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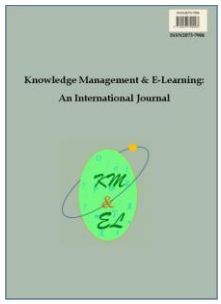


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# The use of MOOCs to support personalized learning: An application in the technology entrepreneurship field

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# The use of MOOCs to support personalized learning: An application in the technology entrepreneurship field

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**Abstract:** Massive open online courses (MOOCs) are changing the way in which people can access digital knowledge, thus creating new opportunities for learning and competence development. MOOCs leverage the free and open use of digitized material through supportive on-line systems. MOOCs have gained worldwide popularity and many education providers have started to offer courses in different domains such as innovation management and entrepreneurship tackling recent demands for better employability and social inclusion. This paper presents a beneficial application of MOOCs to support the design and delivery of personalized learning paths aimed to develop competencies in the technology entrepreneurship domain. Using a design science approach, a platform for the delivery of open courses has been developed along with a set of experimental courses and learner/instructors guidelines. The platform is based on a roadmap purposefully designed to drive

course classification, competence mapping and interactive learning gap/priority analysis. The paper reports a trial set of the system with undergraduate students conducted to draw feedback for iterative system design.

**Keywords:** Competence development; Curriculum development; Entrepreneurship education; MOOC; Open learning; Personalization; Technology entrepreneurship

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## 1. Introduction

The education system has been significantly impacted by the development of information technology and the introduction of web-based knowledge management and learning tools to deliver effective, just-in time and personalized learning processes (Assaf, Elia, Fayyoumi, & Taurino, 2009; Elia, Secundo, & Taurino, 2009).

In particular, the emergence of massive open online courses (MOOCs) has significantly supported the improvement of skills based on free and open access to digitized materials. MOOCs allow accessing three valuable learning "resources", i.e. free

and online digital contents, well-recognized domain experts, and other peers virtually distributed and socially networked (McAuley, Stewart, Siemens, & Cormier, 2010).

Online open courses represent a strategy and a tool to overcome time, spatial and financial barriers that are prerequisites of traditional education processes. MOOCs create distributed and collaborative learning environments, which stimulate knowledge production and application, thus serving both "vertical growth" of people in specific knowledge fields, and "horizontal growth" in terms of soft skills that are essential in the new economic system (Audretsch & Thurik, 2001).

This is in line with the emergence of interdisciplinary "T-shaped" professionals (Oskam, 2009; Elia, Margherita, Secundo, & Moustaghfir, 2011; Secundo, Romano, Passiante, & Del Vecchio, 2013), which are endowed with "horizontal" competencies. Among such competencies, the European Commission (European Union, 2006) has identified the "sense of initiative and entrepreneurship" as one of the eight key competencies for lifelong learning. Such abilities include creativity, innovation and risk-taking, as well as the capacity to plan and manage projects.

Enhancing creativity and innovation, including entrepreneurship, at all levels of education and training is among the four strategic objectives to develop the training systems of European countries (European Union, 2009). In 2008, the European Commission has presented the "Small Business Act" stating that education institutions should create networks to assure the right foundation for entrepreneurial careers and promote a favorable environment for entrepreneurial actions (European Union, 2008).

At such regard, other contributions such as the "Oslo Agenda for Entrepreneurship Education" (European Commission, 2006), the "Youth in Action Programme" (EACEA, 2010), the "Building Entrepreneurial Mindset" (European Commission, 2012), and the "Entrepreneurship 2020 Action Plan" (European Commission, 2013) have provided a strategy framework as well as good practices and guidelines for building entrepreneurial skills and capabilities in Europe.

For the period 2013-2015, the European Commission Executive Agency for Small and Medium-sized Enterprise (EASME, 2014) has proposed the establishment of a network for entrepreneurship education as a pilot initiative to test a new European Hub for Entrepreneurial Learning.

Among the key success factors underpinning the development of entrepreneurship education, the World Economic Forum (Volkmann et al., 2009) has identified active learning methods and interactive curricula. Education and training institutions are experiencing a growing demand for developing new experiential approaches aimed to inject entrepreneurial competencies and skills (Elia, Margherita, Secundo, & Moustaghfir, 2011), and for experimenting the "Entrepreneurial University" model (European Commission & OECD, 2012).

