User's Needs in Education and Training Domain of Apulian ICT Living Labs

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Abstract—Living Labs is a new approach to research activities which allows the end users to participate to the development and experimentation of innovative solutions devised for the inhabitants of a given territory. Through the exchange of ideas and knowledge and the aggregation among researchers, enterprises and organized groups of citizens, the specifications of new products and services are developed, the first prototypes are realized and evaluated, and new innovative technological solutions are experimented. The action Apulian ICT Living Labs aims to implement the open innovation paradigm, where end users co-design a solution to the user needs in collaboration with a SME and a research laboratory. In this context, we have analysed the user needs in one of the eight domains of interest of the project, namely the Education & Training (E&T) domain. This paper introduces the Apulian ICT Living Labs and reports the themes and the technologies elicited from the end users in the E&T domain to address the end users needs. Apulia Future Learning 3.0 thus arises as a solution to cluster the individual local livinglabs in Apulian ICT Living Labs and submitted to ENOLL for networking with advanced experiences in Europe to share a collaborative approach in finding demand-based innovative solution. Conclusions outline the crucial novel aspect of Living Labs, that is the involvement of the end users in all the stages of the development projects.

Keywords— livinglabs, social learning, robotics, augumented reality and virtual reality.

I. INTRODUCTION

THE approach of Living Labs, a concept developed at the Media Lab and School of architecture and city planning of MIT, Boston [14] represents a user-centric research paradigm for prototyping and validating complex solutions in multiple evolving real life contexts, not only in industrial settings, but also in the development of new products and services that meet market expectations and ultimately led to the creation of more and better jobs. Living Labs have thus shown the ability to mould the opportunities offered by new ICT to the specific needs and aspirations of local contexts, cultures, and innovation potentials [20], [29]. This approach is

shaping the agenda of Regional Policy and Territorial Cooperation for 2014-2020, but also HORIZON2020 and the "Smart Specialisation" conditionality requirement, engaging all EU regions. The Living Labs gives the schools the opportunity to overcome the traditional concept of classroom, to create a learning space open to the world, in which to realise a smart, sustainable and inclusive growth, that is Europe 2020 [18], and Innovation Union [19], which sets out an integrated and strategic approach exploiting and leveraging Europe strengths in new and productive ways. In Europe [19], the potential and opportunities generated by a Public-Private-People Partnership from ENOLL [12] shifted the scope of Living Labs from pure academic experiences to regional or national innovation systems [23].

The Living Labs concept is characterized by the "users as innovators" approach [15]. This means to get access to the ideas and knowledge of the users, and not using the users as "guinea pigs" of experiments. The Living Labs stimulate the social and organisational innovation as they transfer the Research & Development (R&D) from the close of the companies laboratories toward contexts of real life, where the citizens and the users become themselves "co-developers"[5]. This new approach is emerging in several productive situations at international levels, as defined by the ENoLL (European Network of Living Labs) network [12] and allows the Small and Medium Enterprises (SMEs) in particular to create experimentation on the real scale in "pilot market", to advance the current prototypes and anticipate the problems in post-sale phase.

 The Apulia Region intends to foster the growth and the development of Apulian SMEs specialized in the Information and Communications Technology (ICT) field, digital services and contents, by using the Living Labs approach, implementing them as a regional policy to improve ICT industry and services in the region. Apulian ICT Living Labs is an action of the ERDF 2007-2013 of the Apulia Region, which allows Apulian ICT SMEs to experiment innovative ICT solutions and prototypes of new products and services, through shared knowledge and exchange of researchers, enterprises and organized groups of citizens: they are regarded as a way of meeting innovation challenges faced by ICT service providers [21]. Sixty four Apulian enterprises are investing in thirty four projects concerning eight domains of reference, namely Environment, Education and Training, Cultural Heritage and Tourism, Creative Industry, Active aging and Health, Mobility and Transport, E-government, Energy. The model Apulian ICT Living Lab has been conceived as an "open innovation ecosystem" [31], [33] where the user actively participate to the research and

experimentation process of innovative solutions, devised through the use of the ICT. The project entrusted to InnovaPuglia for the execution is organized in two phases:

- *Phase 1: Mapping of the End User Needs and Partner Catalogue of Living Lab.* We have published calls for the collection and catalogue of themes, needs and issues expressed by the end users. In the next phase, such issues have been used for experimentation for finding innovative solutions. Qualification of the end users and the research laboratories for building the experimentation for finding innovative solution is performed in the Partner Catalogue, where the interested bodies are included and are available to be involved in the second phase of experimentation.

