The role of Higher Education to foster sustainable development. Practices, tools and solutions

- University of Siena -

1. Introduction:

In September 2015, during the United Nations General Assembly, a new global development agenda was adopted by all the Member states in order to define development priorities to 2030 in line with the Millennium Development Goals and the Education for All (EFA) goals, expired in 2015: the 2030 Agenda for Sustainable Development. The Agenda includes a set of 17 Sustainable Development Goals (SDGs) will succeed the Millennium Development Goals as reference goals for international development for the Post-2015. Within this new international framework, education was identified as a standalone goal (SDG4) in the Agenda's implementation, since it has a pivotal role as a key enabler for sustainable development. Education represents a strategic resource for building resilient and sustainable societies (UNESCO, 2013), because it plays a central role in changing the lifestyle and "minds" of people in relation to specific themes and may lead to right type of actions, attitudes and behaviour, creating conditions for active and aware citizenship (since the earliest age), that will lead to sustainable and inclusive growth.

> "ESD seeks to enable citizens around the globe to deal with the complexities, controversies and inequities rising out of issues relevant to environment, natural heritage, culture, society and economy. Simply put, ESD is education for the future, for everyone everywhere. It is an essential ingredient to ensure quality education and a successful transition to green societies and economies" (UNESCO, p. 12, 2012).

Education is an essential tool for contrasting negative phenomena - such as poverty, child mortality, unemployment, low education levels, lack of opportunities for the younger generation - and can also help to reduce the fatalities linked to hydro-geological risks; to transform agriculture, increasing food production and its fairer distribution in the world (UNESCO, 2016a). Furthermore, quality teaching is essential to shape common values and to improve social inclusion, the respect for common values, with the commitment to "leave no one behind" (H4All), especially vulnerable groups: women, people with disabilities, indigenous populations, ethnic and linguistic minorities, refugees and displaced populations (*Ibidem*).

Certainly, education can have a role not always positive for sustainability. It can "contribute to unsustainable practices, including overconsumption of resources, and exacerbate the loss of relatively sustainable indigenous knowledge and ways of living. Education may need to be shaped and transformed to ensure its impact is positive" (*Ibidem*, p. 11)[1]. For these reasons, it's necessary to analyse in detail what kind of education we need to ensure its impact is positive: best practices, tools and solutions able to foster sustainable development at the global level.

In the last decades, G7 ministers, international Organizations (OECD, UNESCO, etc.), different stakeholders have collectively defined and improved guidelines and principles on which a positive education ought to be based, through several Reports specifically focused on its capacity to foster a development, capable of balancing economic, social and environmental sustainability factors in equal harmony. In line with the 2015 Incheon Declaration, the *Kurashiki Declaration* identify eight guiding principles: education for harmonious coexistence; promoting girl's and women's empowerment for sustainable, inclusive and equitable growth; links between education, employment and society;

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[1] E.g.: "In Rwanda, a review of education policies and programmes over 1962–1994 found that the content contributed to categorizing and stigmatizing Hutu and Tutsi into exclusive groups. Language in education can also be a source of wider grievances" (Ibidem).

education that accommodates technological advance; enhancing and support teaching profession; evidence-based education policy; internationalization of education, sustainable development goal.

Starting from the guiding principles set out by G7 Education Ministers, the Table 2 on "Education and Sustainability" aims at analysing the inclusion of sustainability in HE curricula and classrooms by drawing from recent literature (Brandli, Castro, Newman, 2016; Filho, Skanavis, o Paço, Rogers, Kuznetsova, Castro, 2016) and reports and from a large selection of case studies and best practices at global level.

In particular, the introductory paper aims at identifying methodologies, tools and learning processes in order to conduct a holistic analysis of HE for sustainability and suggest future scenarios for its improvement. The paper highlights evidence, practices and policies looking in particular at:

1. Topics and the methods used in sustainability education in the face-to-face traditional classroom environment;
2. Characteristics of teaching sustainability in MOOCs (Massive Online Open Courses) across different massive open online learning Platforms.

To reach these findings, the University of Siena has developed the survey "The The role of Higher Education to foster sustainable development" in four languages (English, French, Spanish and Italian) to get as much information as possible on the ongoing educational activities on Education and Sustainability worldwide and has structured a digital repository of MOOCs called *ReSi* (REpository on Sustainable Issues). The survey is open to all Institutions (universities, research institutions, NGOs, etc.) that are involved in Education for sustainability and it has been spreading thanks to the support of several international networks (SDSN, EUA, WEEC).

The paper is structured as follows: after two preliminary paragraphs on the background to ESD (§2) and the new skill demands raising from changing job opportunities in greening field of economic (§3); it examines: the key actors for ESD: intergovernmental institutions, universities and networks (§4); the inclusion of sustainability in HE teaching activities (§5) - with a focus on methodologies, tools, learning processes (§5.1) and specific examples of best practices (§5.2) - the role of ICT, in particular the MOOCs, in determine new learning possibilities (§6- 6.3). Finally, the paper identifies some current barriers to the EDS and suggests specific actions for the improvement of sustainability in HE at the same time (§7). The paper "Annex A" (§8) provides a summary table on the last *Unesco policy recommendations* on SDG4 (UNESCO, 2016a).

2. Background to the Education for Sustainable Development.

Nowadays, there is a growing international recognition of ESD as an integral element of sustainable development. However, ESD - namely 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 mentioned the "sustainability education" for the first time and in **1992** the concept was taken up and stressed in the Agenda 21 from the Earth Summit of the United Nations Conference on Environment and Development (Zehui, et al., 2015). In **2013**, during the 37th session of the UNESCO General Conference, the *Global Action Program* (GAP) on Sustainable Development Education was approved and, in **2014,** the UNESCO[2] published the "Roadmap for Implementing the Global Action Programme on Education for Sustainable Development" to mobilise the community of stakeholders for Education for Sustainable Development for urgent action to further strengthen and scale up Education for Sustainable Development (ESD).

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[2] 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.
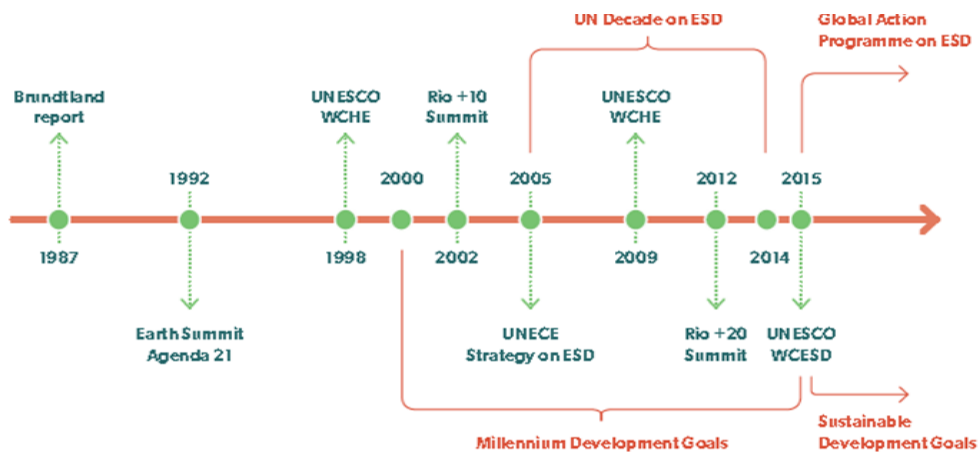
Fig. 1. Timeline of the progress of ESD global efforts with an Impact on HE in the UNECE region.
Source: UE4SD (2015, p. 22)

The GAP combines two-fold approach to scale up ESD action: (a) integrating sustainable development into education and (b) integrating education into sustainable development (Unesco, 2014).
In accordance with this whole approach, the programme has two objectives (*Ibidem*, p. 14).

