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## **Promises, Limitations and Synergies of Rich Learning Landscapes**

### **Exploring Frames of Reference for Massive, Open, Online Courses (MOOCs)**

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#### **Abstract**

Massive Open Online Courses (MOOCs) are Higher-Ed courses with massive enrollments that promise “Education for Everyone and for all Interests”. There is currently substantial enthusiasm, excitement, and hype worldwide surrounding MOOCs — not only in academic circles: they are being broadly discussed in the major news media as well. Articles, discussion groups, and blogs discussing MOOCs and a rapidly increasing number of MOOCs courses are indicators of the involvement of many stakeholders concerned about the future of learning and education. Many of the reflections about MOOCs are based on *economic perspectives* (scalability, productivity, being “free”) and *technology perspectives* (platforms supporting large number of students in online environments, enrichment components such as forums, peer-to-peer learning support, automatic grading). Very few contributions analyze MOOCs from a *learning science perspective* and put them into larger context with other approaches to learning and education.

This article postulates that MOOCs represent one approach in a *rich landscape of learning*. It uses two specific frames of reference (“learning about and learning to be” and “learning when the answer is known and is not known”) to analyze the strengths and weaknesses of MOOCs.

The paper argues that one of the major contributions of MOOCs is to serve as a forcing function to reflect about the core competencies of residential, research-based universities in covering aspects of learning that cannot be easily addressed by MOOCs.

Two interesting questions to ask based on these developments are: (1) *what is covered* by MOOCs (by being free, open, and large-scale; by containing rigorous content; and by offering learning analytics opportunities based on very large numbers of participants)?; and (2) *what is not covered* by MOOCs (e.g., by being focused on a traditional model of an instructionist classroom, there is little support for self-directed learning, debate and discussions, and reflective conversations)?

This paper represents an effort (1) to create frames of references for MOOCs derived from a rich landscape of learning, (2) to articulate ideas and needs for experimentation with MOOCs, and (3) to provide examples what might be the core competencies of residential, research-based universities.

#### **Keywords**

rich landscapes of learning; learning about; learning to be; learning when the answer is known; learning when the answer is not know; open, online learning environments; MOOCs; strength and weaknesses of MOOCs; experimentation; core competencies of residential, research-based universities; conceptual; frameworks and frames of reference (lifelong learning, cultures of participation, meta-design, self-directed, design-based, active collaborative learning; specific developments (courses-as-seeds; apprenticeship programs); implications and challenges

## Table of Contents

<b>Abstract .....</b>	<b>1</b>
<b>Keywords.....</b>	<b>1</b>
<b>Foreword .....</b>	<b>4</b>
<b>Acknowledgements.....</b>	<b>4</b>
<b>1 Introduction .....</b>	<b>5</b>
<b>2 Challenges Facing Higher Education.....</b>	<b>6</b>
2.1 What Does It Mean to Be Educated in Today's World.....	6
2.2 Change.....	7
<b>3 Multi-Dimensional Aspects of Learning .....</b>	<b>8</b>
<b>4 Rich Landscapes for Learning.....</b>	<b>9</b>
4.1 Learning About versus Learning to Be.....	10
4.2 Learning When the Answer is Known versus Learning When the Answer is Not Known .....	10
<b>5 MOOCs: Massive Open Online Courses.....</b>	<b>11</b>
5.1 MOOCs in the Context of Open, Online Learning Environments .....	11
5.2 Ancestors of MOOCs — the Historical Context (or the Lack thereof).....	12
5.3 Differentiation between MOOCs: cMOOCs and xMOOCs .....	13
5.4 Strengths of MOOCs.....	14
5.5 Weaknesses of MOOCs .....	14
5.6 Motivation for Participation .....	15
<b>6 MOOCs: Facts, Assumptions, Data, Opinions, Experimentation, Business Models, And Contributions .....</b>	<b>16</b>
6.1 Facts and Findings .....	16
6.2 Assumptions.....	16
6.3 Big Data and Learning Analytics .....	16
6.4 Opinions: Hypes and Underestimations .....	17
6.5 Experimentation .....	18
6.5.1 <i>Identifying the Fundamental Limitations</i> .....	18
6.5.2 <i>Data for Formative Assessment</i> .....	19
6.5.3 <i>Making Certificates More Meaningful and More Valuable</i> .....	20
6.6 Business Models — MOOCs Being “Free”? .....	20
6.7 Identifying the Contribution of MOOCs to Rich Landscapes of Learning.....	21
6.7.1 <i>MOOCs: in which sense are they more than “gift-wrapping”?</i> .....	21
6.7.2 <i>The Lecture</i> .....	22
6.7.3 <i>The Role of the Teacher</i> .....	22
6.7.4 <i>The Dependency of MOOCs of Disciplines and Prerequisites</i> .....	23
6.8 Universities: Finding their own Ways .....	23
<b>7 Core Competencies of Residential, Research-Based Universities.....</b>	<b>24</b>
<b>8 Exploration of Specific Learning Landscapes in the Center for Lifelong Learning &amp; Design (L3D) .....</b>	<b>26</b>
8.1 Conceptual Frameworks .....	26

8.1.1	<i>Lifelong Learning: Making Learning a Part of Life</i> .....	26
8.1.2	<i>Cultures of Participation</i> .....	28
8.1.3	<i>Meta-Design</i> .....	29
8.2	<i>Specific Developments</i> .....	29
8.2.1	<i>Courses-as-Seeds</i> .....	29
8.2.2	<i>Undergraduate Research Apprentice Program (URAP)</i> .....	32
8.2.3	<i>Identifying and Supporting Different Engagement Levels by Learners</i> .....	32
9	<b>Future Developments</b> .....	33
10	<b>Conclusions</b> .....	35
11	<b>References</b> .....	36
12	<b>Appendices</b> .....	40
12.1	<i>Overview of MOOCs Providers</i> .....	40
12.2	<i>International Developments</i> .....	41
12.3	<i>Examples of Courses</i> .....	41
12.4	<i>Selected Publications, Commentaries, and Presentation about MOOCs</i> .....	43

