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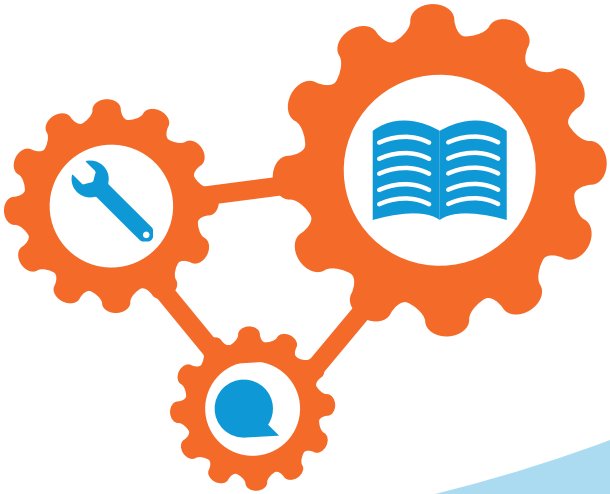
InnovationGym

Alfonso Molina

The InnovationGym

Promoting a national network of education for life and work in the 21st century



FONDAZIONE Mondo Digitale

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Introduction

An unprecedented combination of scientific, technological, organizational, economic, social, and cultural changes, added to a crisis of structural nature, is posing both serious challenges and major opportunities to 21st century Italy. We are facing a complex, dynamic, and interconnected world that gets more and more globalized every day.

The best way to prepare for the future is to take part in its creation with an attitude and mindset open to curiosity, research, and experimentation. We have to be alert, foster relationships, cooperate, and seek to create opportunities for happenstance, in other words, fortuitous positive encounters that can provide opportunities and have significant influence in our lives. Old habits and closed thinking are serious obstacles to the need to provide effective answers to the challenges the country is facing in this century. As Einstein wisely said: "We cannot solve our problems with the same thinking we used when we created them."

At the root of a proper answer to this challenge lies education - schools, universities, and the entire educational and cultural system that must innovate itself to prepare the young and, indeed, everybody to meet the challenges of work and life in the 21st century. The need is for an *education for life,* something that has long been acknowledged in the educational policies advocated by the European Union, international organizations such as UNESCO, and other countries like the USA. In fact, Europe has been promoting, on the one hand, the learning and development of *key competences* as essential elements for the success of people and nations and, on the other, the innovation of educational systems (schools, universities) to make such skills widely distributed throughout society, starting from the young. This requires a farsighted concept of both: (i) the challenges and necessary answers, and (ii) the innovation processes that must be implemented to realize the desired changes.

The objective of this document is to make a contribution to the innovation of the school system, taking advantage of the publication by the Italian Ministry of Education of the strategic policy document: *La Buona Scuola* (*The Good School*) (MIUR 2014). In particular, we wish to build on the important recognition that *La Buona Scuola* has given to the concept of new laboratories identified as InnovationGyms. The Fondazione Mondo Digitale proposed the concept of InnovationGym and a first

practical version was launched in Rome in March 2014. The InnovationGym has the potential to play a central role in the systematic diffusion of the so-called key competences in Italian society, through a gradual and systemic innovation process that builds on the capacity and excellence existing today in Italian schools.

It is obviously easier to innovate by starting afresh, outside the school system, but today the real challenge is to do it inside the existing structure, with all the difficulties and opportunities implied. This is the process that interests us most because it affects the lives of the people at work in over 40,000 Italian schools: teachers, directors, students, families, and administrative and technical personnel. It is also a process that involves the lives of all the nation's citizens and organizations because all can and must play a role: industry, the social sector, governmental authorities at various levels, and community organizations, in transforming into reality the far-reaching changes that will lead Italian education to a position of European and international excellence. We believe the proposal of the InnovationGym offers a path of great significance and potential for this ambitious objective. Of course, it cannot be the only route and, surely, there will be others (such as the introduction of digital skills in the didactics of every discipline or in the management of courses) with which InnovationGyms will interact in order to cover all dimensions of the complex school system. Here, we will concentrate only on InnovationGyms seeking to develop the concepts of InnovationGym, InnovationGym network, and InnovationGym movement. Implicit in the argument there will be an idea of systemic and evolutionary innovation process, starting from what exists today in each and every school.

First, we start with a brief summary of the challenges and opportunities that Italy faces and that make of the innovation of the school system a priority that can no longer be postponed.

Challenges and Opportunities

Figure 1 illustrates how scientific, technological, organizational, economic, and social changes are interacting with Italy's and other countries' structural crisis to create serious challenges but also opportunities. At the centre of the strategic response to this complex environment is education for life in the 21st century, with an emphasis on key or essential competences and the need for innovation in the school system.

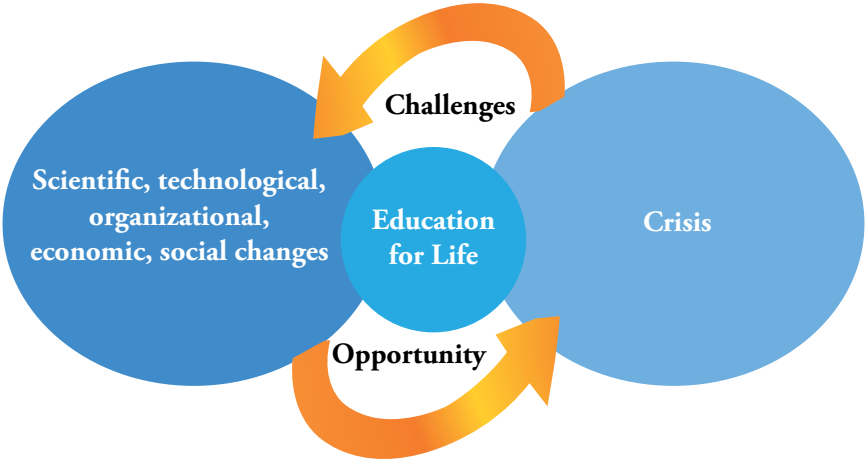

Figure 1.
Challenges and Opportunities of Education for Life

Scientific, Technological, Organizational and Industrial Change

The challenges societies face today are large-scale and wide-ranging. Considering only the impact of scientific, technological, organizational, and industrial change, people must prepare themselves to learn and innovate to be able to use the latest developments in the ICT world. For instance, 3D printers, laser cutters, and the other numerical control machines are now available at affordable costs. Personal and service robotics is growing fast with impact, among others, on the medical, security, environmental, and education sectors. Nanotechnology, big data, cloud computing,