> **Objective 1** "To reorient education and learning so that everyone has the opportunity to acquire the knowledge, skills, values and attitudes that empower them to contribute to sustainable development".
> **Objective 2** "To strengthen education and learning in all agendas, programmes and activities that promote sustainable development".

Sustainable development and education for sustainable development are two sides of the same medal[3]. For these reasons, education is one of the top priorities of the international political agenda on Sustainability. The *Kurashiki Declaration*, which was signed during the G7 Kurashiki Education Ministers' Meeting on 14 May **2016** in Japan, emphasizes this idea, placing strong focus on education as "basic human right [...] essential for the development of peaceful, prosperous and sustainable societies" (Kurashiki Declaration, p. 3).
The growing centrality of education in sustainable development is connect to the increase in the number of courses and books edited 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 the countries (27 out of 32) referred to the adoption of ESD strategies in HE at the national and / or regional scale (UE4SD, 2015). A growing number of the workplace-based programmes called TVET - *Technical Vocational Education and Training* - include ESD in their programmes.

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3 The tight interconnections between education and the other aspects of Sustainability have been analysed by scholars. In particular, Vladimirova and Le Blanc (2015) show how well such links are represented in 40 global reports published by the United Nations.

3. Greening TVET: changing job opportunities and new skill demands

GEM Report from 12 countries showed that about 20% of youth 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. Green jobs have a high projected level of growth between now and 2024, especially in lower income countries (*Ibidem*). This is determined by two processes: on the one hand, the development of the green industry and of the green economy sector and, on the other hand, the demand of new "green skills" in traditional sectors. Technological innovations, environmental policies, the consequences of climate change and new habits of consumption are all factors that determine this new (and growing) demand. According to recent statistics, the growth of the green job market is anticipated to continue to outstrip the growth of other markets. This is depicted in the following figure, reproduced (fig. 2). During the period 2000–13 there was a steady pattern of net job creation within the environmental economy. Annual employment increases were in the range of 2–6 % for most years. For two years in the early 2000s, in 2002 and 2003, the employment remained almost unchanged. Subsequently, it, however, quickly returned to an upward trend. Its growth substantially reduced its pace in 2012 and 2013 again and a very slight contraction was recorded in 2014.
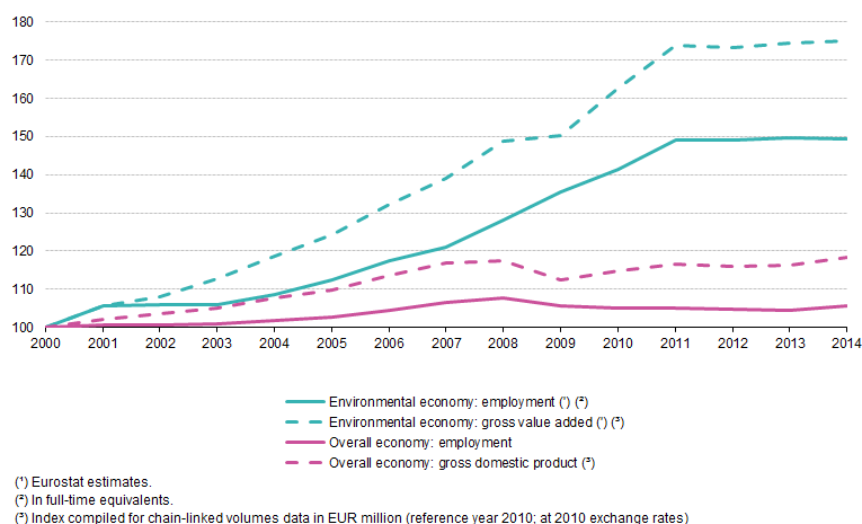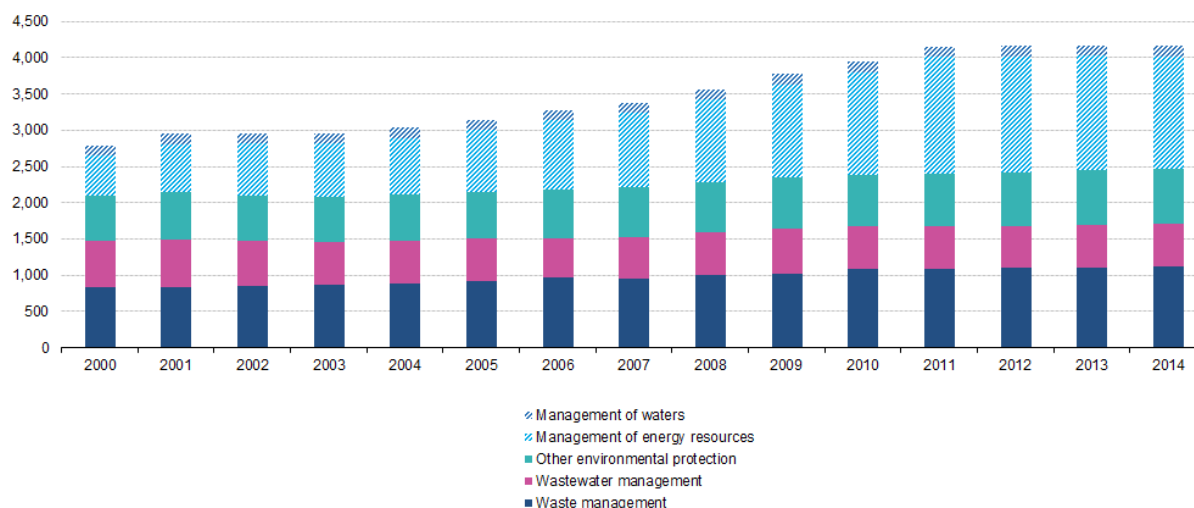

(¹) Eurostat estimates.
(²) In full-time equivalents.
(³) Index compiled for chain-linked volumes data in EUR million (reference year 2010; at 2010 exchange rates)

Fig. 2: The growth of the green job market
Source: Eurostat Development of key indicators for the environmental economy and the overall economy, EU-28, (2000-2014).

Fig. 3: Employment by environmental domain according to CEPA (the classification of environmental protection activities)
Source: Eurostat Development of key indicators for the environmental economy and the overall economy, EU-28, (2000-2014).

Figure 3 analyses employment by environmental domain according to groupings of environmental protection activities (CEPA) and the classification of resource management activities (CReMA), which are specific classifications for environmental accounts (see data sources and availability for more information). The figure presents an analysis by type of environmental action performed (environmental protection or resource management) and type of natural asset concerned. The growing number of persons employed within the environmental economy since 2000 was mainly due to growth in the management of energy resources, especially those concerning the production of energy from renewable sources (such as wind and solar power) and the production of equipment and installations for heat and energy saving. Achieving quality education on sustainability and extending it to everyone can therefore provide access to new jobs and thus overcome current (or future) forms of poverty caused by unemployment rates that are lower among the more educated people (UNESCO-UNEVOC, 2013). Technology has reduced demand for medium-skill jobs, such as sales workers and machine operators, because their activities are more easily automated (UNESCO, 2016a).

4. Key actors for ESD: intergovernmental institutions, universities and networks

> "The greening process has to be backed up by all relevant stakeholders on an institutional, national and global level (three-tier approach). For this purpose, close dialogue and cooperation between all actors of the education system is necessary" (UNESCO-UNEVOC, 2013, p. 7).