## List of Figures

<i>Figure 1: The co-evolution between learning, new media, and new learning organizations</i> .....	6
<i>Figure 2: Multi-Dimensional Aspects of Learning</i> .....	8
<i>Figure 3: Overview of Rich Landscapes for Learning</i> .....	10
<i>Figure 4: MOOCs in the context of open, online learning environments</i> .....	12
<i>Figure 5: Ancestors of MOOCs</i> .....	13
<i>Figure 6: A Fuel Consumption Converter</i> .....	15
<i>Figure 7: Data Illustrating Important Aspects of MOOCs</i> .....	19
<i>Figure 8: An Overview of our Long-Term Research Agenda</i> .....	27
<i>Figure 9: Illustrating the Description of two MOOC Courses</i> .....	42

## List of Tables

<i>Table 1: Different Learning Strategies</i> .....	32
<i>Table 2: Contrasting MOOCs and SDACLs</i> .....	34

## Foreword

MOOCs have generated a world-wide interest in learning and education. This interest has transcended narrow academic circles (e.g.: the NY Times declared 2012 “The Year of the MOOC”). The numerous discussions and analyses of MOOCs have been focused on MOOC providers, MOOC courses, and MOOCs impact on economic and technological aspects.

This paper explores and develops *frames of reference* for MOOCs grounded in a *learning science perspective*. By postulating and describing rich landscapes of learning, it tries to identify the roles of MOOCs in such a landscape by articulating their strengths and weaknesses. It explores particularly how MOOCs can serve an important forcing function to identify the core competencies of residential, research-based universities in the years to come.

The argumentation of this paper is grounded in research activities, practices, experiences, and beliefs that framed my life as a researcher and teacher in universities. My long-term professional objective has been focused “to create socio-technical environments in which people want to learn rather than have to learn”. That this objective is a realistic goal I derived from learning activities in which I participated and observed large numbers of other people participating (including involvement in personally meaningful activities, idiosyncratic interests, sports, and hobbies).

While I believe that teaching and learning are not inherently linked, having had the privilege to work with excellent teachers and mentors, I have no doubt about the importance and impact a good teacher can have on the life of a learner — not necessarily acting as “the sage on the stage” but as “the guide on the side”.

Personally I find it more productive, more interesting, and more rewarding to conceptualize the role of teacher and learner not as an attribute of a person, but of a context. The fact that teachers are seen by many learners as the “all-knowing” experts is derived from instructionist classrooms in which teachers talk about topics which they know and for which they prepare themselves. In self-directed learning activities based on the interests of the learners, teachers will be confronted with questions to which they will not know the answer. I was particularly interested in problems for which no one knew the answer or for which *the* answer does not exist and for which satisficing was the only realistic goal. Many students do not come to our classes with a mindset sharing this understanding which I learned from a student’s commentary on one of my courses: “*the least one can expect is that the teacher knows the answer*” — even though my objective was to explore problems with the students for which the answer does not exist.

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## 1 Introduction

Access to affordable education and literacy (printed, digital, rich media) offering rich landscapes for learning and seeding mindsets for creativity, coping with change, and intellectual curiosity are considered a major indicator and measure of quality of life worldwide.

The recent emergence of MOOCs (Massive Open Online Courses) associated with their promises of providing new, scalable models that can provide an “education for everyone” has generated a renewed broad interest in rethinking learning and education.

The objective of this paper is to identify and establish frames of reference, perspectives, and underlying assumptions in terms of which the meaning and the implications of these developments are conceptualized. The *frames of reference* explored in this paper are:

- a perspective of learning to pass on to future generations the important knowledge, skills, and tools in order to avoid that they have to reinvent the wheel). Csikszentmihalyi ([Csikszentmihalyi, 1996], p 7) argues that in cultural evolution there are no mechanism equivalent to genes and chromosomes: we have to create “memes” to support cultural evolution and pass knowledge from one generation to the next.
- a conceptualization of learning as a *multi-dimensional activity* with the implication that no single approach will serve all the different needs requiring a rich landscape for learning (Figure 3);
  - a more detailed analysis of *two specific frames of references* focused on a differentiation between (a) “learning about” and “learning to be” and (b) “learning when the answer is known” and “learning when the answer is not known” (see Figure 3).

These perspectives have been influenced by a variety of different philosophies and visions of learning including:

- Dewey’s and Bruner’s [Bruner, 1996] notion that students should be *actively engaged participants* in learning, sharing their knowledge with each other rather than competing to get good grades;
- Illich’s *Learning Webs* (articulated 25 years before the Internet came into existence [Illich, 1971]) representing an early vision based on two objectives: (1) provide all who want to learn with access to available resources at any time in their lives; and (2) empower all who want to share what they know to find those who want to learn it from them.

Human cognitive activities such as thinking, learning, teaching, working, and collaborating have never been independent of media (articulated nicely by Postman: “*You cannot use smoke signals to do philosophy*” [Postman, 1985]). Historically the most fundamental transformation in these activities has been the invention of reading and writing and the subsequent changes from oral to literate societies [Ong, 1982] (taking place over long periods of time and facilitated by subsequent developments such as the printing press).

An interesting question is: will *digital technologies* cause a similar fundamental transformation as printed technologies did. Despite the fact that the widespread use of digital technologies is less than 50 years old, we have witnessed amazing changes in our individual cognitive activities and in the social fabric of almost all aspects of our lives.