cyber security, the internet of things and the internet of everything, digital art, augmented and immersive reality, the new developments in biotechnology, genomics, sustainable energy, space technology, and biofeedback technology fed by neuroscience, are all unfolding realities today. New forms of work organization and new markets are accompanying these developments in which open innovation and cooperation play important roles. We now find ourselves immersed in new terms that reflect new realities, such as crowdsourcing, crowdfunding, coworking, coliving, FabLabs, app economy, sharing economy, and most recently, Jeremy Rifkin's zero cost economy. Education itself is generating new terms and new procedures, such as flipped class and MOOCs (Massive Open Online Courses) that offer materials and courses with open content and open courseware. Nor must we forget the non-profit world currently in strong expansion. A recent study by Istat (Institute of Statistics of Italy) reported that non-profit organizations grew by 28% in the last ten years, providing jobs to 650,000 employees, whereas traditional companies grew only by 8.4%. New forms of organization are being created in this sector, such as the social enterprise, the social firm, social business, and we also see traditional for-profit companies implementing new forms of corporate responsibility. New forms of social financing are also arising, including crowdfunding and social investment bonds.

All these developments are radically changing the form and content of jobs, industry, finance, healthcare, education, and leisure. Only a few years ago, it was hard to foresee the enormous growth of the app economy – a world where the entry cost is minimal and even adolescents can create jobs for themselves as app developers, potentially becoming digital entrepreneurs. Many jobs are also threatened in the coming decades, in particular, all those whose procedures can be codified and for such reason easily automated. Figure 2 shows the evolution of routine-oriented work and creativity-oriented work in the USA in the period 1901–2006; it can be easily seen that the creativity-oriented jobs are the only ones showing growth, and even an acceleration in the final two decades (now employing as much as 30% of the workforce). All routine-oriented jobs are in decline, including in services, which had been growing until the last decades of the last century.

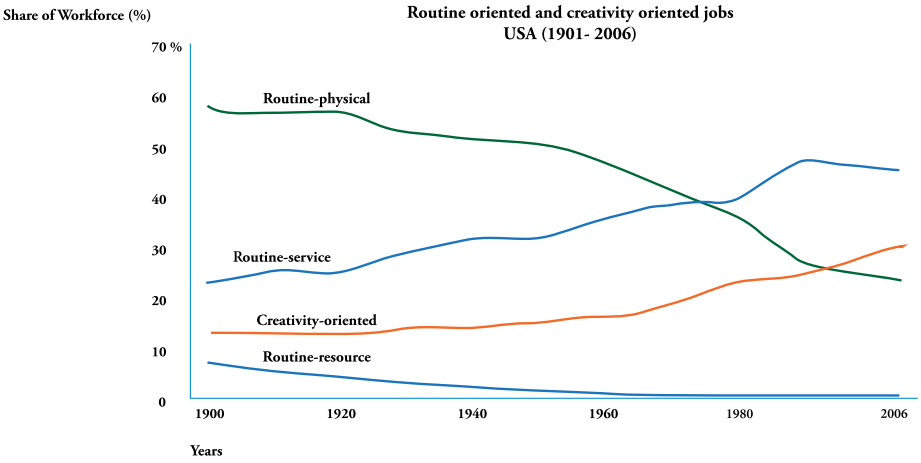

Figure 2.

Evolution of routine-oriented work and creativity-oriented work in the USA (1901-2006)

Source. Martin (2012).

Note. Classification of work: creativity-oriented and routine-oriented: (a) physical routine (e.g. automotive parts assembly); (b) routine services (e.g. file clerk, accountant, payroll officer); and (c) routine resources (e.g. coal miner)

In this context, digital skills play an essential role because the vast majority of jobs and social activities require the use of ICT in at least some form. In 1999, the *Future Work* Report released by the US Department of Labor contained the following warning: "The use of computers and the Internet in workplaces will become more pervasive and the functions performed using computers will dramatically increase. The influence of technology will go beyond new equipment and faster communications, as work and skills will be redefined and reorganized." (US Department of Labor 1999, p.vi) More recently, the European *New Skills for New Jobs* report stated: "Digital skills showcase the importance of the right mix of generic competences and technical skills. E-Skills range from the informally acquired functional digital skills to specialist practitioner skills. At one end of the spectrum, it is almost universally true that any job will require some level of e-skills. Digital and media literacy will be crucial both for life and work, and we should tend to the new goal of digital fluency. For an increasing number of jobs, indeed, digital fluency is increasingly required." (CEC 2010, p.25)

The demand for digital skills in the working world is rising steadily, and the current educational system is not capable of producing the number of ICT graduates required to satisfy it. In an address to the European Council in March 2013, J.M. Barroso, President of the European Commission at the time, reported the existence of a large gap between the ICT jobs available (estimated at nearly 900,000 for 2015) and the number of ICT graduates in Europe (slightly over 100,000 in 2015), amounting to a deficit of approximately 800,000 ICT graduates. In practice, despite the current levels of unemployment, the number of jobs in the digital sector grow by about 100,000 every year, yet the number of new graduates and qualified workers is insufficient to satisfy this need. (CEC 2013)

The robotic sector, which is frequently associated with job losses, foresees a positive impact translated in the creation of hundreds of thousands of jobs. The International Federation of Robotics (IFR) refers to the report *"Positive Impact of Industrial Robots on Employment"* published by Metra Martech in 2011, which concluded: "One million industrial robots currently in operation have been *directly* responsible for the creation of close to three million jobs ... A growth in robot use over the next five years will result in the creation of one million high quality jobs around the world. Robots will help to create jobs in some of the most critical industries of this century: consumer electronics, food, solar & wind power, and advanced battery manufacturing to name just a few." (IFR 2011) These jobs, however, must be filled by people with the appropriate skills, and today, as estimated by the World Economic Forum "10 million jobs with manufacturing organizations cannot be filled today due to a growing skills gap. Despite the high unemployment rate in many developed economies, companies are struggling to fill manufacturing jobs with the right talent. And emerging economies cannot fuel their growth without more talent." (WEF/Deloitte Touche Tohmatsu 2012, p.4)

The situation in the working world is not limited solely to the strategic importance of digital skills because the rapid progress of science and technology is such that completely new occupations are emerging constantly. Davidson (2011) wrote: "By one estimate, 65 percent of children entering grade school this year will end up working in careers that haven't been invented yet."(p.18) Although it is not entirely clear how this estimate has been reached, the point is that a significant percentage of tomorrow's jobs have yet to be created. This underscore the importance of the ability to learn and research permanently, throughout the course of one's life (lifelong

learning), to remain constantly up to date and prepared to deal with the changes and challenges that will certainly arise before each and every individual.

