as solar panel installation, bike sharing, recycling and waste management.

We are going to address in greater detail the first strategy: the integration

of sustainability into teaching activities by keeping in mind that international institutions have set a global framework for HD which create a space for local institutions to determine their educational priorities. Learning globally in this case implies promoting tools to share not only theoretical principles but also practical solutions, and supporting stakeholders in devising appropriate local solutions. While the “what” has been delineated globally, the “how” relies more on local capacity and specific educational systems.

■ Strategies in learning processes

The very transdisciplinary nature of sustainability may hinder its translation into educational praxis. In general terms, ESD is an “umbrella concept” that covers a broad range of themes and aspects to cope with the complexities posed by socio-environmental issues. In order to foster SD, HE needs to innovate and “transform itself” (Tilbury, 2011). As stressed by UNESCO: “For education to be transformative in support of the new sustainable development agenda, ‘education as usual’ will not suffice. Learning should foster thinking that is relational, integrative, empathetic, anticipatory and systemic” (2016a, p. 34). To this end, the UNESCO report on education and skills identifies “four lenses”⁷ (UNESCO, 2012, p. 12) which can enable this transformative process:

1. An integrative lens referring to a holistic perspective, which is a prerequisite for taking into account the multiple aspects of sustainability;
2. A critical lens interrogating prevalent processes that could be unsustainable (e.g. the fact that a continuous economic growth is dependent on consumerism and its associated lifestyles)⁸.
3. A transformative lens leading to real changes and sustainable transformations through empowerment and capacity building.
4. A contextual lens moving from the idea that there is no single way to live or do business which will forever be the most sustainable and suitable for every place.

As regards the teaching and learning process inside the classroom, every activity should facilitate the interaction between different agents involved in the educational process – instructor, student and content – thus configuring specific methodological elements. These are defined through two opposite perspectives that interact with each other, helping to implement the level of inclusion of sustainability in the teaching/learning processes (García-González *et al.* 2017) (tab. 1).

⁷ Cf. “An ESD ‘Lens’ metaphor is used in this document to guide an educational review process. It encourages ‘looking again with new eyes’ – in this case looking with ‘Education for Sustainable Development’ eyes. It helps to see things differently” (Unesco, 2010, p. 4).

⁸ Cf. Fundació Autònoma Solidària, 2015.

Methodological elements for the integration of sustainability into the classrooms		
1	Teacher-student relationship	Vertical ↔ Horizontal
	The integration of sustainability sets up a process in which the teacher is a mediator who, by implementing the tools for learning, shares the responsibilities for what happens in the classroom with the students.	
2	Competencies	Specific ↔ Transversal
	Sustainability enables the incorporation of specific and transversal competencies. Specific competencies are related to the concepts to be learnt; transversal competencies connect the contents with the surrounding medium.	
3	Socio-environmental issues	Unintegrated ↔ Integrated
	It is necessary to adopt a systematic and interdisciplinary perspective of sustainability.	
4	Resources	Internal ↔ External
	It is vital to combine all available resources and their synergies: internal resources and external resources (field trips, dialogue with experts, practice in specific centres, etc.).	
5	Evaluation	Accreditation ↔ Procedural
	Accreditation and procedural evaluations are complementary. Students should understand both evaluation processes which help them to reflect, value and improve their capacity to tackle the complexities of socio-environmental problems.	
6	Classroom dynamics	Closed ↔ Open
	Sustainable dynamics allow us to order ideas, to set bases and orientations, but also to give voice to the students and to their own ideas at the same time.	
7	Class work	Individual ↔ Group
	The learning process should encompass two strategies: individual and group class work. The active dialogue between the individual sphere and the collective one is essential to foster the principles of sustainability.	

Tab. 1: Methodological elements for the integration of sustainability in classrooms. Source: Adapted from García-González *et al.* (2017).

According to Filho *et al.* (2015), specific changes can be identified in learning processes: a shift from discipline focused courses to inter and transdisciplinary courses; more attention to the social impacts not only to the academic ones. “Teaching that informs” is replaced by “teaching that transforms” mind and behaviours. Within this new framework, the teacher is a partner on equal terms with the student rather than the expert of the discipline.

■ Critical perspectives: learn globally, teach locally!