The appearance and development of Massive Open Online Courses (MOOCs) over the last few years has generated a broad-based interest to rethink learning and education [Bowen, 2013; Collins & Halverson, 2009]. To explore the possibilities and impact of digital technologies in learning and education is not new and predates the development of the Internet [Anderson et al., 1995; Papert, 1980]. The Internet greatly facilitated the development of online learning environments (see Figure 4) with some of them open and free and some of them offered as courses. MOOCs are the latest development and based on their promise to offer “education for everyone for free” have caught not only the attention of learners, but of university administrators, politicians, and the business community. Some of the major contributions of MOOCs have been:

- new developments shaking up existing learning institutions;
- generation of a discussion transcending the narrow confines of academic circles;
- attracting and affecting large number of people; and
- a willingness to experiment with different approaches.

The article is based on: (1) theoretical frameworks grounded in the learning science (complementing views, analysis, and opinions from economic and technological perspectives); (2) opinions, insights, and data documented in the literature and commentary appearing at an amazing rate; (3) insight and lessons learned gained from our developments pursued in the Center for Lifelong Learning & Design (L3D) over

the last two decades; (4) my personal experiences gained by a limited participation in a variety of different MOOCs; (5) discussion with faculty members who have offered MOOCs, are in the process of offering MOOCs, or a planning MOOCs; and (6) *initial* feedback from learners who have participated in MOOCs.

This article attempts to break through the hype surrounding MOOCs by identifying their strengths, weaknesses, realities, claims, and potential for the years to come and it situates MOOCs in a rich landscape of learning. The argumentation is grounded in arguing for the importance of the *co-evolution* between learning, new media, and new learning organizations (see Figure 1). New information and communication technologies have been heralded as the major driving forces behind innovation in learning and education. But many approaches have had only a minor impact based on the reduction to:

- *technology-centered developments* (sole focus on the yellow component in Figure 1): Technology alone does not determine social structure but it creates feasibility spaces for new social and cultural practice [Benkler, 2006]. Changes in complex learning environments are not only dictated by technology; rather, they are the result of an incremental shift in human behavior and social organizations and as such require the co-design of social and technical systems.
- *gift-wrapping* (taken the blue component in Figure 1 as a given): Many uses of new media can be characterized as “gift-wrapping” [Fischer et al., 2005]: they are used as add-ons to existing practices rather than a catalyst for fundamentally rethinking what education should and can be in the next century. They change the medium, but leave the content unchanged and contribute little to introducing new epistemologies. Existing frameworks, such as instructionism, fixed curricula, memorization, decontextualized learning and so forth, are not changed by technology itself. This is true whether we use computer-based training, intelligent tutoring systems, or multimedia presentations.
- a sole focus on *existing learning organizations* (not exploring new possibilities of the red component in Figure 1): e-learning environments including massive open online courses (MOOCs), peer-support communities [Gorman & Fischer, 2009] and niche communities of special, idiosyncratic interests [Brown & Adler, 2008; Collins et al., 2009] have provided new opportunities for collaborative learning, but have often been reduced to “gift-wrapping” approaches by conceptualizing “distance learning as classroom learning at a distance”.

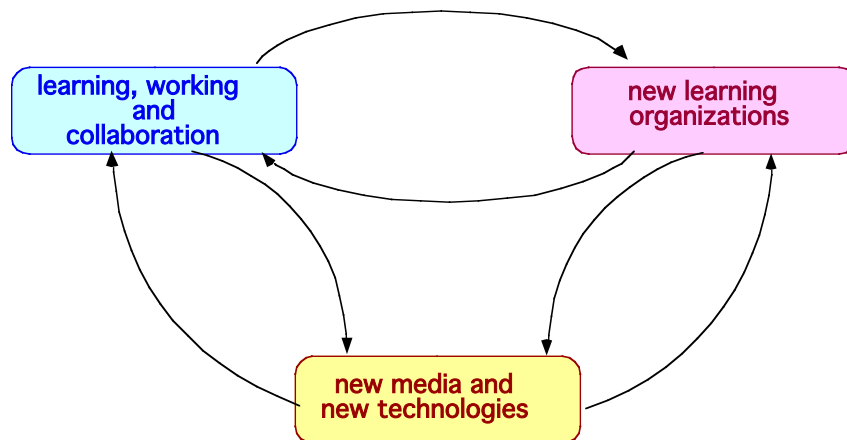


Figure 1: The co-evolution between learning, new media, and new learning organizations

## 2 Challenges Facing Higher Education

### 2.1 What Does It Mean to Be Educated in Today's World

Learning and education are experiencing a period of profound transformation. Phenomena such as globalization, increasing trends to outsource high-level cognitive tasks, and the need to participate effectively in addressing complex world problems are changing how we think, learn, work, and collaborate. New knowledge and skills for students in entering work environments require collaborations with experts from multiple fields, the pursuit of several career paths, and interacting and working with people of diverse backgrounds. These changes create new educational demands: learners need to be



educated for a diverse, technical, problem-oriented world that does not yet exist. Rich landscapes for learning supported by innovative information and communication technologies are needed, in which learners of all ages can pursue topics of interest and take responsibility for their own education by empowering them to thrive and participate as co-designers in collaborative environments with ever-changing disciplinary boundaries.

In addition to learning content and reasoning in specific domain, soft skills are needed (including the ability to learn independently and collaboratively; good communication and collaboration skills) to address the proposition that has served as a guiding principle for the research efforts in our Center for Lifelong Learning & Design (L3D): *“If the world of working and living relies on collaboration, creativity, definition and framing of problems and if it requires dealing with uncertainty, change, and intelligence that is distributed across cultures, disciplines, and tools—then graduate programs should foster transdisciplinary competencies that prepare students for having meaningful and productive lives in such a world.”*

## 2.2 Change

**How Things Are.** The current emphasis on learning is primarily focused on formal learning taking place in schools and university but alternatives such as informal learning are gaining increasingly more attention [National-Research-Council, 2009]. In formal learning environments, learning follows prescribed paths defined by curricula. Large instructionist lectures are still common but there are numerous successful attempts to enrich the learning experiences with design activities embedded in problem-based design activities. Most learning is conceptualized as “learning when the answer is known” and it is grounded in a transmission model in which the learners should learn what the teachers know.