The implementation of ESD is carried out by the major intergovernmental institutions active in the field of education (eg UNESCO, UNECE), national governments whose task is to develop HE strategies (UE4SD, 2015), by universities and research centres.
Within this complex framework of different actors, national and sub-regional education networks also play a key role in promoting ESD has underlined by the EU Sustainable Development Strategy. 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 solutions to the different problems linked to SD. In the flourishing panorama of networks, table number 1 shows a

selection of the main ones: 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).

Network name	Website
SDSN- *UN Sustainable Development Solutions Network*	http://unsdsn.org
SDG Academy	https://courses.sdgacademy.org/
IAU-HESD. *International Association of University*	http://www.iau-hesd.net/
IARU. *International Alliance of Research Universitie*s	http://www.iaruni.org/
COPERNICUS Alliance. *European Network on Higher Education for Sustainable Development*	http://www.copernicus-alliance.org/
HESI - The Health and Environmental Sciences Institute	http://www.hesiglobal.org/
GUPES – Global Universities Partnership on Environment and Sustainability	http://gupes.org
GULF - Global University Leader Forum	https://www.weforum.org
ISCN - International Sustainable Campus Network	http://www.international-sustainable-campus-network.org/
WEEC - World Environmental Education Congress Network	http://weecnetwork.org/
AASHE - The Association for the Advancement of Sustainability in Higher Education.	http://www.aashe.org/
UE4SD - The University Educators for Sustainable Develompment	http://www.ue4sd.eu
ACU – The Association of Commonwealth Universities	https://www.acu.ac.uk/
SEPN - Sustainability Education Policy Network	http://sepn.ca/
ProSPER.Net - Promotion of Sustainability in Postgraduate Education and Research Network (UNIR, UN IAC, Japan).	http://prospernet.ias.unu.edu/
Campus Compact	http://compact.org/
GACER - Global Alliance of Community Engaged Research	https://ucpsarnet.iglooprojects.org
GUNi - Global Universities Network for Innovation	http://www.guninetwork.org
PASCAL International Observatory	http://pascalobservatory.org
MedUnNET - Mediterranean professional development network for ESD	http://platform.ue4sd.eu
GHESP - Global Higher Education for Sustainability Partnership	https://sustainabledevelopment.un.org
ULSF - University Leaders for a Sustainable Future (United States of America)	http://ulsf.org/
PIURN - Pacific Islands Universities Research Network	https://sustainabledevelopment.un.org/partnership/?p=7753
SFA- Sustainable Futures Academy	https://yellow.place/en/sustainable-futures-academy-salzburg-austria
MEdIES - Baltic University Programme	www.balticuniv.uu.se/index.php/.../doc.../502-the-medies-network-for-esd
MIO-ECSDE - Mediterranean Education Initiative for Environment and Sustainability	http://mio-ecsde.org/our-networks/

Tab. 1: Networks on ESD and SD

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 (Tibury, 2011).

Recently, GEM (Unesco, 2016) suggests a "*Whole Approach to Sustainability*" according to which Universities should develop: curricular and extracurricular activities, teaching, research as well as environment-friendly educational structures. They should also cure the relationship between the world of education and the wider social context in which they operate, with a view to "become exemplary spaces that breathe sustainability – inclusive, democratic, healthy, carbon-neutral places that lay the foundation for achieving the SDGs" (*Ibidem*, p. 34).

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; phd and so on.
2. **Research on Sustainability.** Integration of Sustainability in disciplinary and interdisciplinary research activities related to Sustainable Development Goals.
3. **Green campus**. Most universities with a focus on sustainable development education are also concerned with the concrete sustainability of their campus buildings, promoting and leading campus initiatives such as solar panel installation, bike sharing, and a recycle shop to integrate sustainability through both passive and active learning; eg, ISCN - International Sustainable Campus Network.

The paper will address in greater detail the first strategy: the integration of sustainability into teaching activities.

5. The inclusion of sustainability in HE teaching activities

The very transdimensional nature of sustainability may hinder its translation to an educational praxis; moreover it makes the field of ESD very complex and in "a considerable state of flux" (Wortham-Galvin et al,, 2017, p. 365). In general terms, ESD represents an "umbrella concept" that covers a broad range of themes and aspects to cope with the complexities posed by the socio-environmental issues; such complexities are often grouped into the well known three dimensions: economic, social, and environmental (fig. 4).

Fig. 4: The matrix of Sustainability: economic, social, and environmental dimensions
Source: http://www.keywordsuggests.com.

UNESCO (2012, p. 18) has identified a list of ESD-related "adjectives" which include the following:
1. Environmental
2. Peace
3. Human rights

4. Consumer
5. Development
6. Health
7. HIV/AIDS
8. Biodiversity
9. Gender
10. Inclusive
11. Multi-cultural
12. Holistic
13. Global
14. Citizenship
15. Disaster risk reduction (DRR)
16. Climate change (CC)
17. Food security

In order to highlight the main topics addressed by HE courses, we collected data on courses offered by international universities which are advertised in two of the most relevant career platforms (Prospects and Masterstudies)[4] and in the HESD repository by IAU, filtered by the keywords "sustainability" and "sustainable development", with items occurring more than three times. Out of the 515 courses which include master, master of science, phd, programmes and bachelor, the analysis has identified the topics from the titles (figg. 5-6). Furthermore the analysis of co-occurrence reinforce the analysis showing that the offer is diversified but certainly concentrated. The most recurring terms in the course titles analysed (461+32+20) show that - apart form the keyword sustainability and sustainable - most of the courses offer education programmes on energy and renewable energies, architecture and design, business management. Other topics which are so relevant for a more sustainable future seems to be lagging behind (agriculture, food and consumption, and especially transport).
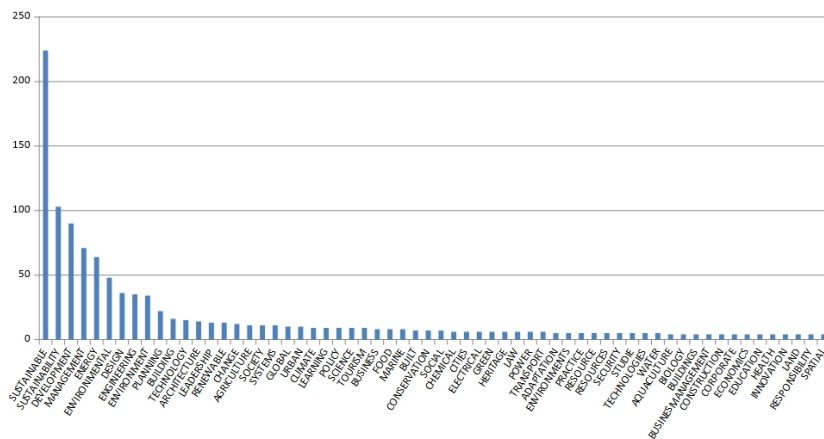