The global scope of education, along with the evolution of technology-based use and sharing of learning material, is creating a new demand for design and experimentation of platforms that support the development of relevant competencies in different fields. In particular, MOOC platforms, more than traditional e-learning systems, capitalize the disruptive trends that characterize the "shared economy" in the form of networked and distributed creation and reuse of knowledge and learning resources.

In such an endeavor, this paper presents an application of MOOCs to support the design and delivery of personalized learning paths aimed to build technology entrepreneurship competencies. Based on a design science approach, a platform for open

course delivery has been created along with a set of experimental courses and learner/instructors guidelines. A preliminary trial set of the system is also presented to draw preliminary feedbacks.

The paper is structured as follows: Section 2 reports the theoretical background of technology-based education and online courses; Section 3 explains the research method; Section 4 illustrates the system developed; Section 5 presents a trial test and preliminary system evaluation; Section 6 concludes the article with limitations and paths for further research.

## 2. Theory background

The use of computer technology in education has experienced a profound evolution in the last fifty years. In the 60's and 70's, based on Skinner's studies, computers were used in behaviourist approaches to highlight teacher's authority on what was being studied (Ravenscroft, 2001).

Starting from the 80's, more relevance was given to the constructivist use of technologies providing students with a chance to create their own knowledge. The latter version of constructivism considered knowledge as a social construct built in the frame of science and technology studies (Boudourides, 2003). In such perspective, Skinner's behaviourism, Piaget's cognitive constructivism and Vygotsky's social constructivism have been facilitated through e-learning (Nichols, 2003).

The evolution of distance education has been analysed with reference to the three generations of cognitive-behaviourist, social constructivist, and connectivist pedagogy that define the learning experiences (Anderson & Dron, 2011; Kanuka & Garrison, 2004). A number of proposals have been launched to build Open Educational Resources (OERs). OERs include full courses, resources, modules, textbooks, videos, tests, software and any other tool used to support free access to information. In such a way, OERs can drive the development of formal and informal learning (McAndrew & Farrow, 2013).

MOOCs have emerged as an evolution of traditional e-learning (Romero, 2013) and they can be considered as a pedagogical strategy, a multi-domain knowledge base, and a technological tool able to stimulate creativity, autonomy, and social networked learning. The term "MOOC" was firstly brought up by Dave Cormier of the University of Prince Edward Island in 2008 (Liang, Jia, Wu, Miao, & Wang, 2014).

MOOCs rely on the active engagement of many learners who self-organize their participation according to their learning goals, in terms of knowledge, skills, and interests. MOOCs normally have a predefined timeline and a structure of topics, and, except in specific cases, have no fees, no prerequisites, no predefined expectations for participation, and no formal accreditation (McAuley, Stewart, Siemens, & Cormier, 2010). Learner can create his/her own learning path by sharing and assembling digital contents and resources, and communicating with the learning system and with other learners (Klett, 2002). Usually, assessment can be repeated several times, by using specific on line tools provided by a technology system.

There are several pedagogical issues that characterize learning based on MOOCs (Mackness, Waite, Roberts, & Lovegrove, 2013). First, learning occurs over distributed platforms. In the age of abundant and open information, students cannot retain all information to memory (Siemens, 2005), and they need to develop capacity of synthesis, critical analysis, and sense making in a networked setting. Practically, converging learners is strongly stimulated by images, simulations and experiments that include

problem solving and decision making (Grünewald, Meinel, Totschinig, & Willems, 2013). Learners can become producers of multimedia content by combining, revising, and repurposing resources they find through their online connections.

Second, knowledge is socially constructed through a flavour of continuous interaction, gradual achievement, and give-and-takes (Wenger, 1998). Learning in a connectivist space is paradoxically troubled by the lack of connection, and learners can feel lost in the social space (Dron & Anderson, 2009). In this perspective, learners need to be self-motivated and self-directed (Kop & Fournier, 2010).

Third, building identity becomes a key concept related to learners and their experience. Learners create networks of relationships with all people they meet (Barnett, 2007), they share and build knowledge with them, and they shape their identity by negotiating the meanings of their experiences.

Fourth, uncertainty helps learners to better achieve their learning goals; indeed, they become much more accustomed with working in less planned, open, different and distributed platforms, where learning performance is a "sweet" emergence.

MOOCs can be thus considered forerunners of course exemplars - early prototypes of improved learning environments which frequently recover flexible educational practice that Mazoue (2013) includes in the post-industrial model of learning.