**How Things Could Be.** A science of learning for the 21<sup>st</sup> century needs to explore many types of learning other than traditional curriculum-based classroom learning. It must conceptualize learning as an inclusive, social, informal, participatory, and creative lifelong activity. The learning goals and the content of the learning activity should not only be determined by curricula but by interest-based, self-directed learning objectives. Many problems (specifically design problems) are unique and ill-defined and the knowledge to address them is not “out there” requiring contributions and ideas from all involved stakeholders. Learners in such settings must be *active contributors* rather than passive consumers and the learning environments and learning organizations must foster and support mindsets, tools and skills that help learners become empowered and willing to actively contribute [Fischer, 2002].

Providing learners of all ages with the means to become co-creators of new ideas, knowledge, and products in personally meaningful activities presents one of the most exciting innovations and transformations of digital media, with profound implications in the years to come. Beyond supporting contributions from individuals, learning organizations need to build a culture and mindset of sharing, supported by effective technologies and sustained by personal motivation to work for the benefit of groups and communities.

**Pressures for Change.** There are numerous factors that create pressure for change in learning and in education. The dramatic changes in people’s lifetime in the last decades make *lifelong learning* a necessity. *Learning on demand* needs to be supported to address the impossible demand of coverage and the guaranteed occurrence of obsolescence. The student body is changing: many “Students” are not traditional students in residence on a university campus anymore, but professionals who have already earned a degree, educators, business people, and researchers, and citizens who want to be lifelong learners. The competition between universities is increasing with alternatives such as the Open University, the University of Phoenix, and broadly available open educational resources (see Figure 4). The qualification system is moving to a more competency-based world in which there will be less interest in how someone acquired competencies (e.g. in an online course, at a four-year-college or by taking advantage of the large number of open, educational resources). The *ubiquitous availability of tools* (e.g.: both Apple and Google claim that they offer more than 800,000 apps for their respective platform) will make memorization and rote learning skills less relevant and put more emphasis on distributed cognition, using on demand, and learning on demand. Education will (or should) shift from “knowing the answers” to “knowing how to find the answers”.

The *cost* of a university education has been growing dramatically (a detailed analysis of this argument requires a comparison between the USA and Germany — two countries in which the costs are distributed very differently). The promise of MOOCs to be “free” is therefore an exciting development (see Section 6.6 for a brief analysis of “free”).

### 3 Multi-Dimensional Aspects of Learning

As the demands for learning undergo a period of profound transformation, there is a need for exploring innovative multi-dimensional aspects of learning. Figure 1 provides an overview of the multi-dimensional aspects of learning — and the following section briefly describes the essential issues related to the different aspects.

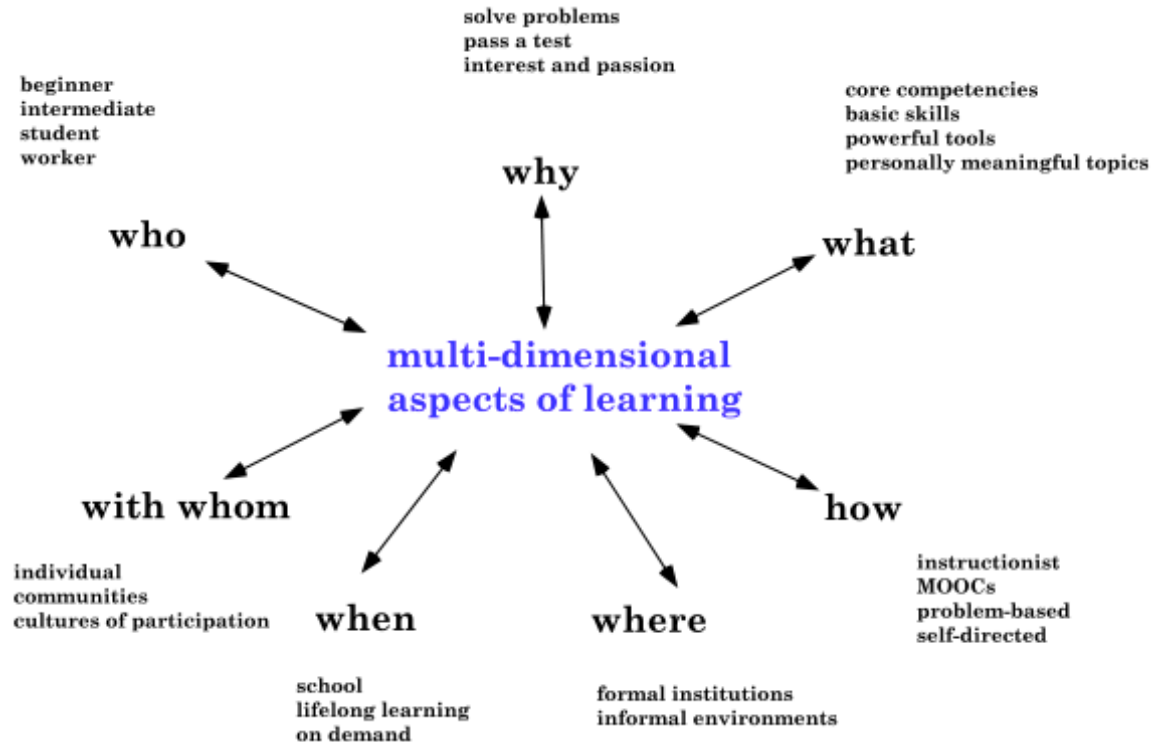


Figure 2: Multi-Dimensional Aspects of Learning

**Who Learns: People at different stages.** The learner may be a student in different grades and institutions (ranging from K-12 to university education), a person working in industry, or curious citizens attempting to understand more about the world surrounding them. Some of the learners may be beginners (and general and uniform introductory courses will serve them well) whereas other may have a rich knowledge background and very specific objectives requiring more individualized instruction.