The Structural Crisis

Together with the challenges and opportunities created by the rapid scientific, technological, organizational, economic and social changes, Italy's profound structural crisis must also be taken into account. They interact deeply. It has become something of a cliché to say that the country is at the bottom of the European league when referring to a variety of indicators linked to her economic, educational, and social wellbeing. Table 1 provides a few of the figures most commonly cited with reference to education and employment, taking into account that the country's growth has been stagnant for many years and with the current financial crisis it has regressed substantially reaching -5.5% in 2009 and struggling to recover since then, for instance, in 2012 (-2.4%), in 2013 (-1.0%) (IMF World Economic Outlook, April 2014) and -0.4% in 2014.

Table 1
Few Figures on Italy's structural crisis

EDUCATION	
Drop-outs	Even if the phenomenon is progressively declining, Italy is still far from meeting European objectives: in 2012, the percentage of young people affected by early school abandonment amounted to 17.6%, with 20.5% males, and 14.5% females (the EU27 average value was 12,8%). (NoiItalia, Istat. http://goo.gl/ zW3k1d).
NEET	In the second quarter of 2014, as many as 2.3 million young people aged 15 to 29 years were included in the category of NEET (not in employment, education or training). When considering young people aged 15 to 34, the figure rises to approx. 3.5 million. (Istat, http://dati.istat.it/Index.aspx?DataSetCode=-DCCV_NEET&Lang=).
High School Graduates	44% of high school graduates state they chose the wrong high school to attend. (Alma Diploma, www.almadiploma.it/scuole/occupazione/occupazione2012/).
University Graduates	In Italy 21.7% of young people aged 30-34 graduated from a university in 2012. Despite a 6% increase from 2004 to 2012, Italy is still in the last place. The EU27 average is 35.8% (Istat, http://goo.gl/L9RXKZ).
S&T University Graduates	There are 12.9 university graduates in scientific-technical disciplines for every 1,000 residents aged 20-29 in Italy. The EU27 average is 16.8% (Istat, 2014, http://goo.gl/rTCX18). Italy ranks 16th in terms of female research workers (34.5%), and is at the bottom of the ranking (21st place) in terms of women university professors (36.2%).

EMPLOYMENT	
Youth Unemployment	At September 2014, the unemployed young people between the ages of 15-24 amounted to 698,000. The unemployment rate of 15-24 year olds, that is, the percentage of young people unemployed over the total of people employed or looking for work amounted to 42.9% (Istat, http://www.istat.it/it/archivio/137142).
Temporary Jobs	The rate of people under 35 with unstable employment has doubled in eight years, rising from 20% in 2004 to 39% in 2011, and in the first quarter of 2012, it would have risen to over 40% (http://www.datagiovani.it/newsite/il-precariato-in-italia-una-crescita-costante/). As many as 51% of female young people aged 15 to 24 are working under short-term contracts.
Skills and Competences	For 29% of female young people, the job found did not match their studies (18% of male young people are dissatisfied). (Marracino 2014) Around one quarter (23%) of the European Union's citizens believe that the education or the training they received has not provided them with the skills required to find a job in line with their qualifications (CEC – DG COMM 2014).
Digital Skills for Work	In Italy, 60% of the population does not possess sufficient digital skills for the workplace compared to an EU average of 47%. Only 21% use e-government services and only 5% of SMEs have a presence in Internet and sells online compared to the EU average of 14%. Only 16% of large Italian companies are active on the Web (the EU average is 35%) and only 20% of Italians purchased products or services online in 2013 compared to the EU average of 47%.

Women and ICT	Only 29 out of 1,000 women graduates obtain a Bachelor's degree in Information and Communication technologies (against 95 out of 1,000 men) and only 4 women out of 1,000 effectively work in the sector. Compared to men, women tend to abandon the sector in mid-career and are under-represented in the managerial and leadership positions (even more than in other sectors). Only 19.2% of employees in the ICT sector answer to a female superior compared to 45.2% in other sectors. Women account for 31.3% of Italy's self-employed workers and only 19.2% of entrepreneurs in the digital sector. The digital sector absorbs 20% of 30-year-old professionals with ICT degrees; this percentage falls to 9% for women over 45. Compared to their colleagues in other economic compartments, female workers in the digital sector earn almost 9% more, can organize their working hours much more flexibly, and are less vulnerable to the risk of unemployment.

Education for Life and Key or Essential Competences

The combination of rapid scientific and technological changes with the dynamics of Italy's structural crisis demands innovative answers throughout every level of society. Among these there is the need to stimulate a widespread culture of innovation through a new form of education that effectively prepares the young and, indeed, the entire population, to face with success life and work in the 21st century.

Many reports published in recent years insist on the strategic importance of a new form of education that grooms the talents required to provide answers to

the issues posed by the 21st century (Adecco 2013, Castellano *et al.* 2014, CEC 2010, Manpower 2013, NACE 2014, OECD 2013, WEF/Deloitte Touche Tohmatsu 2012, WEF 2014). For example, WEF/Deloitte Touche Tohmatsu (2012) emphasize that talented human capital will be the most critical resource in differentiating the prosperity of nations, and nothing will be more important. OECD (2013) reports that modern workplaces are constantly changing under the pressures of competition and technological development; this generates a demand for continually evolving skills, together with a demand for personnel capable of adapting and learning new things. Similarly, CEC (2010) envisions a European citizenry with more and better skills, capable of creating work instead of merely searching for it. In this development, educational and training systems will propose fair and innovative approaches (e.g., flexible learning paths) and focus on the development of both key or essential competences and the skills required for specific work. "Our schools, universities, training and workplaces will foster equal opportunities, entrepreneurship, trust, co-operation, and a sense of responsibility, creativity and innovation that will contribute to economic prosperity, societal good, engaged citizenship and personal well-being." (CEC 2010, p.9) Among the key actions proposed, The European report identifies the "integration of key enabling competences such as creativity, innovation, entrepreneurship, and citizenship, in schools, in higher education and initial and continuous vocational education and training." (p.25) In order to achieve similar objectives, the misalignment existing between the productive system's demand for skills and the training provided by the educational system must be efficiently addressed. Various surveys on the skills necessary for the working world have indicated the existence of a *skills gap* that raises serious cause for concern among companies (Adecco 2013, Castellano *et al.* 2014, NACE 2014). The Adecco study conducted in the USA, for example, revealed that 92% of the company directors participating in the survey believe that there is a *skills gap* between the skills possessed by the workers and the skills that they should have to be productive in today's economy (Adecco 2013). The survey also revealed that the *skills gap* concerns not only technical skills but, above all, the so-called *soft skills* (e.g. communication, creativity, collaboration, and critical thinking). 44% of company directors have identified the *soft skills* missing in their employees and job candidates. 22% identified a lack of technical skills, while 14% and 12% reported a lack of leadership skills and information science skills respectively. The article concludes: "Without the ability to think critically, collaborate, or communicate, employees and employers alike will find it difficult to solve basic problems and