- *Phase 2: Publication of a call for proposal to grant on competitive factors ICT enterprises*, on the basis of the proposals presented together with the bodies selected from "Living Lab catalogue partner". Activation of the living labs of 12 months duration to start the experimentation of the identified prototyped solutions.

Opportunity of economic, social and cultural development in all Europe, the LivingLabs are about 227 which stimulate the innovation, transferring the research from the laboratories to the real life, where the citizens and the users themselves become "co-developers"[9].

This paper reports a reasoned summary of the users needs coming from the E&T domain. This domain has resulted very complex to perform users needs analysis because expressed users needs show several and different themes in fields that cover from the food education program to odontophobia, from the HW and SW infrastructure needs in the schools to the continuing education needs of ICT in Cultural Heritage.

In [4] we performed the analysis of the demand of users' needs of Apulian ICT LivingLab of the 100 expressions of interests in the E&T domain in a table, which reports a classification of each theme of the E&T and the technologies proposed by the end users to address these themes. In particular, to each theme of the E&T domain we have described the end user(s) who have expressed it, the potential users that can be interested in it and besides the underlined technologies potentially applicable to face the solution to the user's need itself.

In this paper, as well as in [10], we consider the classification made in the Apulian ICT LivingLab inside the E&T domain in the following three technological sub-domains, as described in the sections below.

Section 2 outlines the user's needs in e-learning sub-domain of E&T.

Section 3 gives the detected user's need in interactive platforms for the development and sharing of didactic contents and instruments sub-domain of E&T.

Section 4 describes user's needs in educational social network platform sub-domain of E&T.

Section 5 provides some hints of the follow up programme LIVINGLAB SMARTPUGLIA 2020 and the clustering of the individual projects in E&T of the two programmes in Apulia Future Learning 3.0.

Conclusions discuss the issue of the user involvement in the LivingLab approach and how it is addressed in Apulia Future Learning 3.0.

II. E-LEARNING USER'S NEEDS

One of the issues expressed by the user's needs on the current e-learning platforms is the user profile and a personalized training path based on such a user profile. There are several user's needs that can be satisfied by the adaptive learning, an educational method which uses the computers as teaching interactive device. The computer adapts the educational material presentation based on the students learning needs, as indicated by their answers and tasks. The adaptive learning transforms the user from a passive receptor of information to a collaborator in the educational process [28]. Examples in which the adaptive learning can play a role are in the food education in the schools, to face the gender gap through personalised training actions expressed by the "times" and "modes" of women learning, in training and management of cultural heritages where the profile of the user/tourist of the museum plays a key role in providing the information useful for a personalized visit of the museum itself. Other applications concern the orientation, specialization, continuing training, updating of the staff, where the user profile plays a key role for planning specific training actions, in monitoring school dropouts where it can provide a user's profile useful to understand the school population dispersed up to 16 years.

At the basis of the mobile learning is the museum fruition and teaching which use mobile technological instruments as the most modern audio and video guides, especially the youngest levels of the large public. The mobile learning as technology can satisfy also other needs coming from the end users such as life long learning and learning at the workplace in integrating the training aspects with the organisational aspects of the personnel/human resources, in the orientation, specialisation, life long learning and personnel updating. It can also face the adolescent issues in the schools and the theme of equal opportunities, where it is required from the young women a life long learning process on science education based on mobile devices, smartphones, tablets more used by young population. The promotion of more attractive and playful study of the scientific fields than the current teaching adopted in the schools by using e-learning, web 2.0 and virtual reality is underlined as a need of the school.

III. USER'S NEEDS ON THE INTERACTIVE PLATFORMS FOR THE DEVELOPMENT AND SHARING OF DIDACTIC CONTENTS AND TOOLS

The technological need of the educational institutions is to computerize the creation and sharing process of digital didactic contents usable with the new technological instruments such as notebooks, tablets, smartphones, which are going to be spread in the schools to support a teaching able to involve all digital natives students. The sharing of contents created by the teachers and the students should be performer both online and offline with the possibility to have access to a library of these contents of the school or individual teacher.

Besides the computerisation of the contents an operation is required to make more simple the evaluation and feedback process of the teaching, through quiz and multimedia tests to be shared in real time by all the tools used by the students, and

whose answers are evaluated with the use of graphics and statistics for each student.