**Why Learn: Different Objectives.** Some people learn because they need to pass a test, fulfill the requirements of a course in school or university, and others learn because they are passionate about some activity (e.g. [Collins & Halverson, 2009]. "*October Sky*" ([http://en.wikipedia.org/wiki/October\\_Sky](http://en.wikipedia.org/wiki/October_Sky)) is an interesting film based on a true story illustrating passionate and interest-driven learning: a personally motivating event (seeing the Sputnik in the sky) serves as a source of interest in rockets and space science for boys in a coal mining town. The group pursues this interest and eventually wins a major science fair. For all members of the group, this engagement represents a life-changing experience.

**What to Learn: Exploring Personally Meaningful Problems and Acquiring Basic Skills and Core Competencies.** In formal learning environments, students' learning is determined to a large extent by a curriculum. Learners encounter few opportunities to gain experiences by exploring personally meaningful problems that need to be identified and framed. The engagement with personal meaningful problems should be complemented with learning opportunities to acquire the basic skills and core competencies for the 21<sup>st</sup> century [Collins et al., 2014]. These competencies do not primarily consist of learning and memorizing facts, but should be focused on (1) acquiring and using information; (2) identifying, organizing, planning and allocating resources; (3) collaborating with others; and (4) working with a variety of technologies.

**How to Learn: Learning in Different Ways.** Learning in today's world must conceptualize learning as an inclusive, social, informal, participatory, and creative lifelong activity. Many problems (specifically design problems) are unique and ill-defined and the knowledge to address them is not "out there"



requiring contributions and ideas from all involved stakeholders. Learners in such settings must be *active contributors* rather than passive consumers and the learning environments and organizations must foster and support mindsets, tools, and skills that help learners become empowered and willing to actively contribute [Fischer, 2002; von Hippel, 2005].

**Where to Learn: At the Right Places.** Historically, schools provided the setting where individuals engaged in learning. The seeds of a new education system can be seen in the explosive growth of home schooling, workplace learning, distance education, adult education, and a variety of design spaces (museums, zoos, environmental centers, educational television and videos, computer-based learning environments, and Internet cafes). Research on everyday cognition demonstrates that the formal learning in schools and the informal learning in practical settings have important differences [National-Research-Council, 2009]. What we discover about learning in schools is *insufficient* for a theory of human learning: schools are often focused on individual cognition, on memorization and on learning general facts whereas learning in the world at large need to rely on shared cognition, use of powerful tools and external information sources, and situation-specific competencies [Resnick, 1987].

**When to Learn: At the Right Time.** Information overload and the rapid change of our world have created new problems and new challenges for learning and education. People will have to keep learning new knowledge and skills throughout their lifetimes as their lives and jobs keep changing. New approaches are needed to circumvent the unsolvable problems of *coverage* and *obsolescence*. *Learning on demand* [Fischer, 1991] is a promising approach for addressing these problems because: (1) it contextualizes learning by allowing it to be integrated into work rather than relegating it to a separate phase, (2) it lets learners see for themselves the usefulness of new knowledge for actual problem situations, thereby increasing the motivation for learning new things, and (3) it makes new information relevant to the task at hand, thereby leading to more informed decision making, better products, and improved performance.

**With whom: Transcending to Individual Human Mind.** Systemic problems require more knowledge than any single person possesses because the knowledge relevant to either frame or resolve these problems is usually distributed among stakeholders coming from different disciplines [Fischer & Sugimoto, 2006]. The “Renaissance Scholar” (meaning the person who is knowledgeable in all relevant fields) no longer exists [Csikszentmihalyi, 1996]. To deal with complex multi-disciplinary problems, people need to use the powerful tools technology provides for finding, analyzing, manipulating, and communicating knowledge bringing different and often controversial points of view together to create a shared understanding among these stakeholders can lead to new insights, ideas, and artifacts. In the past, most computational environments have focused on the needs of individual users. Our research has evolved from empowering Renaissance Scholars in specific domains (e.g., with domain-oriented design environments) to creating shared understanding among “Renaissance Communities” as communities of interest [Fischer, 2013]. Bringing people with different background knowledge and different value systems together, overcoming the biases and barriers of their separate languages, and integrating different educational experiences will not be an easy undertaking.

## 4 Rich Landscapes for Learning

Learning needs and learning objectives vary greatly requiring rich landscapes for learning. Figure 3 provides an overview and establishes frames of references for the future sections of this paper. It illustrates:

- Formal learning in schools needs to be complemented by informal learning [National-Research-Council, 2009].
- “Knowledge in the head” needs to be complemented with “knowledge in the world,” emphasizing the importance of distributed cognition [Derry et al., 1998; Salomon, 1993].
- Supply-oriented models (in which learners are presented with knowledge that later may become relevant for them) need to be complemented by learning on demand [Collins & Halverson, 2009].
- Consumer-oriented cultures need to be complemented by participatory cultures [Jenkins, 2009];
- “Learning about” needs to be complemented by “learning to be” [Brown, 2005].
- “Learning when the answer is known” needs to be complemented by “learning when the answer is not known” (and exploring problems that have no answers) [Engeström & Sannino, 2010].

These objectives represent *antinomies* [Bruner, 1996]: pairs of truth, each worthwhile to pursue in different contexts, but also contradicting each other at a certain level. It is important to note

that these different dimensions are not independent from each other but overlap in numerous ways.