A common aim and ambition is certainly to achieve a “Whole Approach to Sustainability” according to which – as suggested by UNESCO (2016a)

– Universities should develop curricular and extracurricular activities, teaching and research as well as environment-friendly educational structures. They should also nurture the relationship between the world of education and the wider social and geographical context in which they operate, in order to “become exemplary spaces that breathe sustainability – inclusive, democratic, healthy, carbon-neutral places that lay the foundation for achieving the SDGs” (Ibidem, p. 34). Literature often provides the most cited definition of sustainable development – i.e. Development that meets the needs of the present without compromising the ability of future generations to meet their own needs - without specifying its practical and operational dimension (Boron, Murray, Thomson, 2017). To shape a solution-oriented approach to sustainability and to implement HE activities on these themes, it is interesting to observe how different universities have tackled sustainability issues at the centre of their mission. Best practices come from all around the world and are related to different approaches: whole institute engagement, research focus, integration into curricula, networking (ISCN-GULF, 2017). The following table shows some examples (tab. 2).

Fields of innovations	Examples of Best Practices
Whole-institution approach	Sustainable infrastructure developments, volunteering opportunities, sustainability awards, funding for sustainability projects, academic initiatives, internships (University of Edinburgh). Centre for sustainable development that works in five focus areas: teaching, research, operations, transfer, and governance to empower students as change agents (Stuttgart University of Applied Sciences).
Research for sustainability	Campus as a Living Lab, supporting the integration of academic and operational work on sustainability (University of British Columbia). Transformative and integrative space for students to conduct sustainability-driven research with support from multidisciplinary staff (The 'Challenge Lab', Chalmers University of Technology).
Sustainability across curricula	Integrated courses: a broad perspective that crosses all disciplines (Hong Kong University). The Transdisciplinary Course of the University of Siena.
Collaboration to address global challenges	Sustainable Weekend Conference (Carnegie Mellon University). Interdisciplinary, multi-actor working space, underpinned by the principles of transdisciplinary, co-generation and community involvement (Technical University of Madrid).

Tab. 2: Examples of best practices and fields of innovations Source: the 2017 WEF ISCN-GULF Report.

At University of Siena a transdisciplinary course on sustainability has been offered since 2013 to students and general public. With a total of 24 lessons,

the course addresses the basic issues related to environment monitoring, green economy and social and legal-institutional issues. It is taught by the University staff and by invited speakers from private enterprises or public institutions. The course is innovative not only because it is transdisciplinary but also because it is offered as an elective course with credits. It attracts an average of 142 students every year with a good gender balance (66 females and 75 males). Target students are BSc and MSc students from any disciplinary programme in the University but also technical/administrative staff, external practitioners and stakeholders. The educational backgrounds of students are generally diversified: more than 50 different degree classes are represented, both from the hard and soft sciences, including (in order of their importance) economics (the highest proportion at 27%), management and governance, medicine and chemistry, biotechnologies, political sciences and earth and environmental sciences. 6% of the participants are University administrative personnel who attend the course as part of their life-long learning programme; a small proportion (4%) are members of other research institutions (such as ESA) or employees from banks and large enterprises (e.g. Trenitalia). Moreover, the University of Siena has, through the software Semantic Media Wiki, structured a digital and open repository of MOOCs called ReSi (Repository on Sustainable Issues) to collect international sustainability-related courses in an open online environment⁹. Best Practices can provide useful guidelines for other users, but – as shown by the concept of “contextual lens” (UNESCO, 2012) – “each institution has its own unique culture, context, and characteristics and sustainability initiatives should take these factors into account” (Wortham-Galvin et al, 2017, p. 378). In this respect, we propose a new motto “Learn globally, teach locally” (Riccaboni, Aru, Capineri, 2017)¹⁰ which means to refer and share global resources to address global environmental problems, which then needs to be tuned to the local contest since sustainability is a globally accepted but locally declined and put in practise. Like the slow food movement which introduced quality, equity and awareness against the globalised fast food way, a slow teaching may assure deeper interaction between teachers / researchers and society in order to accommodate the learning process to locally relevant needs (e.g. energy substitution, waste management, food production and so on).

■ A panorama of ESD courses and MOOCs: trends and approaches.

In order to draw a general panorama of the ESD courses in HE, we developed an empirical analysis as follows. From a methodological point of view, 515 courses and 139 MOOCs were selected by using two keywords in the course

⁹ Cf. https://edatasi.ladestlab.it/index.php/Main_Page.