foster a productive company culture. Innovation will also suffer if those who engage with the company's products or services on a daily basis can't find collaborative and creative ways to solve routine issues."

Both Europe and Italy have dedicated serious attention to the problem of the skills necessary for successful life and work in the 21st century. In particular, in 2006, the European Parliament and the Council of the European Union identified eight key competences for life in the 21st century. These eight key competences are briefly described in Table 2, and seen as a combination of knowledge, skills, and attitudes appropriate to context. Specifically, they are defined as competences "which all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment." (EU Parliament 2006, p.13). About the same period, in August 2007, the Italian government presented its own view on the key competences for citizenship. These are presented in Table 3, and as can be seen, they are eight competences that all young people must develop "to a level such that prepare them for adult life while constituting the basis for further learning occasions, as well as for working life." (MIUR 2007a, p.1) It is clear that both the European vision of the key competences for 21st century life and the Italian vision of the key competences for citizenship have a deep relationship between them, as well as with the themes about the competences and *skills gap* described previously in this text. All the issues converge on one urgent demand: the necessity to innovate the educational system for the correct alignment of its results -the education and the training of young people and the entire population- to the challenges of living and working in the 21st century.

Table 2.
Eight Key Competences for 21st Century Life According to the European Union

1. Communication in Mother Tongue	**The ability to** express and interpret concepts, thoughts, feelings, facts and opinions in both oral and written form (listening, speaking, reading and writing) and to interact linguistically in an appropriate and creative way in a full range of societal and cultural contexts; in education and training, work, home and leisure.
2. Communication in Foreign Languages	**Communication in foreign languages** broadly shares the main skill dimensions as communication in the mother tongue, while also demanding mediation and intercultural understanding skills.
3. Mathematical Competence and Basic Competences in Science and Technology	(i) **Mathematical competence** is the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations. (ii) Competence in science refers to the ability and willingness to use the body of knowledge and methodology employed to explain the natural world, in order to identify questions and to draw evidence-based conclusions. Competence in technology is viewed as the application of that knowledge and methodology in response to perceived human wants or needs.
4. Digital Competence	Digital competence involves the confident and critical use of Information Society Technologies (IST) for work, leisure and communication. It is underpinned by basic skills in ICT: the use of computer to retrieve, assess, store, produce, present, and exchange information, and to communicate and participate in collaborative networking via the Internet. Individuals should also be able to use IST to support critical thinking, creativity, and innovation.

5. **Learning to Learn**	This is the ability to persist in learning, to organize one's own learning, including through effective management of time and information, both individually and in groups, and means gaining, processing and assimilating new knowledge and skills as well as seeking and making use of guidance.
6. **Social and Civic Competences**	These include personal, interpersonal and intercultural competence and cover all forms of behaviour that equip individuals to participate in an effective and constructive way in social and working life, and particularly in increasingly diverse societies, and to resolve conflict where necessary.
7. **Sense of Initiative and Entrepreneurship**	These refer to an individual's ability to turn ideas into action, and include creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives. These competences support individuals in their everyday lives at home and in society, but also in the workplace in being aware of the context of their work and being able to seize opportunities. This should include an awareness of ethical values and promote good government.
8. **Cultural Awareness and Expression**	This means being aware of the importance of the creative expression of ideas, experiences and emotions in a range of media, including music, performing arts, literature, and the visual arts. It implies an awareness of local, national and European cultural heritage and their place in the world. Skills relate to both appreciation and expression: the appreciation and enjoyment of works of art and performances as well as self-expression through a variety of media using one' s innate capacities. Skills include also the ability to relate one's own creative and expressive points of view to the opinions of others and to identify and realise social and economic opportunities in cultural activity.

Source. EU Parliament (2006).

Table 3.
Eight Key Citizenship Competences to Be Acquired by the End of Compulsory Education (Italy)

1. **Learning to Learn**	Organization of one's own learning, identifying, choosing, and using various sources and modes of information and training (formal, non-formal, and informal) also on the basis of the times available and one's own personal strategy, and study/work methods.
2. **Project-building**	Ideation and implementation of projects regarding the development of one's own study and work activities, using the knowledge acquired to establish meaningful and realistic objectives and the relative priorities, assessing the existing possibilities and restrictions, defining the action strategies and verifying the results achieved.
3. **Communicating**	(i) *understanding* messages of various kinds (daily, literary, technical, scientific) and of diverse complexity, transmitted using different languages (verbal, mathematical, scientific, symbolic, etc.) through different supports (paper, IT, and multimedia). (ii) *representing* events, phenomena, principles, concepts, norms, procedures, attitudes, moods, emotions, etc. using different languages (verbal, mathematical, scientific, symbolic, etc.) and diverse disciplinary knowledge, through different supports (paper, IT, and multimedia).
4. **Collaborating and Participating**	Interacting in groups, understanding the different points of view, valuing one's own capacities and those of others, managing conflict, making contributions to shared learning and to the implementation of collective activities, with full respect for the fundamental rights of others.