Fig. 5: Word frequency from course title.
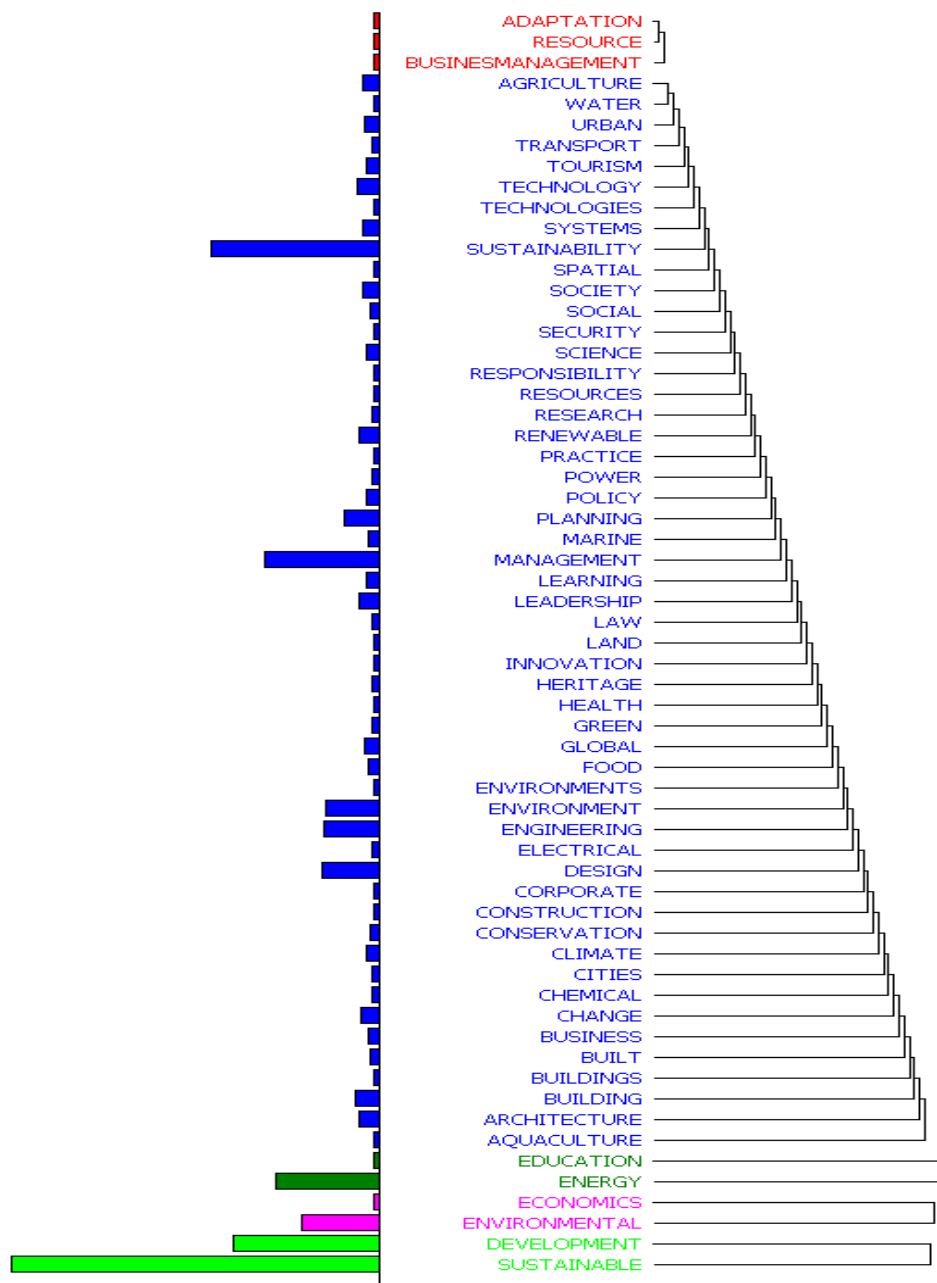*Source*: Ladest (Laboratory of socio-geographical research, University of Siena)

Fig. 6: Word clusters from course title.
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

Distribution of the offer is highly concentrated in certain countries and also in some cities whose universities develop many activities (fig. 7). It must be taken into account that the data are biased by the origins of the platform. The high concentration at European level in UK is due to the fact that the data sources used in the analysis are British but generally the offer of internation courses in English is definitely concentrated in Uk.
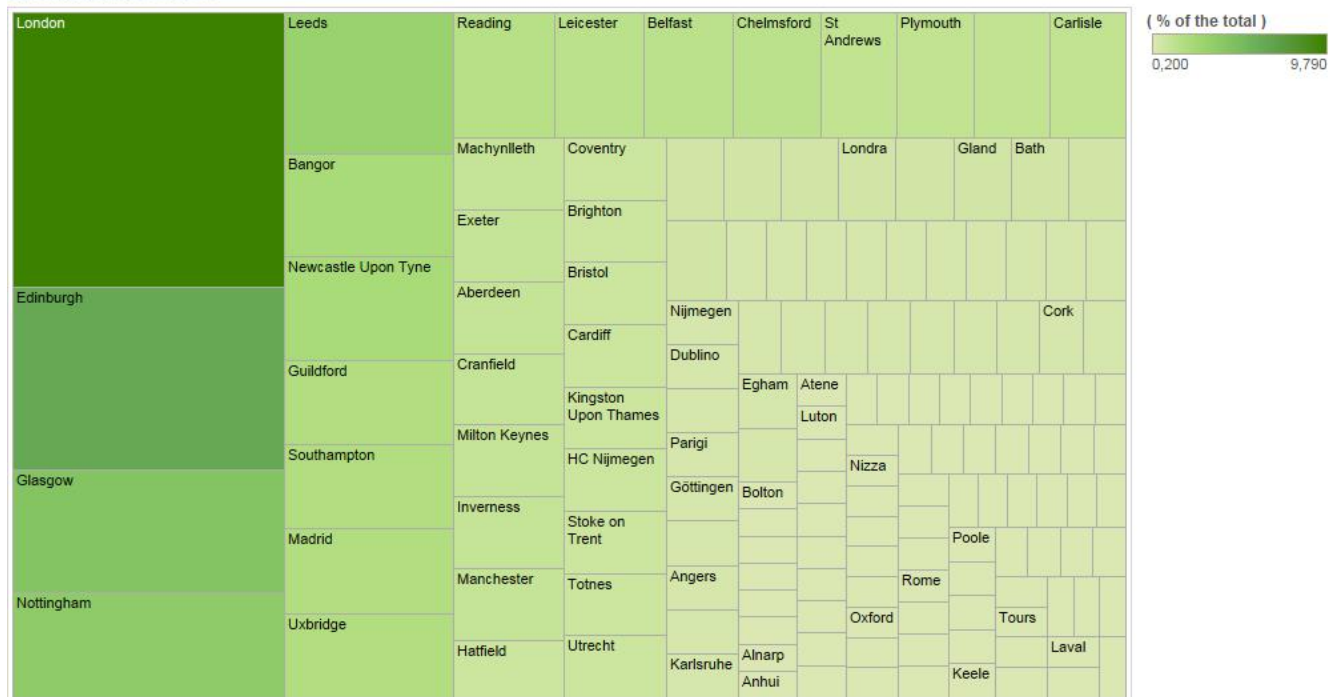
Fig. 7: The distribution of the offer in Prospects and Masterstudies platforms.
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

5. 1. Methodologies, tools, learning processes

In order to respond to the requirements of SD, HE needs to innovate and "transform itself" (Tilbury, 2011). Indeed, the UNESCO report on education and skills identifies "four lens"[5] (cita in nota) (UNESCO, 2012, p. 12) which can foster this transformative process of HE:

1. **An integrative lens** referring to a holistic perspective, that is a prerequisite for taking into account the multiple aspects of sustainability (e.g. ecological, environmental, economic, socio-cultural; local, regional and global; past, present and future);
2. **A critical lens**: interrogating prevalent ideas that could be unsustainable (e.g. the fact that a continuous economic growth is depending on consumerism and its associated lifestyles).
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 isn't a unique way to live or do business that is the most sustainable forever and suitable for every places. Places and people around the world are different and times will change and, for this reason sustainability needs to be tared according to realities change.

ESD engages universities and colleges in a quest for interdisciplinary and participatory pedagogies and learning strategies, using helpful tools as "social learning" that "provides an opportunity for the

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5 Cfr. "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).