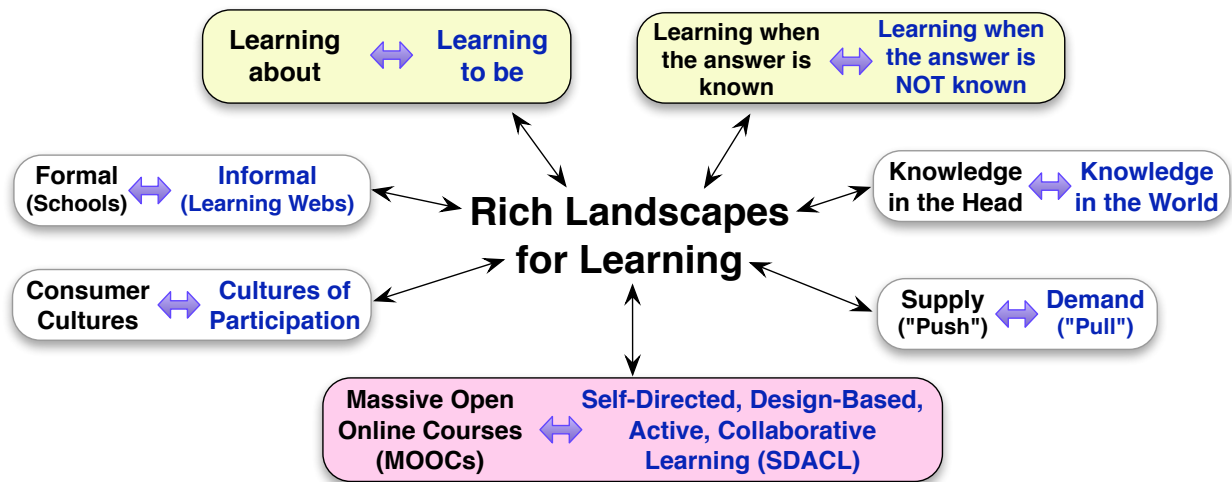


Figure 3: Overview of Rich Landscapes for Learning

#### 4.1 Learning About versus Learning to Be

*Learning about*, as an objective for learning and education, is focused on the accumulation of intellectual capital realized in a curriculum that stresses the communication of culturally central theories, facts, and skills [Hirsch, 1988]. This curriculum is identifiable and structured as a coherent and fine-grained sequence of educational objectives. Instructionist approaches can be effective and are often well suited for “learning about” (e.g., learners getting introduced to domains of knowledge that are new to them, e.g., Math 101, Physics 101, Design 101, etc.).

*Learning to be* [Brown, 2005] is focused not as much on teaching about mathematics, physics, or design, as on what it means and takes to be a mathematician, a physicist, or a designer (or a “Wikipedian,” a skier, or a surfer). Important dimensions of *learning to be* include learning by being engaged in personally meaningful problems, teachers engaging in problem-solving activities in front of their students rather than lecturing, and enculturation into communities of practice with legitimate peripheral participation [Lave & Wenger, 1991]. To promote and support “learning to be”, the Center for Lifelong Learning & Design (L3D) has (1) initiated and supported an “Undergraduate Research Apprenticeship Program” supported in large part by NSF REU grants (<http://l3d.cs.colorado.edu/urap/>) and (2) established and nurtured communities based on “horizontal and vertical integration” (bringing together individuals coming from different disciplines and including undergraduates, graduates, post-docs, faculty members, and people in industry). Learning to be involves enculturation — articulated by ([Brown & Duguid, 2000b], p 220) as follows: “engaging with communities of practice and of concepts. Teaching and education, from this perspective, are not simply matters of putting in touch with information. Rather, they are matters of putting students in touch with particular communities. The university’s great advantage is that it can put learners in touch with communities that they don’t know about.”

#### 4.2 Learning When the Answer is Known versus Learning When the Answer is Not Known

In many introductory courses (particularly in disciplines belonging to the natural sciences [Simon, 1996] such as mathematics and physics), the answer to the problems discussed in courses exists and is known by the teacher, and the core challenge is “for learners to learn what the teacher knows”. But in many other situations (e.g., exploring wicked, ill-defined design problems), the answer is not known by any stakeholder; instead, all participants engage in collaborative knowledge construction and evaluation processes. In many of these problem-solving situations, a correct, final “answer” does not exist (e.g., the antinomies indicated in Figure 3).

In settings where *the answer is known by the teacher and not by the learner*, instructionism and lectures based on the transmission model are reasonable and cost-effective strategies. The emphasis is on transmitting “subject matter” to pass on the memes to the next generation [Csikszentmihalyi, 1996]. Under which conditions it is the best way to achieve learning by the learners is not ultimately decided. Theorists like Bruner argue that the most important gift of cultural psychology to education is the reformulation of the impoverished conception that “*teaching is fitted into a mold in which a single, presumably omniscient teacher explicitly tells or shows presumably unknowing learners something they presumably know nothing about*” ([Bruner, 1996], p 20).

In settings where *the answer is not known and the “right” answer may not exist* (as it is the case in wicked, ill-defined design problems), learning is not a commodity to be consumed but is collaboratively designed and constructed, emphasizing innovation, continuous learning, and collaboration as important processes in which workers as stakeholders create new knowledge as they carry out their problem framing and problem solving activities. The role of the omniscient teacher does not exist in such settings: “*In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not there yet. They are literally learned as they are being created. There is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes.*” ([Engeström, 2001], p 138).

## 5 MOOCs: Massive Open Online Courses

MOOCs are one of the “hottest” topics these days in the world of education, learning, and teaching (the New York Times declared 2012 the year of the MOOC; <http://www.nytimes.com/2012/11/04/education/edlife/massive-open-online-courses-are-multiplying-at-a-rapid-pace.html?pagewanted=all&r=0>). They are

- “*massive*” because they are designed to enroll tens of thousands of students (and have done so in numerous cases);
- “*open*” because anyone with an Internet connection can sign up;
- “*online*” being available on the Internet and referring not just to the delivery mode but to the style of communication;
- “*courses*,” referring not only to content delivery (as it was the case with MIT’s Open Courseware) but including other aspects (lectures, forums, peer-to-peer interaction, quizzes, exams, and credentials) associated with courses.

Over the last few years, numerous MOOCs providers (including: MIT’s and Harvard’s edX project (<http://www.edxonline.org/>) and Coursera (<https://www.coursera.org/>) and Udacity, (<http://www.udacity.com/>) two private companies founded by faculty members associated with Stanford University) are shaping and organizing numerous MOOC developments (more details are provided in Appendix 12.1). A fast growing number of courses from different universities are available as MOOCs (details and examples are provided in Appendix 12.3).