¹⁰ Cf. http://www2.crui.it/crui/g7_university/Draft_Table%20_Education_and_Sustainability_v2.pdf

title (“sustainability” and “sustainable development”) to highlight the main topics addressed by HE courses. Courses were collected from the most relevant career platforms (Prospects and Masterstudies)¹¹ and the IAU-HESD repository. MOOCS were collected from the Platform “MOOC list”, Edx, Coursera, FutureLearn and FUN Platforms, SDG Academy, IAU- HESD platform. Furthermore, in spring 2017 the University of Siena has developed a survey “The role of Higher Education to foster sustainable development” to collect as much information as possible on the ongoing educational activities related to sustainability worldwide. The Survey (in four languages) addressed all institutions (universities, research institutions, NGOs, etc.) involved in Education for sustainability. The survey was disseminated with the support of several international networks (SDSN, EUA, WEEC, RUS and ISCN) and by Twitter. The Survey gave 50 answers¹² and despite the small number of participants, some general remarks can be drawn¹³.

1. ESD courses

We selected 515 courses, including Masters, PhD and Bachelor’s programmes. The analysis of the most recurring terms in the titles highlight the main topics addressed (e.g. development, design, food, climate, etc.).

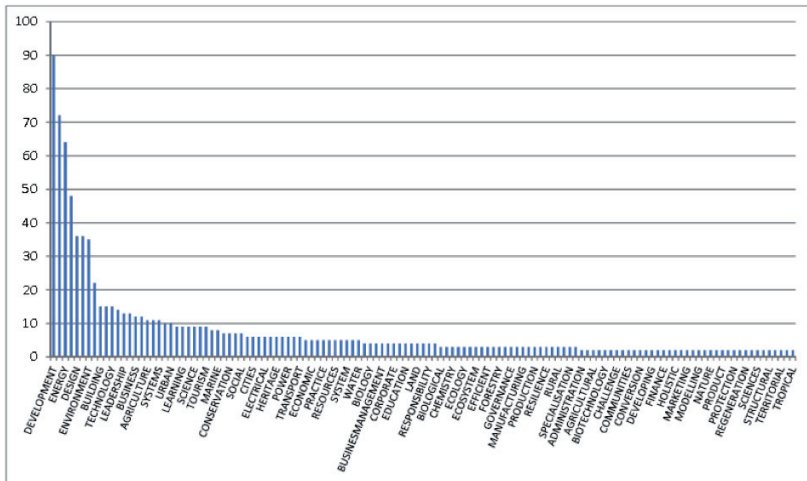


Fig. 2: Word frequency from 515 course titles (2017). Source: Ladest (Laboratory of socio-geographical research, University of Siena).

The topics are highly concentrated since 50% of the frequency mainly

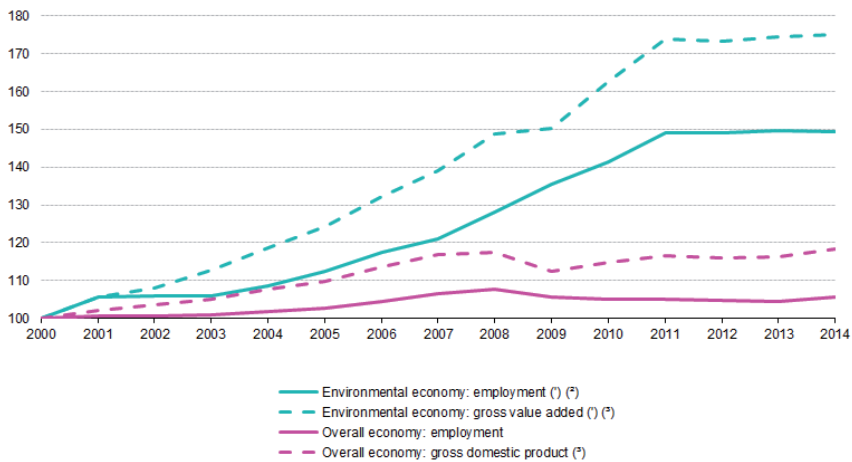
¹¹ Cf. <https://www.prospects.ac.uk/>; <https://www.masterstudies.com/>.