'emergence' of new solutions within a given dialogue (Wals, 2009)" (Dlouhá et al., 2013, p. 6). For even, working together and in cooperation is in line with the principles and values of sustainability.
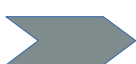
> "For education to be transformative in support of the new sustainable development agenda, 'education as usual' will not suffice. Learning should foster thinking that is relational, integrative, empathetic, anticipatory and systemic" (UNESCO, 2016a, p. 34).

To this end, targeted actions can be envisaged within the educational structure. Inside the classroom, every action is related to the interaction between different agents involved into the educational action —instructor, student, and content—thus configuring specific methodological elements. These are defined through two opposite perspectives that interact each others, helping to implement the level of inclusion of sustainability in the teaching/learning processes (García-González et al. 2016) (tab. 2).

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, implementing the tool for learning, shares the responsibilities for what happens in the classroom with the students.	
2 **Competencies**	**Specific ◄──► Transversal**
Sustainability enables to incorporate 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 reality**	**Unintegrated ◄──► Integrated**
The socio-environmental reality is complex so much that there are many perspectives through know and understand it. At the same time, there are also different ways to resolve any given problem. It's necessary to improve link between this reality with knowledge of the discipline, adopting a systematic and interdisciplinary perspective of sustainability.	
4 **Resources**	**Internal ──► External**
In order to promote sustainability, it's central to combine all the resources available and their synergies: internal resources and external resources (field trips, dialogue with experts, practice in specific centres, etc.). The environment should enter the classroom, as well the classroom should get out of the University.	
5 **Evaluation**	**Accreditation ◄──► Procedural**
Accreditation and procedural evaluations are complementary. The first one, asked by the legal context, is a final assessment that ensures to society what has been learnt. Whereas, the second one includes information about cognitive, affective, and action aspects about the process and the participants. It helps to regulate teaching and learning. Students should understand both evaluation processes which help them to reflect, value and improve their capacity to face the complexities of the socio-environmental problems.	
6 **Classroom dynamics**	**Closed ◄──► Open**
A sustainable dynamic allows to put order into ideas, to settle 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. The implementation of this dialogue addresses knowledge through negotiation of meaning. By this way, it can be possible to recreate situations in the classrooms that the students will meet up with during their professional and personal life.	

Tab. 2: Methodological elements for the integration of sustainability into the classrooms.
Source: García-González et al. (2016).

According to Filho et al. (2015, p. 20), specific trend change can be identified in ESD teaching (tab. 3)

Shifts from		To be more inclusive of
Discipline focused courses		Inter and multidisciplinary courses
Academic impacts		Social impact
Teaching that informs		Teaching that transforms
Researcher as expert		Researcher as partner

Tab. 3: Trend change in ESD teaching.
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

5.2. An action-oriented approach to ESD: some Best Practices

Often literature provides the most cited definition of sustainable development – as the "*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 lead a solution-oriented approach to sustainability and to implement HE activities on these themes, it is interesting to observe how different universities have lead sustainability issues in 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) (tab. 4).

Fields of innovations:	Examples of Best Practices:
Whole-institution approach to educating for sustainability	Sustainable infrastructure developments, volunteering opportunities, sustainability awards, see funding for sustainability projects, academic initiatives, internships **(University of Edinburgh).** Centre for sustainable development that works in five focus areas: teaching, research, operations, tranfer, and governance to enpower students as change agents **(Stuttgard 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 the curriculum	Integrated courses: a broad perspective that crosses all disciplines **(Hong Kong University).** (see also the *Transdisciplinary Course* of **University of Siena** in the box)
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 involvment **(Technical University of Madrid).**

Tab. 4: Examples of best practices and fields of innovations
Source: the 2017 WEF ISCN-GULF Report.

Transdisciplinary Course on Sustainability at Siena University
The University of Siena offers since 2013, a transdisciplinary course on sustainability which is structured in 24 lessons (March to June) which address the basic aspects related to the environment, the economy and social and legal-institutional sustainability. It is taught by the University staff and by invited speakers from private enterprises or public institutions. The innovative character is not only the transidiciplinarity but also the fact that it is offered to the Univeristy students as free choice credits Each year the course attracted 142 students (average) with a good gender balance (66 female and 75 males). The target students BSc and MSc students from any disciplinary program in UNISI, technical/administrative staff in UNISI, external practitioners, officers and stakeholders. The background of the students has been highly diversified: more than 50 different degrees both form hard and soft sciences, including (in order of their importance) economics (the most represented, 27%), management and governance, medicine and chemistry, biotechnologies, political sciences and earth and environmental sciences. The 6% of the participants have been administrative university personnel who attended the course as part of their life long learning programme; a small proportion (4%) has been represented by members of other research institutions (such as ESA) or employees from banks and large enterprises (e.g. Trenitalia).

Best Practices can provide useful guidelines for other users, but of course any initiative must adapt to the specific context:

> "We recognize that each institution has its own unique culture, context, and characteristics and that sustainability initiatives should take these factors into account in order to ensure that they are aligned with and leverage the institutions key assets and aspirations. Indeed, the process of discovering the best path forward for a college or university should make full use of their experiential knowledge, one of the canons of sustainability theory and practice" (Wortham-Galvin et al, 2017, p. 378).

6. The role of ICT: the experience of MOOCs (*Massive Online Open Courses*)

Globalization and technological innovation (i.e. social network, Internet of Everything - IoE) have brought significant changes, opening new opportunities for wider access to information and to knowledge. At the same time, their impact on society has allowed more (and different) exchange between people worldwide. The use of the internet, and its capacity to lay large voluntary networks at very low cost, can create and improve low cost knowledge networks and peer reviewed materials for wide distribution (UNESCO, 2012) and it can also open up new possibilities in the field of education. To accommodate more learners and facilitate the spread of knowledge, HE looks now also at the important role played by technology and online learning (Daniel, Cano and Cervera, 2015). The growth of social media and open source platforms facilitates access to education (UNESCO, 2012, p. 24) and allows for more direct involvement of younger generations:

> "Promising 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. Mass mobilisation of youth towards sustainable development requires empowering youth with information on the impacts of their daily choices and actions, while tapping into their creativity and determination to find workable and innovative solutions and alternatives" (UNESCO, 2014, p. 22).

In particular, Massive Open Online Courses (MOOCs) are recognized as "one of 30 the most promising trends in education until 2028 among", "the tool for 'innovative disruption' that will improve education" (Tirthali, 2016, p. 115). The online courses are capable of overcoming the barriers that distance presents. By this way, they could filling the gap between centre and peripheral areas in terms of learning opportunities given to this inhabitants and allow low- income students to get access to a quality learning without paying and moving from their place. MOOCs (and ICT more in general) can represent an enormous opportunity to introduce positive changes also across the developing world, especially since the availability expands and the cost of access continues to decline. The online courses could therefore be a "win-win situation": for society and for the environment, (reducing the environmental impact of movements)[6].

MOOCs could become an important milestone in the evolution of HE, as a way to reinforce rather than replace traditional universities and their courses (Daniel, Cano and Cervera, 2015).

6.1. MOOCs. Sustainability education in massive open online courses:

> The sustainability of the MOOCs and their place in the HE system depends not only on the cost-revenue maths of MOOCs, but in realizing ways in which various learning systems, digital, face to face or hybrid, massive or one to one, including MOOCs, fit together to enhance the current system of HE to make it more relevant for the students individually and as part of the society in its current as well as future form" (Tirthali, 2016, pp. 122-123).