5. Acting Autonomously and Responsibly	Knowing how to introduce oneself actively and consciously in social life, asserting one's own rights and needs, while at the same time acknowledging those of others, the shared opportunities, limits, rules, and responsibilities.
6. Problem Solving	Addressing problem situations, formulating and verifying hypotheses, identifying adequate sources and resources, collecting and evaluating data, proposing solutions that use content and methods from diverse disciplines, in accordance with the type of problem.
7. Identifying Connections and Relationships	Identifying and representing -developing coherent arguments- connections and relationships between different phenomena, events, and concepts, even from different disciplinary contexts, and distant in space and time, grasping their systemic nature, identifying analogies and differences, coherences and incoherencies, causes and effects, and their probabilistic nature.
8. Acquiring and Interpreting Information	Acquiring and critically interpreting information received in various areas and through diverse communication instruments, assessing its reliability and utility, distinguishing facts from opinions.

Source. MIUR (2007b).

Note. "Competences" indicate the demonstrated ability to apply knowledge, skills and personal, societal and/or methodological capacities in situations of work or study and for personal and/or professional development; competences are described in terms of responsibility and autonomy. "Ability" indicates the capacity to apply knowledge and use know-how in order to complete tasks and solve problems; abilities are described as cognitive (the use of logical, intuitive and creative thinking) and practical (that imply manual ability and the use of methods, materials, and instruments). (MIUR 2007a, p.3)

Innovating the educational system, however, is no easy task. In fact, as illustrated by CEC (2010): "Key competences require different kinds of didactic and learning methods than those traditionally applied. The skills and competences needed today and in the future cannot only be learned through subject teaching but also require more cross-curricular and innovative approaches, such as, learning-by-doing or project-based learning. Learning through experience is seen as one of the most efficient learning methods for professionalisation and stimulating creativity and

innovation." (p.26) And this refers only to the methods of learning and teaching. The innovation of the educational system is a much more complex effort and, as said already, particularly regarding the reduction of the skills *gap,* the common effort of all stakeholders will be required (WEF 2010).

The InnovationGym

The Fondazione Mondo Digitale (FMD) developed the concept of InnovationGym in 2013 with the precise objective of making an innovative contribution to the challenges and opportunities of education for life in Italy. The InnovationGym was inaugurated in March 2014 at the premises of Rome's Educating Cities managed by the FMD. That day, Alfonso Molina, Scientific Director of the FMD and a Professor of Technology Strategies at the University of Edinburgh defined the InnovationGym with the following words - slighted adapted for use here:

> The Phyrtual InnovationGym (physical + virtual) is an original Italian site dedicated to self-awareness, creativity, entrepreneurship and innovation across the board: technological, social, civic, and personal innovation. The InnovationGym intends to provide the setting for education for life in which the young and old alike can acquire the tools they need for the journey of life and work. The Gym is a place where inventing and constructing means inventing and constructing oneself, discovering means discovering oneself, creating and innovating means creating and innovating oneself and, ultimately, becoming an entrepreneur of oneself. The Gym is a space where teamwork, creative collaboration and solidarity are nourished in the spirit of serving the community and the local territory for the promotion of the common good and a widespread culture of innovation.
>
> The InnovationGym makes use of all the most advanced forms of learning, starting with experiential learning, in which the innovation project, rapid prototyping through the FabLab, and other digital activities play key roles. The Gym also values and uses the knowledge accumulated over decades by universities and industry, particularly today, when the development of open content, cloud computing, and big data is starting to make it available through innovative forms of visualization and analytics. In this way, the Gym always looks to the future, to the opportunities and the challenges that emerge from the rapid evolution of technology and society as the whole. It also looks to Europe and strives to make its own contribution to the positioning of Italy among the most innovative countries.
>
> We have a dream: a dream of many InnovationGyms of different size and configurations arising in one city after another, particularly in the world of schools. Just as laboratories of physics, chemistry, information technology, and physical education exist, we imagine the creation of "phyrtual" InnovationGyms in all Italian schools.

In the few months that have passed since its inauguration, the InnovationGym has

become a place for the encounter and dialogue between old and new professions, between schools, technical institutes, research institutions, universities, companies (both large and small), non-profit organizations, government institutions, and citizen organizations, with the participation of communities of teachers, students at every level, makers, digital artists, artisans, managers, and the young and the old.

We have worked on self-awareness and self-esteem, ideation and inspiration, design, project-building, coding, and problem-solving for the identification of solutions in the form of physical and virtual products, services, processes for personal, community, and territorial development. We have spoken the language of fabrication (traditional and digital), experimentation, and creativity to stimulate professional growth and self-enterprise and exercise the skills and competences of the 21st century. We have practiced education for life and work through the experiential learning of standardized formal knowledge, key competences for life, and personal character's values and attitudes for responsible citizenship.

At the heart of the InnovationGym's educational activity is the solidarity model that facilitates the multiplication of skills and competences and the generation of a growing variety of templates of codified learning activities that can be replicated in other InnovationGyms. These codified learning activities become part of the Gym's virtual area, which together with the physical environment realizes the concept of "phyrtuality": the integration of the physical and the virtual in one single learning environment for education for life and work. The website Phyrtual.org, dedicated to social innovation projects developed in the Gym environment is also a part of the virtual landscape. Phyrtual.org offers a crowdfunding function to stimulate learning and fundraising through new Internet-based methods.

The FMD InnovationGym is in continuous evolution, and today vaunts various operating spaces for the practice of education for life. These spaces are listed in Table 4 and they are enabling the construction and implementation of an educational path that begins with self-awareness and self-esteem, advancing towards ideation and implementation activities and, moving on further towards innovation and entrepreneurship. The rich variety of themes and functionality offered by the various spaces allows for a more effective response to one of the fundamental challenges facing education today, i.e., the need for personalization of learning processes to the specific style, motivation, and multi-dimensionality of each and every one of us.

Table 4.
FMD InnovationGym Functional Spaces (March, 2015)

Ideation Room	A space for the learning and exercise of self-awareness, problem solving, decision-making, design, innovation strategies, and business modelling. The Ideation Room has Lego Serious Play, Wii Remote interactive whiteboard, Self-awareness Tools, Root Cause Analysis Tools, Business Model Canvas, didactic micro modules, software, and app design challenges.
FabLab	This space is dedicated to design, coding, and both traditional and digital fabrication, animated by new artisans (the makers) and open to the territory and the school world. The first FabLab in Rome built to the instructions provided by the MIT's Center for Bits and Atoms offers: a Sharebot 3D printer, a PowerWASP 3D printer, laser cutter, plotter, milling machine, pantograph, polishing machine, lathe, drill press, welding machine. The various activities include laboratories and workshops open to schools and the public, as well as professional training.
Robotic Centre	Space for the development and implementation of new didactic and coding methodologies for the stimulus and training of young people in scientific-technological disciplines and professions. The Centre offers didactic kits with Ape Robot, We Do Lego, NXT Mindstorm, EV3, renewable energy kits, bench welders, Arduino, electronic components. The activities proposed include robotic labs and competitions for schools of every order and level.