¹² The survey is still open at <http://www.sdsn-mediterranean.unisi.it/survey-higher-education-to-foster-sustainable-development/>

¹³ Cf. <https://www.prospects.ac.uk/>; <https://www.masterstudies.com/>

includes (with the exception of the keywords sustainability and sustainable) topics related to: development, energy, planning and design, engineering and technology, climate change. Other relevant topics such as agriculture and food, tourism, policy and leadership, law are relegated to a secondary position (fig. 2).

Such concentration can be explained by the growing number of people employed within the environmental economy since 2000 and in particular in the management of energy resources, the production of both energy from renewable sources (such as wind and solar power) and equipments and installations for energy savings (fig. 3).



(*) Eurostat estimates.
 (*) In full-time equivalents.
 (*) Index compiled for chain-linked volumes data in EUR million (reference year 2010; at 2010 exchange rates)

Fig. 3: Growth of the green job market (2000-2014). Source: Eurostat Development of key indicators for the environmental economy and the overall economy, EU-28, (2000-2014).

The distribution of the offer is highly concentrated in certain countries and also in some European cities (e.g. London, Edinburgh, Glasgow, Nottingham, etc.) whose universities develop a large range of activities. It must be taken into account that the data are heavily biased according to the origins of the platforms: the high concentration at European level in the UK is due to the fact that the data sources used in the analysis are British.

2. MOOCs

The first MOOC started in 2008 at the University of Manitoba in Canada. Despite their high cost of implementation, the number of MOOCs has grown at a rate of more than 15 courses per day since 2012. In particular, user growth rate is greater than 2000% (160,000 learners at one university in 2011

to 35,000,000 learners at 570 universities and twelve providers in 2015)¹⁴.

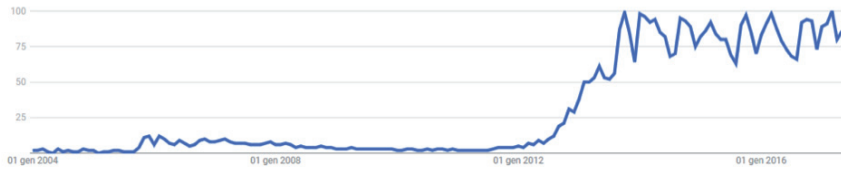


Fig. 4: Increase in Google searches for the general term 'MOOC' (2004-2016). Source: Google Trend.

The repository ReSi by the University of Siena has collected data on the main characteristics of 139 online courses such as the topics, languages, geographical distribution of the educational offer (fig. 5), and learner interaction (including blog, social networks, etc.).



Fig. 5: Geographical distribution of educational offer mapped in RESI (spring 2017). Source: Ladest (Laboratory of socio-geographical research, University of Siena).

¹⁴ Cf. Karsenti, 2015 and <http://www.onlinecoursereport.com/state-of-the-mooc-2016-a-year-of-massive-landscape-change-for-massive-open-online-courses/>

Most of the sustainability-related courses are incorporated on Edx, Coursera, FutureLearn and FUN Platforms. The analysis of the most recurring terms in the MOOC titles reveal that the topics are – as for courses - highly concentrated but on few different topics (fig. 6). Fifty percent of the most frequent terms refer to issues related to: introduction to sustainability, energy, and management but also food. It is interesting to note that more theoretical issues appear in MOOCs like resilience, system theory and global issues.

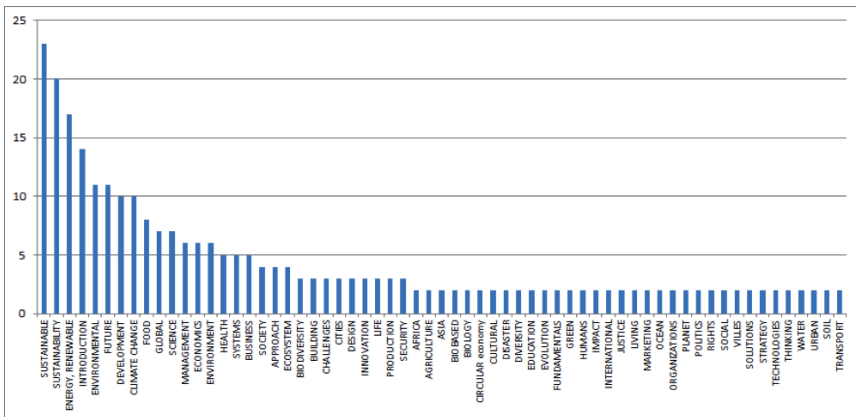


Fig. 6: MOOC main topics (spring 2017). Source: Ladest (Laboratory of socio-geographical research, University of Siena).