Literature highlights different types of MOOCs. The pMOOCs (project-based MOOCs) focus on knowledge production through a constructivist approach. xMOOCs ("x" stands for eXtended) are an extension of the conventional teaching model developed thanks to the new opportunities of network technologies. The cMOOCs (connectivist MOOCs) emphasize creativity, autonomy and social networking in the learning processes (Daniel, 2012). More in detail, successful learning achievements with cMOOCs can be realised through five stages: orient, declare, network, cluster and focus (Cormier, 2008). In cMOOCs, knowledge is not a static or individual element, but it is generated through interactions with others (Conole, 2013), and connections between people and nodes of information. Learning occurs through four types of activity (Kop & Fournier, 2010), such as conjunction of information, reflection on the resources and relating them to what people already know, repurposing them to create something of their own, and sharing work and activities with others.

A wide network of leading universities such as Harvard, MIT and Stanford have launched MOOC platforms such as Udacity, Coursera, edX, MIT Open Courseware, and Stanford eCorner. Courses have been realized using many different kinds of technological support for self-learning (papers, short videos on well-focused contents, flash animation) and for synchronous and asynchronous interaction. Asynchronous mode delivery brings to reality the idea that anybody can approach education at any time and from anywhere; synchronous delivery demands the learner to synchronize his or her learning agenda with anyone else (Atif, Benlamri, & Berri, 2003).

In the entrepreneurship domain, there are many educational chances (Siemens & Tittenberger, 2009). The offer of MOOCs is relatively varied (Skiba, 2012) and it ranges from idea creation to competitive development (Welsh & Dragusin, 2013). The Coursera platform is specialized in the domain of entrepreneurship education whereas the Entrepreneurship Corner of Stanford University offers videos and podcasts on a wide range of technology and entrepreneurship issues that are delivered by successful and famous entrepreneurs such as Mark Zuckerberg of Facebook and Larry Page from Google. Udemy, in partnership with George Mason University, has launched in 2013 a MOOC on social entrepreneurship.

Accelerator and incubator learning programs also outside of academies, such as YCombinator, TechStars and the Founder Institute have also fully-fledged (Eesley & Wu, 2015).

Against this background, and before describing in detail the MOOC-based system realized and used for the trial, the next section introduces the research method applied in this study.

## 3. Research method

The research method adopted to the design and implementation of the MOOC system, which serves as a basis for this research, has been the design science approach. Specifically, this method includes six key phases (Hevner, March, Park, & Ram, 2004; Peffers et al., 2006), i.e. problem identification, research goal definition, artefact development, demonstration, evaluation and research communication.

First, the design and development work has been grounded on the analysis of theory background and state of the art, which has allowed identifying the need for developing entrepreneurial competencies within the society as the key problem to address. The research goal was defined coherently with the problem identified at the outset. In particular, the objective was to conceptualize and build an innovative technology system to streamline a large-scale development of entrepreneurship-related abilities and culture. The third step of the research process, i.e. the design and development of the artefact, has included knowledge domain analysis and classification, curricula development, technology system benchmarking, platform customization and service development.

The demonstration of the artefact has been organized in a controlled setting. A small sample of students (exactly ten) enrolled in the *Management Engineering* degree at the University of Salento has been involved with the goal to beta-test the platform and related services.

The evaluation phase has been carried out by collecting feedback through a structured questionnaire that students have filled in after 4 weeks of system usage. Results have been classified and discussed in separated documents, which have been synthesized for the purpose of this study. The last step of the research process is represented by the scientific communication of the work being realized. This paper represents a primary contribution in this perspective as it presents guidelines and insights useful for researchers and practitioners as well.

## 4. MOOC-based system for technology entrepreneurship

The MOOC-based system realized and described in this research has a two-fold dimension: the process-oriented view (which concerns the roadmap required to transform an idea into an entrepreneurial venture), and the technology-oriented view (which focuses on the platform and software components used to implement the system). The next two sub-sections address in detail both dimensions.

### *4.1. Technology entrepreneurship roadmap*

Several contributions in literature have focused on the description of activities required to transform a promising idea into a successful start-up. Allen (2010) has identified eight phases: i) opportunity discovery; ii) opportunity recognition; iii) market feasibility; iv)

intellectual property and regulatory management; v) prototype development; vi) market and customer test; vii) launch strategy design; and viii) business planning. Byers, Dorf, and Nelson (2011) has described four milestones: i) venture opportunity, concept and strategy design; ii) venture formation and planning; iii) detailed functional planning; iv) financing and building the venture. Aulet (2013) has analysed 24 steps and six key pillars of an entrepreneurial journey: i) targeted customers; ii) value proposition; iii) process and modality that customers adopt to acquire the offerings; iv) revenue generation process; v) product/service design and realization; vi) company scaling process.