Activity Space	This edutainment area is dedicated to leadership, team building, and motivation. Physical and mental exercises, games, and many more ways to learn and apply 21st century competences. The Activity Space offers ZoomeTool, Toobeez, balls, ropes, etc.
GameLab	Space dedicated to the demonstration, learning and development of game design e interactive storytelling to stimulate creativity, innovation, and entrepreneurship through an area of significant growth and digital innovation. The GameLab offers HW: Gaming Desktops, Oculus Rift, Leap Motion, Nvidia 3D Vision, Unity 3D, GNU Gimp.
VideoLab	Space dedicated to the demonstration, learning and development of 3D Animation and Visual Effects to stimulate creativity, innovation, and entrepreneurship through an area of significant growth and digital innovation. The VideoLab offers iMac Desktops, Autodesk 3DStudio Max, BlackMagic Fusion.
ImmersiveLab	Space dedicated to the demonstration, learning and development of immersive virtual reality to stimulate creativity, innovation, and entrepreneurship through an area at the frontier of digital technologies. The ImmersiveLab offers Desktop Workstation, Gaming Desktops, Immersive CAVE VR, Oculus Rift, Leap Motion, Meta One AR Glasses, Emotiv Epoc NeuroHeadset, Nvidia 3D Vision, Unreal Engine, Articy Draft, EON iCube, Second Life.
Conference Room and Workshop Room	Spaces for meetings, conferences, training and performances.

Phyrtual.org	The first virtual social innovation environment based on knowledge, learning, community building, and crowdfunding that allows the InnovationGym and all related projects to connect with the rest of the world and potentially stimulate networked financing. The Gym's virtual environment also contains all the didactic material for the learning activities conducted both at the Gym and in the school world and other organizations.

In addition, to be effective, InnovationGyms must certainly interact with other institutional and territorial initiatives dedicated to promoting widespread innovation and education for life.

The InnovationGym in the Italian Educational Policy Document The Good School (La Buona Scuola)

The InnovationGym inspired the Italian Ministry of Education (MIUR) to introduce the concept as part of the proposal for new laboratories made in the Renzi government's policy document *The Good School* (*La Buona Scuola)*. The text of the proposal is found in Box 1.

Box 1. The InnovationGym Proposal in the Document *The Good School (La Buona Scuola)*

In the past, the technical laboratories in our schools trained the professional figures who became protagonists of Italy's post-war industrial success. Today, in a similar fashion, young people are using new-generation laboratories to learn to combine the material with the digital, print in 3D, cut with lasers, and learn robotics and open-source hardware. These young people are also experimenting with creativity and discovering themselves inventors, learning early how to use enterprise tools, understanding what makes the Made in Italy so special, and what are the most interesting prospects for the nation in the next 15 or 20 years, that is, the areas worthy of specialization. **This will permit our best manufacturers to be leaders in the 21st century as well.** Making laboratory activity a customary part of didactic activities means redefining the very idea of a laboratory as a "demonstrative" place only, associated exclusively with a technological dimension. **Today, there is a need to promote an interpretation of laboratories as InnovationGyms linked to the stimulation of creative capacities and "problem solving" in students.** The demand for scientific-technological professionals is growing constantly.The number of Italy's graduates in science disciplines (also known as STEM – Science, Technology, Engineering, Maths) is well below the European average despite the undeniable need for such qualified personnel in sectors related to these areas. The issue is all the more urgent if we consider the population of women, who are still far removed from these subjects. This is an opportunity to be seized, and one that can be taken by starting right from the school laboratories.

Source. MIUR (2014), p.111.

As may be easily seen, the text from MIUR has a strong link with the objectives and activities already underway at the FMD InnovationGym. In this respect, the step taken by the Ministry and the Renzi government is crucial because it can give a strong push to the wider spread of the concept of InnovationGym in the school world and beyond. This opens the opportunity for the implementation of a process of systemic and systematic innovation that starts from the reality and areas of excellence that already exist in the world of the school. This means stimulating the development of InnovationGyms that are evolutionary and can be configured as required to the different educational situations, resources, and motivations of every school. Il also means developing a true InnovationGym movement in which each Gym can be linked to every other in order to facilitate the accumulation and sharing of knowledge, experience, and available didactic resources.

InnovationGyms as Configurable, Evolving, Inclusive, and Bottom-up Reality

Transforming into reality the concepts of configurability and evolution of the InnovationGym means emphasizing the excellence and resources existing today in every school, especially the human resources: directors, teachers, students, technical and administrative personnel, and parents. It may also mean starting from a configuration that is easy to achieve in the short term but one that is also capable of evolving towards a wider and richer scope in the mid- and long-term. For this reason, the content and activities we envision in the model of the InnovationGym are inclusive and varied. Table 5 below proposes a matrix with a sample of functions(themes) that can also be conceived as experiential didactic spaces for creating configurable, evolving, and inclusive InnovationGyms. The content of the Table is proposed as a starting point and can certainly be enriched with further functions(themes).

Table 5.
Matrix of Functions(Themes) or Spaces for Configurable, Evolving and Inclusive InnovationGyms

Robotics						
Industrial	Educational	Domestic	Environmental	Medical	Security	Entertainment
Sustainable Energy and Green Technology						
Solar	Wind	Tidal Wave (Mare)	Geothermal	Biomass	Hydroelectric	Low Carbon Technologies
Craft						
Woodwork	Metal	Ceramics	Jewellery	Fashion / Tailoring	Stone	Paper / Flowers

Arts						
Music	Painting	Sculpture	Graphics	Film / Video	Theatre	Digital
Special Needs						
Hearing	Vision	Language	Learning / Intellectual Activity	Physical / Motor	Mental	Chronic Illness
Key Competences / Digital Competence						
Self-awareness/ Orientation, Communication (foreign language)	Team-building, Leadership	Problem Solving, Ideation for Innovation at 360° (tech., social, civic)	Project Development, Business Modelling	Digital Making/ Prototyping (FabLab, VideoLab, GameLab, Immersive Lab)	Robotics & Internet of Everything	Entrepreneurship and Financing
Informatics Lab						
Computer Use	ECDL	Internet Research / Social Nets / File Sharing / Open Content/ Groupware (online collaboration)	e-commerce, e-government e-health, e-learning	Coding, App Development, Websites	Big Data Cloud Computing	e-Strategy (e.g., process innovation (productive, didactic), e-marketing, e-enterprise)
Subjects and Laboratories of Standardized Knowledge						
Mathematics	Natural Sciences (Physics, Chemistry, Biology)	Literature	History/ Geography	Civic Education / Economic Discipline	Philosophy	Foreign Language

How can the idea of the InnovationGym matrix be interpreted? There are various aspects to consider:

1. InnovationGyms can be conceived as variable and evolving combinations of functions(themes)/spaces to be didactically integrated on the basis of the resources available in the short-, mid-, and long-term. In this way, the ideal "dream" Gym can be designed while ensuring the success of the first steps.