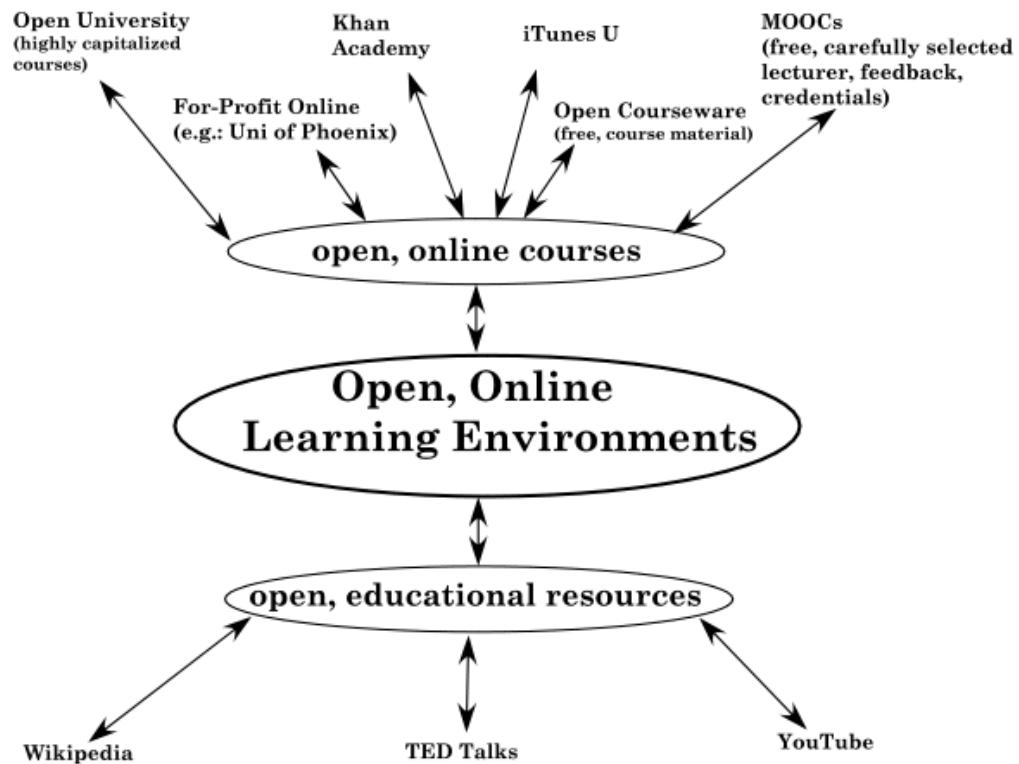
MOOCs enrich the landscape of learning opportunities (see Figure 2 and **Error! Reference source not found.**) and they have the potential to reduce the digital divide by providing education for everyone by “making the knowledge of some of the world’s leading experts available to anyone free of charge”.

MOOCs deserve credit because they have woken up academia and the media to bring online learning and teaching to the attention of the public. A special impact considered specifically in this paper is the challenge of MOOCs to “force” residential, research-based universities to reflect, define, and emphasize their core competencies. These should consist of moving away from large lectures with learners listening to teachers towards active learning environments characterized by personal attention from teachers and opportunities for participation.

This section will characterize MOOCs from different perspectives, put them in the context of previous developments, analyze their current strengths and weaknesses and explore questions, claims, open issues, and challenges for MOOCs.

### 5.1 MOOCs in the Context of Open, Online Learning Environments

MOOCs can be characterized as one specific approach in the context of *open, online learning environments* providing resources (mostly available on the Internet) associated with courses. In analogy to Figure 3 showing a rich landscape of learning, Figure 4 provides an overview and a classification about the rich landscapes of open, online learning environments representing places and institutions that complement traditional universities [Brown & Duguid, 2000a].



**Figure 4: MOOCs in the context of open, online learning environments**

Open, educational resources serve different purposes and can be differentiated from open, online courses:

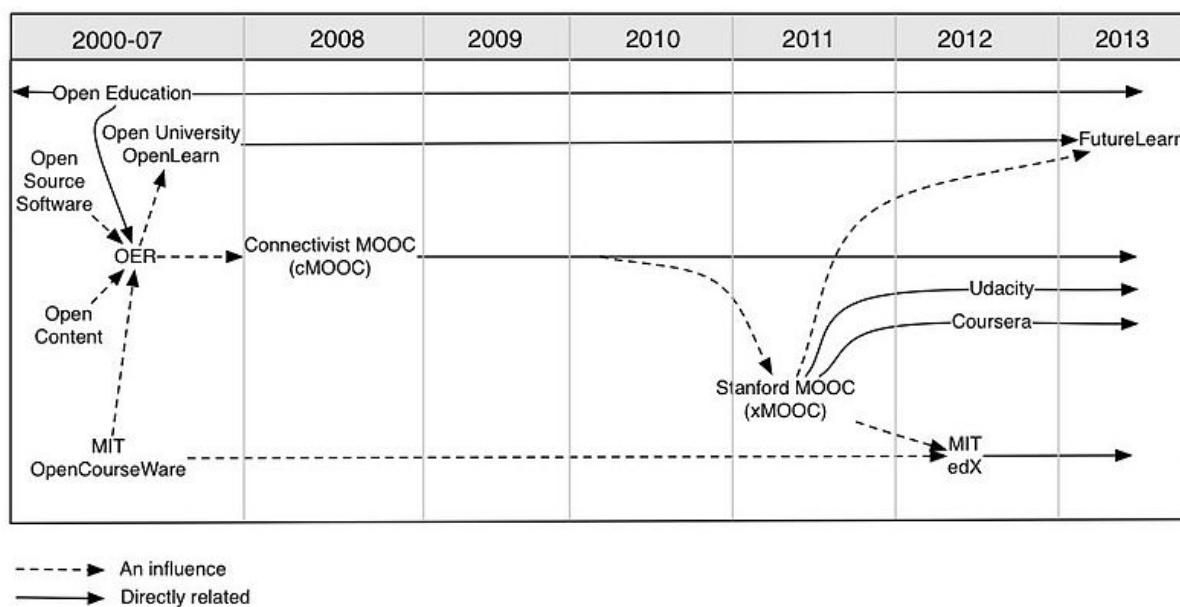
- the content of the former being largely independent (with little cohesion between individual components), allowing learners to find answer to specific questions;
- whereas the latter having at least some of the attributes defining a course (such as mentioned above: lectures, forums, peer-to-peer interaction, quizzes, exams, and credentials).