The MOOC is a specific form of online course in the open education environment which provides free open learning opportunities to a large number of people. It's characterized by being open and using social online interaction. The first MOOC took off in 2008 at the University of Manitoba in Canada. Despite their hight cost of implementation, the number of MOOCs grew at a rate of greater than 15 courses per day, in particular the user growth rate is greater than 2,000% (160,000 learners at one university in 2011 to 35,000,000 learners at 570 universities and twelve providers in 2015)[7] (fig. 8).
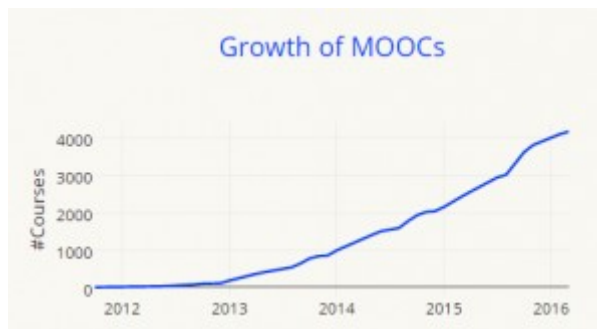

Fig. 8: Growth of MOOCs
Source: *d*learn. European digital learning network on Class Center Data

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6 Of course, the "digital divide" still exists. This term describes a gap in the access and use of information and communication technology. The divide may refer to inequalities between countries or geographic areas, but also between different individuals categories (e.s.: the poor/the wealthy; young and old people; female/male; etc.).

7 Cfr. http://www.onlinecoursereport.com/state-of-the-mooc-2016-a-year-of-massive-landscape-change-for-massive-open-online-courses/
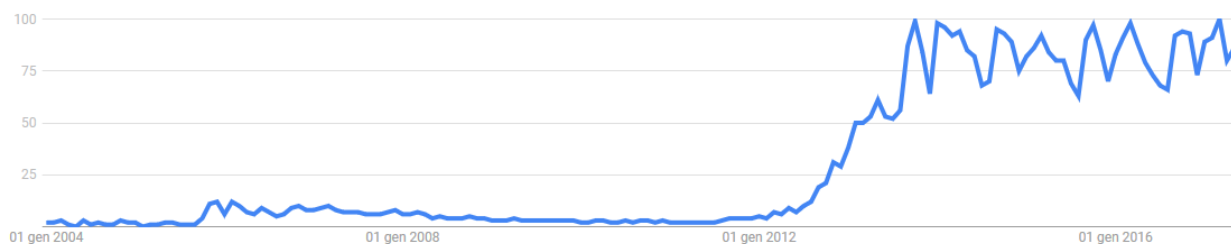
Fig. 9: The increase of searches on Google for the term "MOOC"
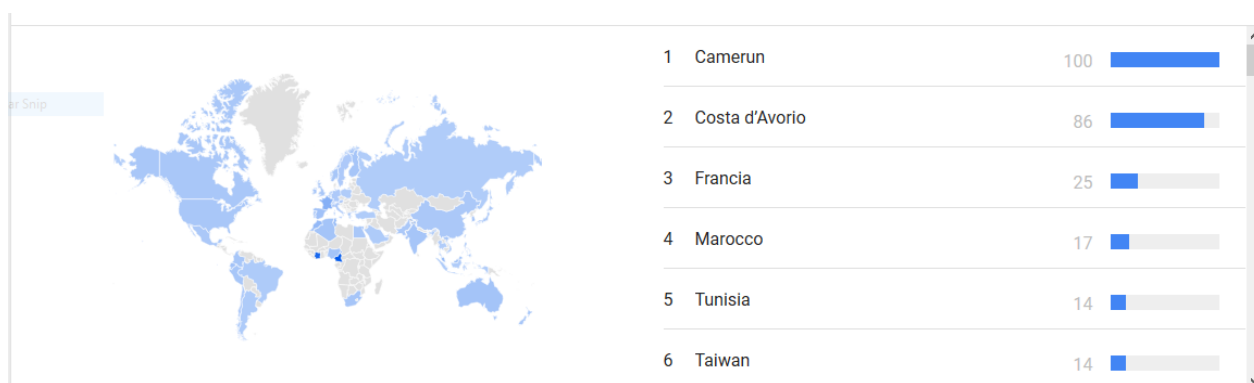*Source*: Google Trend

Fig. 10: The geographical distribution of the increase in the searches
Source: Google Trend

Whether MOOCs are run by individual universities or large consortia, they can present different designs. Many are collections of various learning resources: video with homework/assignments, and online quizzes or exams, others promote adaptive and personalized learning by student discussion forums. The courses are often blended learning experiences comprising of recorded lectures, discussion blogs, case studies and modular evaluations. The courses combine different teaching methods: lectures, self-study, and exercises, game-like labs. The participation of students from different parts of the world creates an intercultural learning and teaching environment.

The differences between the courses, their teaching model and the degree of interconnection between teacher and students and within students' groups can determine the quality and effectiveness of MOOCs.

The main MOOC platforms – such Edx, Coursera and Udacity - have created an interactive environment that allows learning dynamics "many to many, a welcome change for educators who celebrate multiplicity of opinion" (Tirthali, 2016, p. 122). Trough blogs, chat, social networks and (in some case) virtual groups, thousands of learners are connected each others in order to debate ideas, discuss course materials, and get help mastering concepts: "Social interactions are open by default to encourage vicarious learning and allow all to benefit from the discussion. We encourage everyone to be sociable because one of the best ways to learn is through talking with others" (FutureLearner)[8].

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8 Cfr. https://www.futurelearn.com/about-futurelearn/our-principles.

	MOOCs
Strengths	- Innovation in training and attractiveness to new students, student recruitment, courses for professionals - Flexibility and availability of training - International visibility
Weaknesses	- Underestimation of the organizational aspects - Lack of teacher training opportunities - Other: institutional organization

Tab. 5: Strengths and weaknesses of MOOCs
Source: CRUI (Conferenza dei Rettori delle Università Italiane).

The concept of "open education" doesn't refer only to free access to material, but also to the wider idea of a whole opening in learning processes, "breking down the traditional roles of instructor and student, moving away from prescribed content and encouraging variety of ways of showing mastery" (Tirthali, 2016, p. 119). The "opening up learning" is the basis of a new "philosophy" (MiríadaX)[9], 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)[10].

Direct and indirect benefits of the MOOCs for the Universities
Verified certificates (usually with fee).
Recruitment of new students.
Partnership with other HEIs.

6.2. Partecipation in MOOCs: users' profiles and the most recent trends

MOOCs attract diverse students from different countries. Research on participants' demographics and reasons for enrolling in MOOCs are yet rare (Bayeck, 2016). MOOC learners are in their vast majority college degree holders and employed. Males often constitute the majority of learners; but specific studies sustained that the gender gap is related to the type of course taught[11].
Learners frequently join a MOOC for educational pursuits, professional development, or to learn new things:

> "However, the reason for joining MOOCs was also dependent on the type of course offered. For instance, 74.6% of students who took humanities courses (e.g., poetry, or music) were driven by curiosity and 11.9% took these courses to improve their job performance (Christensen et al., 2013). For the social sciences MOOCs, 54.1% enrolled to acquire skills to improve their job performance; half registered out of curiosity (Christensen et al. 2013). However, 39% of students who joined science, health science and math MOOCs did so to gain skills that will help them do their job better (Christensen et al., 2013)" (Bayeck, 2016, p. 225).

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9 "Conoce nuestra filosofía: Con MiríadaX ponemos a disposición de 1.345 universidades iberoamericanas un espacio en el que puedan transmitir conocimiento de forma libre, para fomentar entre todos el intercambio de experiencias e ideas entorno al mismo entre quienes lo reciben a través de la red", Cfr. https://miriadax.net/web/guest/nuestra-filosofia.