2. The term *functions(themes)/spaces* has been used because it is not necessary to restrict the functions to completely separate spaces for each one of them. Certainly the *space* resource (together with other resources) affects the choices to be made but it does not determine entirely which and how many functions can be inserted in the Gym.

3. There are three types of functions(themes)/spaces provided in the sample illustrated by the matrix:
   (i) functions(themes)/spaces dedicated to key competences for life (*life skills*), which include digital skills. These key competences are shown in grey in the matrix of Table 5 because they tend to be transversal, while the others surrounding them belong to rather specialized fields such as the disciplinary subjects at the bottom of the matrix. The transversal competences lie at the heart of the InnovationGym, and every one should contain and didactically integrate a selection of them.
   (ii) functions(themes)/spaces dedicated to competences for specific topics, such as specialized forms of robotics, sustainable energy and green technologies, crafts, specific forms of art, and special needs. These dedicated functions(topics)/spaces can be combined with a set of key competences in order to generate InnovationGym specialized on specific topics.
   (iii) functions(themes)/spaces dedicated to the subjects and laboratories of standardized knowledge typical of the school world, (similar configurations can be conceived for the standardized knowledge typical of school or university programme). To the extent that InnovationGyms develop and enrich their content, it is possible to think that, in the future, teachers of curricular subjects will be able to take advantage of the didactic potential of the new functions/spaces to construct innovative and effective didactic methods for their own subjects. For example, nowadays, it is an accepted fact that robotics offers the

possibility to implement an interdisciplinary, entertaining and constructivist didactic approach applicable to both scientific and humanistic studies such as literature and philosophy. Similar potential lies in the functions/spaces dedicated to producing videos, educational games, and immersive reality, in which didactic methods based on story-telling or flipped classes can be proposed and implemented.

The InnovationGyms can stimulate innovation in the didactics of standardized subjects and, gradually, in the overall school dynamics, naturally giving all due consideration to the time required for what would be a profound educational and cultural change. It goes without saying that such change requires long-term policy programmes that forcefully support their systemic implementation.

The InnovationGym Network

The natural development of the concept and reality of the InnovationGym is the creation of a physical-virtual (*phyrtual*) network of Gyms that stimulates and facilitates solidarity and the sharing of knowledge, and experience, as well as the use of resources and activities. The establishment of such network would multiply the potential for change towards a widespread culture of innovation for life in the complex 21st century society. Figure 3 illustrates the concept of InnovationGym network. There are various aspects to be borne in mind, as discussed below.

In accordance with the principles of configurability, evolution, and inclusion, there will be a variety of InnovationGyms. Such Gyms may emerge in any sector of activity and will differentiate from each other on the basis of their content, activity, and size. Figure 3 illustrates this aspect through the variety of circles of different sizes identified with four different sectors (selected as examples): **S** (School), **U** (University), **F** (Foundation) and **I** (Industry). The different sizes of the circles indicate the richness of resources in terms of knowledge, experience, and equipment of the different Gyms.

All InnovationGyms must have the possibility to link with other Gyms in order to facilitate the sharing and exchange of knowledge and experience, and also the use of resources and activities. This possibility for direct and mutual support is illustrated in Figure 3 by both the many-sided polygon (near circle) that unites all the smaller circles and by the dotted arrows. They represent the strategic need for the establishment of relationships of collaboration between all Gyms. This possibility is of critical importance because it will provide humbler structures with access to the resources of the larger structures, in this way promoting inclusion through solidarity.

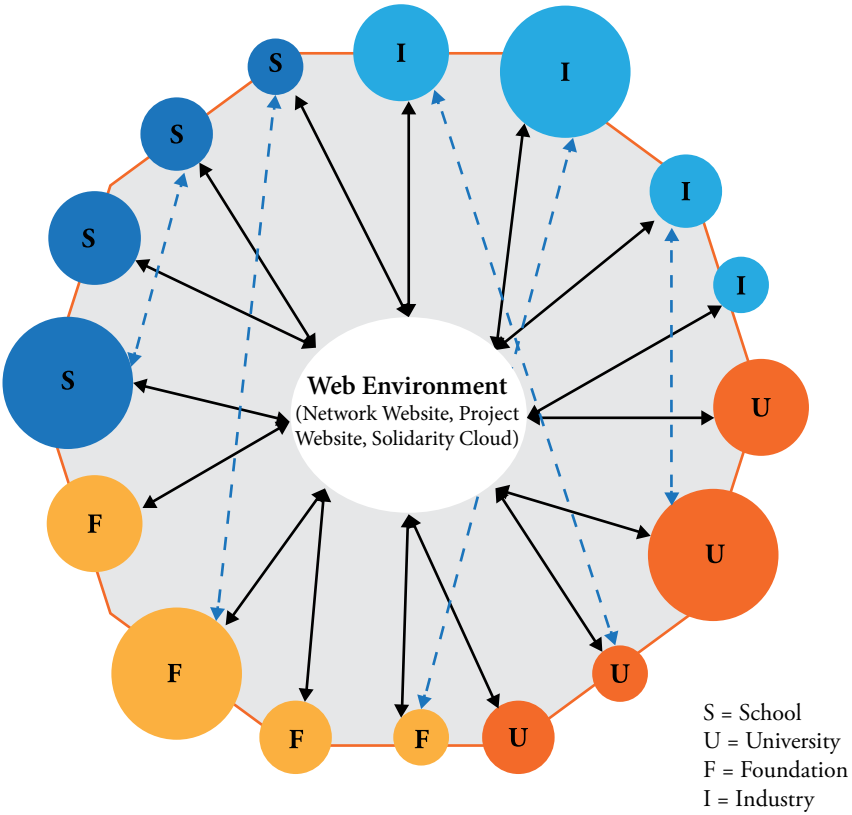

Figura 3.
The Phyrtual InnovationGym Network

All the Gyms must be able to connect to an online collaborative environment. Every Gym must also try to interact with other territorial realities, such as the spaces dedicated to co-working, FabLabs, and incubators. In Figure 3, the solid arrows that link all the different Gym circles with the central *Web Environment* circle represent the virtual connection of all the Gyms: (i) between themselves and (ii) to the online environment for communication, didactic resources, relationships, project-building, and online collaboration. This environment is conceived with three integrated elements (websites): (1) the institutional website of the network of InnovationGyms at http://www.innovationgym.org/rete-delle-palestre/; (2) the