In accordance with the study by Zahan *et al.* (2014), the vast majority of the sample courses provide an introductory level without prerequisites. The average course length is between 4 and 8 weeks, so shorter than a typical university course. Most MOOCs (118 out of 139) issue a certificate but 41 of these require fees (the average cost of the certificate is between 25 and 150 dollars). Some MOOCs provide paid upgrading that allows unlimited access to the courses and to all the material provided at any point in the future.

Sometimes the MOOCs offer interactive case studies in order to challenge the shared brainpower of course participants¹⁵. Some courses emphasize peer-to-peer and mentored project-based learning by using a case-study method. For example the course titled “Managing the Arts: Marketing for Cultural Organizations”, designed by the Leuphana Digital School in cooperation with the Goethe-Institut e.V. engaged participants “to apply theory and marketing strategies to four existing pre-selected art institutions and their real-life challenges”¹⁶.

The concept of “openness” in MOOCs refers not only to free access to material, but also to the wider idea of a whole opening in learning proc-

¹⁵ Cf. <https://www.canvas.net/browse/centreofexpertise/courses/biobased-economy>.

¹⁶ Cf. <http://digital.leuphana.com/courses/managing-the-arts-2015/>.

esses, “breaking down the traditional roles of instructor and student, moving away from prescribed content and encouraging a variety of ways of showing mastery” (Tirthali, 2016, p. 119). “Opening up learning” is the basis of a new “philosophy” (MiriadaX)¹⁷, with specific “principles” (FutureLearner). Thanks to this characteristic of openness, the MOOCs are often presented as “a mission”: “to help fund free education for everyone globally” (edX)¹⁸. MOOCs attract diverse students from different¹⁹ countries. Research on participants’ demographics and reasons for enrolling in MOOCs are still rare (Bayeck, 2016) and certainly some feedback would be valuable for a more efficient online activity. Analysis on this aspect show that the vast majority of MOOC learners are college degree holders and employed people; males often constitute the majority of learners but specific studies sustain that the gender gap is related to the type of course taught; learners frequently join a MOOC for educational pursuits, professional development, or to learn new things (Bayeck, 2016, p. 225).

■ Conclusions: a socio-technical scenario

The analysis of the recent literature and the findings of our survey (2017) on the integration of ESD in HE allow us to highlight some criticalities, useful for identifying specific actions in order to implement the role of universities in fostering SD at an international and a local level.

Our survey data revealed the following critical aspects:

- Difficult integration of sustainability courses within existing curricula (65%).
- A lack of adequate knowledge of the teaching staff (25%).
- Most initiatives are carried out by single teachers or disciplines.
- Lack of whole institution involvement.
- Most of the teaching is still face-to-face, and rarely uses participatory or multidisciplinary methods, while in the online environment (e.g. MOOC), learner interaction is provided mainly by blog and social networks and through interactive case-studies.
- Higher engagement in research rather than teaching / education.
- Field work and experimental/practical approaches are not much developed.

There is still a long way to go, but there are positive signs (UNESCO, 2016b) since the survey also revealed that most of the institutions declared their intention to develop ESD further in the near future; others have intro-

¹⁷ Cf. <https://miriadax.net/web/guest/nuestra-filosofia>.

¹⁸ Cf. <https://www.edx.org/course/resilient-future-science-technology-epflx-tech4dr>.

¹⁹ Gender differences in traditional education courses are replicated in MOOCs (Macleod *et al.*, 2014): courses, fields, or majors such as science, technology, engineering, and maths where men are overrepresented in traditional education will experience the same gap in MOOCs.

duced an institutional sustainability manager.