10 Cfr. https://www.edx.org/course/resilient-future-science-technology-epflx-tech4drr.

11 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.

The most recent trends in MOOCs
- MOOCs No Longer Massive
- Regional MOOC Providers Pick up
- Decreasing Number of Standalone Courses
- Increasing of Paid Only Courses

6.3. ReSi: the Repository of Education on Sustainable Issues (University of Siena).

The University of Siena structured through the software Semantic Media Wiki a digital repository of MOOCs called ReSi (*Repository on Sustainable Issues*) to understand how world-class university teach sustainability-related knowledge in an open online environment. Sample MOOCs were searched for from the Platform "MOOC list" which offers a complete list of the main Massive Open Online Courses available on Sustainability since 2015, by using "sustainability" and "sustainable development" in English as key-words. 139 courses were collected through *ReSi* and analysed using SPSS in order to conduct a content analysis of the MOOCs identified in the first step. *ReSi* collected data on the main characteristics of the online courses such as the topics, the languages, the geographic distribution of the educational offer, the learner interaction (including blog, social networks, etc.).
Most of the sustainability-related courses are incorporated by Edx, Coursera, FutureLearn and FUN Platforms (tab. 6).

Platform:	Frequency:	Percentage (%)
EdX	37	26,6
Coursera	33	23,7
FutureLear	21	15,1
FUN	13	9,4

Tab. 6: Main platforms of sustainability-related online courses
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

In accordance with the study of 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 it's shorter than a typical course at University. Moreover, the majority of the courses analysed encourage students to attend the course modules from 1 to 4 hours per week (tab. 8).
118 MOOCs issue a certificate, 41 of these for hire (the average cost of the Certificate is between 25 and 150 dollars). Some MOOCs provide pay upgrading that allows an unlimited access to the courses and to all the material provided at any point in future.

Weekly hours	Frequency	Percentage (%)
1-4	**71**	**51,1**
5-10	40	28,8
> 10	3	2,2
Not specify	25	18,0
Total	139	100,0

Tab. 7: MOOCs: weekly hours of classes.
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

Sometimes the MOOCs present interactive case studies in order to challenge the shared brainpower of course participants[12]. Some courses emphasize peer-to-peer and mentore project-based learning by using a **case-study method** (e.g. in the course titled "Managing the Arts: Marketing for Cultural Organizations"), designed by Leuphana Digital School in co-operation with the Goethe-Institut e.V. the participants learned "how to apply theory and marketing strategies to four existing pre-selected art institutions and their real-life challenges"[13].
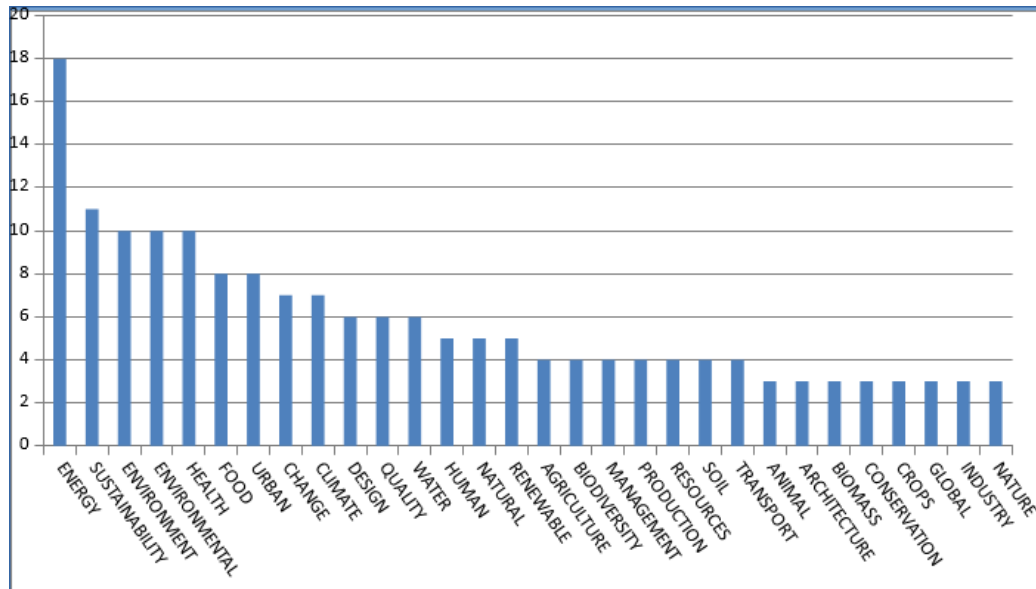

Fig. 11: The topics of the MOOCs.
Source: Ladest (Laboratory of socio-geographical research, University of Siena)

Furthermore, MOOCs offer on Sustainability issues is very diversified (fig. 11), but there are concentrations on certain areas such as energy, environment and health.

7. Sustainability: learn globally, teach locally

"One central motive that all these pedagogies – that is, principles and methods of instruction – have in common is an eff ort to make the educational process directly relevant to people's lives, t**o focus learning on the solutions to real problems that people are experiencing** (KIS, United Kingdom)" (UNESCO, 2012, p. 21).

Sustainable skills and knowledge should be implemented and applied in theory and practice. Challenges related to the impact of man on the environment are constantly evolving, and that is why education must be thought (and structured) in life-long learning[14].

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12 Cfr. https://www.canvas.net/browse/centreofexpertise/courses/biobased-economy.

13 Cfr. http://digital.leuphana.com/courses/managing-the-arts-2015/. As an example of action-based learning, see also the REI Mooc: https://learning.climate-kic.org/courses/rei-mooc?
utm_medium=referral&utm_campaign=pagebody&utm_source=mooc-list.

14 Beyond formal education, it's also necessary a) to learn and exchange knowledge related to sustainable development also in everyday life with peers, friends and relatives (*Learning through work and daily life*)(UNESCO, 2016a); b) to learn from the past when the relationship with nature and the environment was structured within the family and the traditional communities (what in Italy we call "*saper fare*").

On the basis of our findings, participatory learning – increased with the use of web 2.0 tools - contributes to the strength of sustainability in HE, enabling learners to contribute in varied ways to a safer, greener and fairer planet for all. Moreover, participatory learning in ESD could drive them to citizens with awareness[15]. As seen, "*Openness*" has become a keyword for all emerging pedagogies, aimed at stimulating innovation on three levels: learning processes; research and society (Tammaro, Pantò, De Rosa, Nascimbeni, 2016). However, there are still some critical issues and concerns that should be observed in order to try to fix that. First of all, there is a significant delay in reaching global education commitments (SDG4), as underlined by UNESCO (2016a, p. 33):

> "The world will be 50 years late in achieving its global education commitments. On current trends, universal primary completion will be achieved in 2042; universal lower secondary completion in 2059; and universal upper secondary completion in 2084. The poorest countries will achieve universal primary education over 100 years later than the richest. The principal conclusion is that, in low and middle income countries alike, the SDG scenario requires an unprecedented break with past trends if the attainment component of target 4.1 is to be achieved".

Barriers to ESD

- Difficulty to institutionalize sustainability in higher education for the very transdimensional nature of sustainability.

- Across-the board reductions in the financing of research and education.