project-building website – here, the Fondazione Mondo Digitale has created the community-building website for social innovation, www.Phyrtual.org;[1] and (3) the *Solidarity Cloud,* which contains all the didactic resources developed by the members of the network, as well as useful didactic resources developed by other people. The Solidarity Cloud houses knowledge and learning objects, such as didactic templates, video-lessons, various apps and software and, also, volunteer professionals. The FMD has developed the *Solidarity Cloud* concept and has begun work on its structural and content development.

1 The phyrtual.org website was set up to fill the strategic need to integrate, from the very beginning, the physical and the virtual aspects of project development. *Phyrtuality* (physical + virtual) is considered to be another key competence for the 21st century.

The InnovationGym Movement for a Widespread Culture of Innovation

The creation and implementation of a widespread network of InnovationGyms do not involve only the organizations that build and operate the Gyms. This process must involve all the organizations and individuals interested in supporting and participating in the construction of Gyms in the school world, in universities, or in the territory. Only this will facilitate the mobilization of all the material, financial, and human resources necessary to transform the vision of the InnovationGyms network into a true social and educational innovation. The outer circle in Figure 4 exemplifies the presence of various types of stakeholders capable of playing large or small roles in the construction of Gyms. The dream is the creation of a real and authentic InnovationGym movement, a farsighted and generous movement for the country's common good.

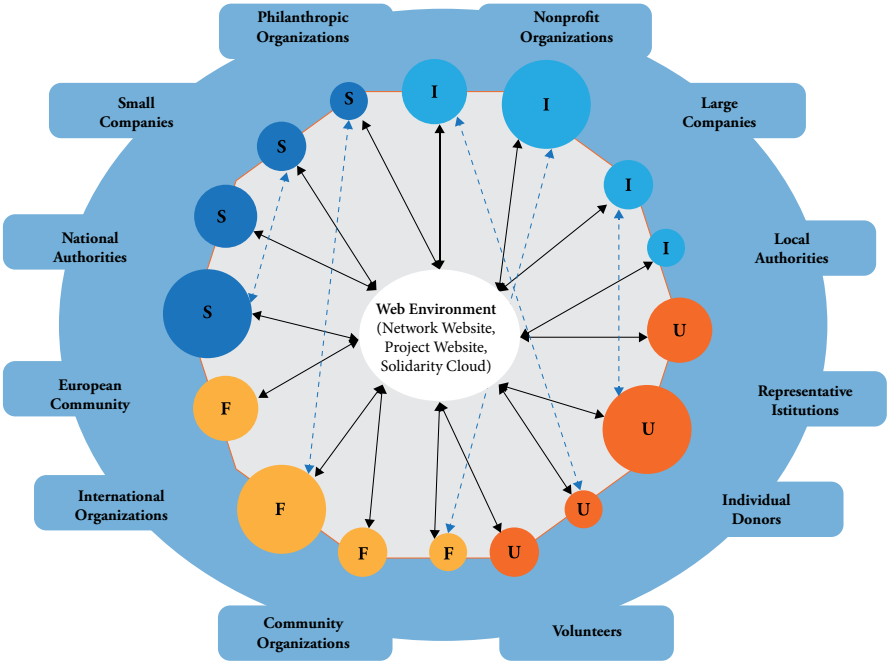

Figure 4.
The InnovationGym Movement

Conclusions

The fulfilment of the vision and dream proposed by the Fondazione Mondo Digitale in this document can have a strong impact on the country's educational, social, cultural and economic life. The challenge is complex, as today's world, and the process of facing it with success demands a serious, systemic, systematic and farsighted effort capable of involving the competence, experience, energies, and enthusiasm of all the organizations and individuals, young and adult, willing to commit themselves to seeing Italy regain its rightful position as one of the world's most dynamic, innovative, and economically and humanly rich countries on Earth. This is something we must achieve, above all, for the sake of the new and future generations!

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About the author

Alfonso Molina is Professor of Technology Strategy at the University of Edinburgh and co-creator and Scientific Director of the Fondazione Mondo Digitale. He has conducted theoretical and practical activities aimed at developing an environment integrating academic theories, tools of practical application, as well as projects on diverse themes: technological and social innovation, industrial clusters, multi-sectorial networks for local development, ICT-based didactic innovation. His research activity has placed special attention to: the mapping and governance of the multi-sectorial hybridity of social innovation, knowledge-oriented non-profit organizations, regional intelligent specialization, and ad hoc innovation and collaboration in education. The practical application tools he has developed include: diamond of alignment, evolving business plans, real-time evaluation methodology, and dynamic-strategic mapping.

Alfonso is the author of the original theory "Sociotechnical Constituencies" on the nature and dynamics of innovation processes on which he has written and published numerous books, articles for scientific journals, book chapters, conference papers and reports.

Alfonso has worked with the European Commission as advisor and consultant. He developed the original strategy for the *Global Cities Dialogue*, including the text of the Declaration of Helsinki that has now been signed by over 180 cities throughout the world. He has worked with the cities of Rome, Stockholm and Edinburgh. He has served as the president of international juries for the *Stockholm Challenge*

Award and the "European Citizenship for All" Award promoted by Telecities and Deloitte and Touche. He is currently president of the international jury of the *Global Junior Challenge* (Rome). He has led the creation of the *Multi-sectorial Network for Educational Robotics in Italy* and presides its coordinating committee. He is also the creator of *Phyrtual.org*, the first virtual social innovation environment, as well as the creator of the Phyrtual InnovationGym.

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