In the museum context awareness is raised on the production of services of Augumented Reality and Virtual Reality to exploit the territory resources and make them accessible to different types of users and tourists, through different types of devices, ranging from multimedia totem to mobile devices and the creation of virtual guides. In such a context, the interest extends also in didactic and biomedical field.

The interactive platforms for the sharing of didactic contents can be a useful support for the training, recreational and cultural activities of disabled people, such as dyslexic or autistic children.

IV. USER'S NEEDS IN THE EDUCATIONAL SOCIAL NETWORK PLATFORMS

A key issue of the user's needs in the domain of educational social network platform is the *social learning* [6], that is the didactic innovation making use of advanced digital tools, the social networks and the opportunities offered by the web2.0. It aims to overcome the traditional training logics which dominates the training in whose methodologies was the top-down approach by implementing training processes based on the direct participation of the students to the creation, management and organization of the contents in a social perspective more shared and collaborative one, which is proper of the learning communities.

A social learning environment includes the functionalities of a Learning Management System, a Learning Content Management System and a Community. The technologies supporting the social learning are an open source e-learning platform, a personal portfolio, a competences evaluation and certifications system, a chance to export the contents in ebook, an advanced usability through the WebAPP IOS or Android, and a Multimedia Interactive Blackboard. Specific objectives of the social learning are to support the adoption by the school of didactic and management modalities more suitable to the current processes of knowledge development; to activate applications and methodologies of the tools of the WEB2.0 to E&T by overcoming individualistic approaches; to design new evaluation forms of the students and of the training processes; to devise connected ebook to internet so called also SmartBook originated from the work of students as a innovative way to design and circulate digital contents. This will result an involvement of the students in building their own training courses; the promotion of the cooperation between teachers and students as an opportunity of collaborative training; the evaluation and correction of contents; the availability of an explicit knowledge corpus made by the students with the support and revision of the tutors and teachers which will be a reference for different teaching courses; the availability of a reticular structure of knowledge for the development of interdisciplinary approaches to the domains; the introduction Smart eBook as an innovative form of processing and organization of the contents by student's groups and individuals students.

V. APULIA FUTURE LEARNING 3.0

The follow up of Apulian ICT Living Lab is LIVING LABS SMARTPUGLIA2020, which is framed in the building process of the Regional Strategy for the research and innovation based on Smart Specialisation for the programming cycle 2014-2020 with the objective to involve all the regional innovation system in the logic of the four helix, respectively Public Administrations, Enterprises, Research Centers, Citzens/Users.

New technologies could have an extraordinary effect on efficiency, access and equity of education. Teaching and learning could be optimised by supplying the individual pathways of learning, improving the cooperation on-line and the mix between formal and informal learning. Thanks to web 3.0 and new multimedia tools as well as virtual reality and augumented reality, the informal way of learning has become dominant, conditioning the evolution of E&T. Innovation leads to an upgrade of the "old" virtual learning environment, based on the use of LMS/LCMS platforms, with more flexible personal learning environment, i.e. the education environment is oriented to the individual user, supplying both informal learning, based on the web resources, and formal learning based on the conventional designed e-learning platforms.

To address the above and the educational user's needs described in this paper, a Living Lab based on the aggregation of all the livinglabs projects in the Education&Training domain of Apulian ICT Living Lab and Living Lab SMART PUGLIA 2020 has been founded, namely the Apulia Future Learning 3.0. It aims at the analysis and experimentation of new learning methodologies starting from the demand for innovation of the regional context. It represents a true unique experience of thematic aggregation of stakeholders looking at three lines of development, that are Innovative Learning, New Media and Robotics, and Adaptive Learning clusters. They are linked by the desire for necessary change in learning methodologies for the European society of the future.

Innovative Learning cluster focuses on social learning. Through research, participatory design and experimental development, the realization of an enabling platform for the social learning has been achieved, for the use of schools (teachers, students, families, experts) [36]. In this context, ICT tools can help to support the construction and management of a hyper-dimensional space of knowledge, the access to "intelligent" content authorship and authenticated by the experts, the creation of individual paths in the acquisition of knowledge and skills, as well as the definition of a social model for the aggregation and authentication of multimedia content, which includes open content can be acquired from the Web. Further, an open source social learning platform is able to support training in the building industrial sector, besides the schools [11]. The Innovative Learning cluster encompasses an integrated platform for the digital identity recognition of the student and teacher, the use of WIFI networks, the publication of multimedia and elearning contents, the electronic registry management, and the social interaction with all the actors involved in the learning and training process [7]. Further, a technological platform for the schools, with integrated administrative and didactic services has been identified [35].