Sustainable shift of HE

- Increase the level of participation and democratic engagement

- Strengthen networking and partnerships//Revitalized global partnership

- Empower HE institution to customise solutions based on needs

- Provide equal access to learning

- Leverage ICT to scale up quality learning

- Transform Ministries (National bodies) delivery capabilities

- Partner with communities, Private sectors at scale (locally)

- Increase networking

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1. **Increase the weigh of social and cultural issues on ESD programs.** The concentration of training and education programs on energy and technology betrays the leading market demand in these sectors, while other (more socially or culturally oriented) seems to be lagging behind.
2. **Difficulty to institutionalize sustainability in higher education.**

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15 "A study of 35 countries showed that openness in classroom discussion led to an increase in the intention to participate in politics. In Israel and Italy, an open, participatory classroom climate has been shown to help students become more civically and politically involved" (UNESCO, 2016a, p. 23).
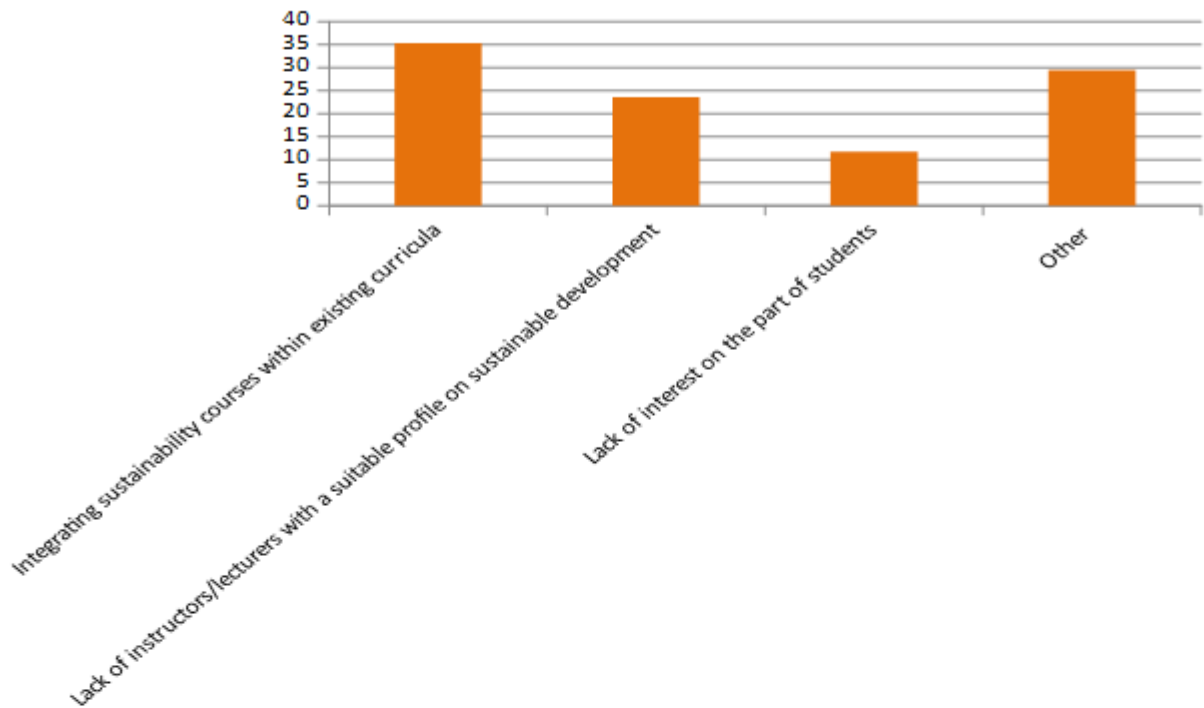
Fig. 12: The main challenges in setting up SD courses offering.
Source: Survey data - Ladest (Laboratory of socio-geographical research, University of Siena).

3. **Increase the level of participation and democratic engagement.**
4. **Strengthen networking and partnerships.** through networking and partnership, innovative and effective initiatives, best practices, approaches, and processes will be shared in order to support implementation of the GAP (Global Action Programme).
5. **Increase trans-disciplinary collaborations and cross-sectoral partnerships.**
6. **Specific measures are needed to mobilize domestic funds and address the funding gap between rich and poor countries.** 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. Actions to be taken (UNESCO, 2016a, p. 31):
   - Earmarking more funds for education through multilateral mechanisms;
   - Using more aid to build national authorities' capacity to increase;
   - Domestic resources; and better targeting aid to the countries and education levels most in need.

7. **The private sector (Prosperity and Profit) shouldn't never be over-represented in the partnership. Centrality of the other "two P", that is Planet and People.** Many educational systems try to expand and improve by diversifying their funding sources (families, fees, public-private partnerships, income-generating activities and donor support). Private sector must never be the main actor in financing or a basis for the public to decline to directly manage ESD. The coordination of different stakeholders becomes a topic of central concern:

20

"SDG-Education 2030 Steering Committee, Global Education Meetings, regional meetings and collective bodies of NGOs. **The Steering Committee** is expected to be the main mechanism to support countries, review progress and encourage coordination of partner activities" (UNESCO, 2016a, p. 32).

8. **Strengthen the Global monitoring framework.** Need to find indicators for monitoring the 2030 Agenda for Sustainable Development at global, national and regional level (UNESCO, 2016b). "The weakness of coordination efforts remains a critical issue" (UNESCO, 2016b); "The focus of M&E systems has been shifting from compliance to performance, shedding light on student learning outcomes" (UNESCO, 2016b).

9. Annex A

Unesco policy recommendations on SDG4:	
Support collaborations and synergies across all sectors and partners.	*Since systemic problems require multiple actors and diverse perspectives, stronger efforts are needed to involve all partners, including ministries, education experts, and civil society, at the local and national level, and across sectors.*
Governments need to view formal and non-formal education and training as key to their efforts to tackle cross-sector problems.	*Education can be an important tool for capacity-building in all sectors. Many SDG targets require specialized skills and expertise that education systems provide.*
Education can help reduce income inequality, but not on its own	*Expanding access by marginalized groups to good quality primary and secondary education will help ensure decent incomes and reduced disparity. Changes to labour market regulations and technology should not penalize workers in less secure jobs, especially in the informal sector.*
Education systems need increased and predictable financing to:	*a) universalize completion of primary and secondary education; (b) increase numbers of qualified, knowledgeable and motivated teachers; (c) provide good quality education to marginalized populations; and (d) prepare for the impact of climate change and the possibility of protracted conflict.*
IMPROVING EQUITY	
Universal primary and secondary education, especially for girls, is central to promoting women's autonomy and decisionmaking.	*Achieving this target would curtail population growth, transform social norms and practices across generations, and limit the burden on the planet.*
Education policies targeting minority, refugee and internally displaced populations should prioritize appropriate languages of instruction and ensure the use of non-biased curricular and learning materials.	*Building up a pool of qualified teachers proficient in appropriate languages is important in countries with high proportions of ethnic minorities and migrant populations.*
Urban planning needs to involve education planning, and not leave rural areas behind.	*Planning of education, among other basic services, for slum dwellers is vital. Public amenities and good quality teachers should be equitably distributed, and schools made safe and violence free. Rural areas with declining populations and rural school consolidation require planning attention and community involvement.*
CHANGING THE FOCUS OF EDUCATION	
In developing skills policies, education systems should consider both medium- and long-term needs and the implications of sustainable growth	*Teaching green skills to students and providing workers with opportunities to retrain and improve their skills are needed, as are changes in secondary and tertiary level curricula. Better cooperation with business and industry would improve relevance and quality of teaching.*
Civic, peace and sustainability education programmes can be important levers for SDG progress	*Effectively implemented, they can ensure a more equitable justice system, build capacity in judicial and law enforcement, foster less violent and more constructive societies, increase understanding of the links between culture, economy and environment, and prioritize actions that improve the lot of future generations.*

Tab. 4: Unesco policy recommendations.
Source: UNESCO (2016a, pp. 34-35)

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