The activities which have been operationalized in the MOOC platform are based on a technology entrepreneurship roadmap (TER) including 12 activities categorized in three groups (5 "desk", 4 "pre-market", and 3 "market" activities). The TER, which has been also adopted in previous learning programs (Elia, Margherita, & Petti, 2014), is reported in Table 1.

**Table 1**
Technology entrepreneurship roadmap (TER)

| Desk stage activities | Pre-market stage activities | Market stage activities |
|---|---|---|
| 1. Scenario Scanning<br>2. Opportunity Recognition<br>3. Concept Definition and Value Proposition<br>4. Revenue Model and Value Capture Definition<br>5. Business Planning | 1. Funding and Capital Raising<br>2. Resources Acquisition and Team Organization<br>3. Intellectual Property Analysis and Legal Formation<br>4. Product and Service Development | 1. Operations Management<br>2. Profit and Harvesting<br>3. Venture Expansion and Development |

Related to the desk stage, the Scenario Scanning includes examining industries and regions to elaborate a comprehensive vision of the world. Opportunity Recognition is intercepting social, technological, and economic trends to identify market needs that can be satisfied with an innovative solution. Concept Definition and Value Proposition consist in defining the total benefits that the company can offer to its customers. Revenue Model and Value Capture Definition serve defining the basis for generating profits and ensuring a good return on investment. Business Planning is the elaboration of a "story" with a coherent business plan to convince potential investors to fund the company.

Related to the pre-market stage, Funding and Capital Raising concerns the estimation of financial capital required and the choice to go towards bootstrapping or other sources of capital (e.g. business angels, venture capital). Resources Acquisition and Team Organization address the collection of physical and human resources to set up and run the company. Intellectual Property Analysis and Legal Formation focus on the choice of the legal form and define the intellectual property assets (e.g. trade secrets, patents, trademarks, copyrights). Product and Service Development are associated with designing the product or service and making a prototype to test it within the market.

Related to the market stage, Operations Management is the set of activities linked to organizing the value chain by orchestrating physical, financial and informational flows.

Profit and Harvesting target generating revenues from the customers, managing cash flow and raising new funds from investors. Venture Expansion and Development consist in defining the strategy for business growth (e.g. acquisition, internationalization).

### *4.2. MOOC-based system design and implementation*

The design and implementation of the MOOC system is based on three key assets: 1) an open source technological platform; 2) a learning catalogue organized around the TER; 3) a purposeful software component developed to allow learners to access and use effectively the digital contents.

The platform integrates open source software, which has been customized to enable students, mentors, and teachers to attend MOOC courses. The platform used is Open edX, which is currently the most visually engaging learning and teaching MOOC environment, supported by Stanford University, Google and many other international universities. The platform includes a learning management system (LMS) for content delivery and management of interaction with teachers and learners, and a content management system (CMS) to manage the creation and delivery of digital materials and courses. Other learning services include discussion groups, wikis, real-time assessment, and other interactive tools. The platform realized is available at http://apollo.emi.unisalento.it (Fig. 1).


**Fig. 1.** Welcome page of the developed MOOC-based system

The second asset of the system is represented by the learning catalogue containing resources associated to TER activities. Every course in the catalogue has a pre-defined structure, which includes 3 to 5 modules aimed to develop one or more entrepreneurial competencies related to each stage of the TER. Each module is structured in learning activities (online lectures, virtual classroom, online collaboration, face-to-face seminars, events, self-study, assessment, etc.) and contains digital resources. Learning assessment

consists in a final test that can be automatically corrected or supervised by the mentor, depending on the typology. With the purpose to favour the reuse of digital contents and speed up the growth of the learning catalogue, a "SCORM Importer" XBlock has been developed and implemented into the system. In Open edX, the XBlock represents the architectural component for building courseware similar to web applications. The "SCORM Importer" allows content creators to import and run existing SCORM packages in Open edX.

Finally, the third asset is represented by a software component which has been purposefully developed to support an effective access and use of digital contents. Such component is an XBlock that implements a questionnaire composed by seven questions (Table 2) aimed to "guide" learners into their entrepreneurial journey.