Finally, the Innovative Learning cluster fosters an innovative method of e-learning to experiment means, and innovative and effective methods of orienteering and promotion of positive role models of women in the research field, in the technology and start up creation [24].

The New Media & Robotics cluster, with particular focus on friendly interface, encompasses a prototype of GiS based mobile application, which makes use of Augumented Reality and Virtual Reality to define a new paradigm of laboratory and didactic education, but at the same time a versatile platform to be used by the network of museums of the University of Salento [13]. Further, it also investigates the web3.0 and new media tools, such as augumented reality and informal learning which become a dominant aspect in the evolution of e-learning from the past virtual learning environments (VLEs), based on the use of LMS/LCMS, with more communicative and flexible personal learning environments [26]. It also manages the development, testing and integration of specific training modules within elearning platforms already in the market, or "pills interactive/experiential" which allow users to know, using interactive technologies-cognitive and smart (3D augumented reality and interaction) the concept of learning by interacting and remote collaborative learning. A strong characterization of this cluster is due to the adoption of robotics technology to address the dyslexic and autistic children educational issues [32], [3]. It includes a platform of Learning Management System interfaced with tablets, PC, Smartphone and robotic multimedia systems for personalized learning and the production of educational ad hoc contents, for students with specific disabilities, such as dyslexic which involves the 4-5% of the school population. The kit produced in this cluster will include an anthropomorphic robot which interface itself with several hardware systems such as tablets, Pc and Noteboks and a LMS platform hosted in a remote server connected via Internet.

Adaptive Learning cluster provides an "adaptive training system" web based which integrates and makes available in an innovative manner contents oriented to the training of professions, employers, simple citizens, and most important people belonging to the disadvantaged categories, such as women and young people. The learning themes will include topics of special interest to bridge the cultural gap and gender gap and contrast the wrong role models [2]. The integrated information system for agriculture companies training is also included in this cluster [1]

VI. Conclusions

Living Labs methodology with its emphasis on "user involvement" [37] and the "co-creation" process [16] makes it different from other testing and evaluation methods [23], [22]. In the Living Labs approach for user-driven open innovation [25], [27] the integration of end users and other stakeholders into development projects remains a difficult task [34].

In the Apulian region Structural Funds are being used to promote high impact Research Development and Innovation carried out by ICT LivingLabs that effectively responds to specific requirements priory stated by beneficiaries (belong to the public administration and third sector) who are directly involved in the project partnerships with the task of managing the pilot phase. This corresponds to the logic proposed by the so-called challenge mechanism set forth with the CIP (ICT-PSP) Connected Smart Cities project Peripheria[1]. The governance model adopted is based on citizen engagement and generally follows the scheme of Public-Private-People Partnerships (PPPPs) or quadruple helix scheme, which opens up innovation systems to new actors such as cities and region with chief innovation officers, local SMEs selling in global markets, social innovators and entrepreneurs, digital artists, and a myriad of urban innovative communities [20].

The most innovative aspect of Apulian ICT Living Labs is related to the involvement of the end users in all stages of the product development lifecycle, not just at the end phase, as for example in more classical field trials or user testing of products [30]. Many studies come to the result that one of the most innovative aspects of successful product development is to involve the user into the development process [8]. The analysis and comprehension of the end users through specific phase of co-design of the solution to a user's need has been performed in all projects of Apulian ICT Living Labs.

In the Apulian ICT Living Lab, the DemoLab, located at users' headquarters plays a fundamental role, where the deployed technological solutions could be applied every day by a number of users: teachers, students, families, professionals etc. The DemoLab becomes the core of the Living Lab, the connection between knowledge, real life and concrete experience, and technology.

The users' role in Apulian ICT Living Labs is strategic in terms of co-design of services/products to be realized as solution for user needs, test and validation of services/products to be realized as solution for user needs, market design for business model developments. Methods and tools adopted for the active involvement of users are operative focus group for sharing problems and difficulties, designing solution perspectives, suggesting strategies for the development of results, further stakeholder involvement, networking actions, workshop for dissemination, and communication plans.

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