Furthermore, globalization processes have brought significant changes, opening new opportunities for wider access to information and to knowledge. The use of the Internet, and its capacity to create large voluntary networks at a very low cost, may potentially create and improve low cost knowledge networks and peer reviewed materials for wide distribution (UNESCO, 2012). The most innovative aspect is the cultural change which very recently has led to the adoption of an open access, collaborative and sharing approach to information resources. The open source movement enables – at least in theory – any user to participate in the information society by sharing know how and skills mediated by Web 2.0 tools and applications. Famous initiatives like Wikipedia, founded in 2001 or, more specifically in the geography realm, OpenStreetMap, launched in 2004 do not need any further explanation. The growth of social media and open source platforms facilitates access to education (UNESCO, 2012, p. 24) and allows for the more direct involvement of younger generations (Daniel, Cano and Cervera, 2015), “[p]romising approaches include e-learning on ESD and on-line platforms where young people can share their own ideas and actions on sustainable consumption and sustainable lifestyles” (UNESCO, 2014, p. 22). Nevertheless, the existing digital divide is still a barrier to the goal exploitation of such digital innovations.

In particular, Massive Open Online Courses (MOOCs) are recognized as “one of 30 of the most promising trends in education until 2028” and “the tool for “innovative disruption” that will improve education” (Tirthali, 2016, p. 115): online courses are capable of overcoming the barriers that distance presents. In this way, they could fill the gap between central and peripheral areas in terms of learning opportunities and allow low-income students to get access to quality learning without paying or moving away from home: a win-win scenario reducing also the environmental impact of movements. MOOCs can be an enormous opportunity to introduce positive changes also across the developing world, especially as availability expands and the cost of access continues to decline. MOOCs could become a way to reinforce rather than replace traditional universities and their courses (Daniel, Cano e Cervera, 2015).

Another interesting innovation is the growing participation of the public in scientific research and in learning: we refer to participatory and “citizen science” approaches (Haklay, 2010). Lately, it has been witnessed a global increase of citizen science projects and citizens engaging in projects as amateur researchers, as sensors, as advocates and even watchdogs (Haklay, 2015; Dickinson et al 2012). Further, crowdsourcing methods, data processing and visualization technologies are developing rapidly, leading to a wide range of new opportunities for public participation in a compelling range of topics (Bonney *et al.*, 2014). As an example, it can be seen that a tremendous increase of environmental observation activities in this area, i.e., various citi-

zens' observatories that encompass different models of citizen science and span a diverse range of subjects (e.g., biodiversity, water, air, climate change, agriculture, disaster, etc.), empowering people but also students to monitor their environment, collectively generate scientific data and support environmental knowledge.

In conclusion, all social and political eras, when deep changes have occurred, have required new educational systems and transformation in values, tools and approaches. If education has to accommodate sustainability, it will imply a fundamental change in skills, management and experimental practices of both the learning process and the institutions' administration. Specific actions can contribute to the improvement of sustainability in HE and to the educational transformation that is required to create a sustainable future.

First of all, sustainable skills and knowledge should be implemented and applied in theory but also in practice. For this reasons it is important to shift from purely theoretical to more in practice or solution oriented approaches. In this respect, the introduction of ICT (e.g. internet accessibility and affordability, sensors of different type, etc.) will support more applied and participatory approaches(e.g. citizen science projects in biodiversity, environmental quality, etc.) and the diffusion of MOOCs (Massive Open Online Courses) to reach also peripheral areas. More diversified funding sources (families, fees, public-private partnerships, income-generating activities and donor support) are needed to finance education globally (UNESCO, 2016a, p. 31). Both the 2015 Incheon Declaration and the 2016 Kurashiki Declaration underline the importance of public funding to ensure quality education for all. More resources are needed to finance education globally (UNESCO, 2016a, p. 31).

Secondly, the involvement of the whole institutions in ESD needs to be improved and replace the current individual professors or singular disciplines involvement.

Thirdly, the training of qualified and knowledgeable teachers is necessary by complementing acquired skills with "pills of sustainability" for any subject, from history to biology and so on.

Moreover, new collaborations between hard and soft sciences are needed for an holistic approach. In this regard, networks are relevant to enhance sharing of best practises and materials. Furthermore, a stronger Global monitoring framework is advisable. In order to realize such a framework, indicators are needed for monitoring the 2030 Agenda for Sustainable Development at global, national and regional level (UNESCO, 2016b).

Finally, the adoption of ICT (e.g. internet accessibility and affordability, sensors of different type, etc.) is advisable to develop field work (e.g. citizen science projects in biodiversity, environmental quality, etc.) and leverage MOOCs (Massive Open Online Courses) to scale up quality learning.

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