**Table 2**
Technology entrepreneurship questionnaire

1. Have you defined the value proposition and the revenue model of your entrepreneurial initiative? *[YES – NO]*
2. Did you prepare a business plan for your entrepreneurial initiative? *[YES – NO]*
3. Did you find the financial and organizational resources of your entrepreneurial initiative? *[YES – NO]*
4. Did you register a trademark or a patent for your product/service?
5. Did you develop a prototype of your product/service? *[YES – NO]*
6. Does your company exist on the market and aim to expand the boundaries? *[YES – NO]*
7. Are you evaluating the opportunity to raise the funds through an IPO? *[YES – NO]*

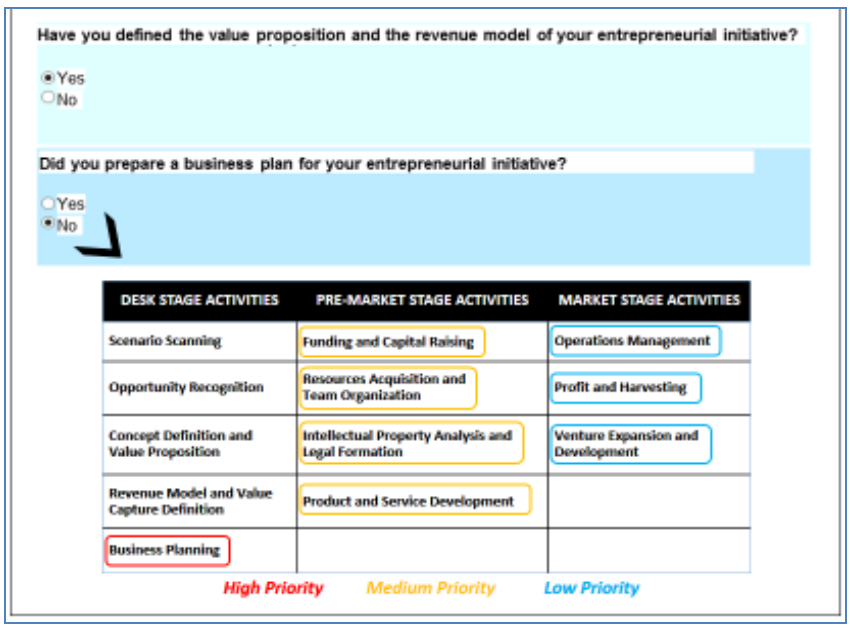


**Fig. 2.** Course recommendation based on learner's answers

Based on answers provided by the user, the system suggests the activities of the TER that should be deepened and points to the particular level of priority (high, medium, or low). Then, by clicking on a specific activity, the system provides a list of courses to follow. The logic and the algorithm embedded into such component have been defined by a pool of researchers and experts in entrepreneurship processes. Fig. 2 shows an example of course recommendation based on the answers provided by the learner.

## 5. Trial test and system evaluation

A trial test of the system has been carried out with 10 students enrolled in the *Management Engineering* degree course at the University of Salento (Italy). Each student has been asked to access the platform and enrol to the course entitled "*Financing start-up through crowdfunding*". The course includes a module titled "*Introduction to crowdfunding*" with a 30-minute video and further additional resources like online articles, digital reports, web link, case studies, as well as Facebook and Twitter pages to create a peer network. The module assessment is based on multiple-choice questions (Fayyoumi & Elia, 2015).

**Table3**
Course evaluation by learners (1=poor; 5=excellent)

| **DIDACTIC ISSUES** | **4.5** |
|---|---|
| Clarity of contents | 4.6 |
| Clarity of learning objectives | 4.5 |
| Coherence between learning objectives and contents | 4.7 |
| Usefulness of additional resources | 4.7 |
| Coherence between foreseen work and effective work | 4.7 |
| Acquisition of new knowledge | 4.4 |
| Usefulness of tutorship and mentorship | 4.3 |
| Typology of assessment | 3.9 |
| Effectiveness of professor (competency and clarity) | 4.8 |
| Organization of learning activities | 4.5 |
| **TECHNOLOGICAL ISSUES** | **4.1** |
| Simplicity in the use of the platform | 4.3 |
| Access to services | 4.5 |
| Communication tools | 4.1 |
| Digital content management tools | 4.2 |
| Teacher-learner interaction tools | 4.1 |
| Learner-learner interaction tools | 3.6 |
| **OVERALL EVALUATION** | **4.0** |
| Level of involvement respect to traditional learning | 3.6 |
| Level of originality respect to traditional learning | 4.1 |
| Overall satisfaction level | 4.4 |
| Level of recommendation of the course to other colleagues | 9 yes - 1 no |

The duration of the test was 4 weeks and, at the end of the course, the students have been invited to answer to a questionnaire designed to capture their evaluation about didactical and technological issues, and to collect further insights. These sections of the questionnaire have been set up according to the main contributions of Huang and Luce (2003) and Liaw (2008). The questionnaire included 20 closed questions with a five-point Likert scale (1 for *poor* evaluation and 5 for *excellent*), as commonly applied in online education research (Roberts, Irani, Telg, & Lundy, 2005). The average evaluation provided by students is reported in Table 3.

Results obtained from the experiment are positive overall, with average evaluations of didactic and technological issues that are above "4". The relatively low value for "typology of assessment" (3.9) suggests expanding the multiple-choice assessment by including an assignment to submit at the end of the course. One possibility could be to ask learners to design a crowdfunding campaign with the active involvement of real stakeholders, thus experiencing the challenges of crowdfunding in a realistic scenario.

With reference to technological issues, the 3.6 mark out of 5 related to "learner-learner interaction tools" can be explained by the fact that most of students in the experiment have a physical interaction as they meet in class to attend traditional courses and they, thus, do not significantly use online communication tools. However, a deeper analysis of their opinions and learning behaviour is needed to support the design and development of other services in the MOOC platform (e.g. on line laboratories, brainstorming sessions), or the definition of preliminary activities (e.g. an initial training phase on the system and its services). Also the evaluation of the "level of involvement respect to traditional learning" (3.6) can be influenced by the counter-effect of attending physical courses in the same timeframe of the MOOC use.

## 6. Conclusions

Massive open online courses (MOOCs) are changing the way in which people use and share digital knowledge, thus creating new opportunities for learning and competence development in market-relevant areas such as innovation management and entrepreneurship. MOOCs are predestined to reach a large audience that can enjoy the autonomy of self-paced instruction with the assistance of the network of online peers (Welsh & Dragusin, 2013).

Institutions such as the World Economic Forum, the World Bank and the Organization for Economic Co-operation and Development (OECD) have included the development of entrepreneurial skills among their strategic recommendations for the creation of future human capital (European Commission & OECD, 2012). Entrepreneurship education focuses on developing and applying the skills required to set up a new venture, to develop and to grow an existing business, or to design an entrepreneurial organization. Entrepreneurial attitude supports individuals also in their everyday lives, contributing to their personal fulfillment, social inclusion, active citizenship and employability in the entrepreneurial society.

This paper has presented a MOOC platform for building entrepreneurial behaviour and competencies. Based on a purposeful roadmap of activities, learners can self-evaluate the status of their entrepreneurial journey and, obtain, accordingly, appropriate recommendations in terms of activities to perform and courses to access.

This personalization mechanisms are crucial to make learning processes more effective and efficient (Chen, Lee, & Chen, 2005), as well as to reinforce learners to manage the complexity of the learning experience (Xu, Wang, & Wang, 2005; Cormier, 2008; Siemens & Tittenberger, 2009; Conole, 2013; De Freitas, Morgan, & Gibson, 2015). Actually, creating personalized on-line paths provides students with alternative learning activities and a higher motivation (O'Donnell, Lawless, Sharp, & Wade, 2015). In such perspective, running a MOOC represents a beneficial example for opening learning chances and supporting in a self-paced way the development of the students' entrepreneurial potential (Welsh & Dragusin, 2013).

MOOC courses can be considered as an appropriate tool to teach entrepreneurship-related courses, because they can increase personal entrepreneurial attitudes and inclinations, and improve problem solving capabilities and multiple tasks execution (Al-Atabi & DeBoer, 2014).

The research presented provides useful insights for the design of effective MOOC-based learning experiences in the technology entrepreneurship domain, and offers valuable details about applicable teaching approaches. In particular, a set of guidelines on the course structure and architecture is given. By adopting an open approach to feed the knowledge base of the system, it is possible to involve companies, universities, experts and stakeholders in the design and implementation of on line courses.

The trial test of the platform has provided a positive feedback to bring research efforts ahead. Further research will be conducted to design a performance dashboard to monitor in real time the progress of learners in terms of both, individual performance and social network dynamics. Besides, other courses will be developed to build more complete learning paths. A larger experimentation will be thus conducted to involve learners coming from academy and the civil society as well.

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