## 5.2 Ancestors of MOOCs – the Historical Context (or the Lack thereof)

The opinions about how innovative MOOCs are vary greatly. The Wikipedia article provides a good history section (including Figure 5) of distance learning that predates e-learning with correspondence courses. Radio and television as new technologies at the time were used for educational purposes to overcome distances and reach larger audiences. Many universities (starting in the 1980s; including my university), CU Boulder; <http://cuengineeringonline.colorado.edu/>) created special classrooms with video access for providing convenient and flexible education for working professionals by offering graduate engineering degree programs and certificates in an accessible, online format.

The Open University (OU) in the UK (founded in 1969; <http://www.open.ac.uk/>) has been the pioneer of distance learning “founded on the belief that communications technology could bring high quality degree-level learning to people who had not had the opportunity to attend traditional campus universities”. A more recent development is that the OU is making an increasing amount of teaching and learning resources available free of charge to anyone with access to the Internet via:

- OpenLearn (<http://www.open.edu/openlearn/>);
- the Open University on iTunes U (<http://www.open.edu/itunes/>);
- OUView on YouTube (<http://www.youtube.com/user/TheOpenUniversity>); and
- Open Research Online (<http://oro.open.ac.uk/>), a open access repository of research publications and other research results that can be searched and browsed freely by everyone.



**Figure 5: Ancestors of MOOCs**

<< source: Yuan, Li, and Stephen Powell. MOOCs and Open Education: Implications for Higher Education White Paper. University of Bolton: CETIS, 2013. <http://publications.cetis.ac.uk/2013/667>>>

The MIT OpenCourseWare (MIT OCW; started in 2002; <http://ocw.mit.edu/>) is an initiative of MIT to put all of the educational materials from its undergraduate- and graduate-level courses online, partly free and openly available to anyone, anywhere. In 2013, about 3000 courses are available online, some of them limited to reading lists and discussion topics, others including lecture notes, homework problems and exams, and some of them including interactive web demonstrations and streaming video lectures.

### 5.3 Differentiation between MOOCs: cMOOCs and xMOOCs

The name MOOC was created in 2008 by Dave Cormier and the first examples were cMOOCs followed by xMOOCs in 2011. Both approaches being MOOCs (massive, open, online, and courses), cMOOCs are based on connectivism and networking and give learners an active role whereas xMOOCs are based on an instructionist, transmission-based approach augmented with additional components. As xMOOCs are the focus of interest and attention, *this paper will mostly focus on them*.

#### cMOOCs

Connectivism is based on the assumption that knowledge is distributed across a network of connections, and that learning consists of the ability to construct and traverse those networks. cMOOCs provide opportunities for non-traditional forms of teaching and learning where teachers are not omniscient telling and showing unknown learners something they presumably know nothing about [Bruner, 1996]. The objectives of the cMOOC approach (supporting students learning from one another and online communities 'crowd-sourcing' answers to problems) are closely related to:

- Illich's concept of "Learning Webs" (chapter 6 in [Illich, 1971]) in which he outlines educational systems that "provide all who want to learn with access to available resources at any time in their lives; empower all who want to share what they know to find those who want to learn it from them; and, finally furnish all who want to present an issue to the public with the opportunity to make their challenge known";
- Rogoff's concept of "community of learners" being an alternative to adult (teacher)-run education and child (learner)-run education [Rogoff et al., 1998]; and
- our concept of "courses-as-seeds" [dePaula et al., 2001] (further discussed in Section 8.2.1).

cMOOCs have the potential to be both a disruptive and progressive force in education by

- develop and fostering collaborative learning in online environments;
- support learning based on interests and passion of the learners that does not fit into the curriculum [Collins & Halverson, 2009]; and



- connect groups of like-minded individuals who share interests (thereby supporting a Long Tail framework [Anderson, 2006] for learning and education [Collins et al., 2009]).

### xMOOCs

xMOOCs are the prevailing version of MOOCs offering technology-enriched teacher-centered instruction (for specific examples see Appendix 12.3). Being developed and offered by elite US institutions and well-known lecturers, their success in attracting large numbers of participants, their efficiency in delivering information in particular subjects areas (e.g., well-established, non-controversial knowledge in mathematics, physics, and computer science and introductory courses in different disciplines) has created the extensive interest from an economic (“Wall Street”) perspective and a technological (“Silicon Valley”) perspective.

## 5.4 Strengths of MOOCs

Important potential *strengths* of MOOCs are:

- they represent an innovative, new effort that is shaking up learning institutions;
- they generated a discussion transcending the narrow confines of academic circles by getting the world at large involved and excited;
- they make the knowledge of some of the world’s leading experts from the best universities available to anyone free of charge thereby attracting and affecting large numbers of people;
- they allow teachers to experiment with different approaches (e.g.: standalone versus hybrid courses, courses with fixed time duration versus courses to be taken anytime, etc.);
- they support for learners the ability “to pause, rewind, and replay” in online instruction;
- by recording students interactions, they empower researchers to analyze large amounts of data measuring how specific experiences and interactions will affect students’ learning; and
- they force residential, research based universities to reflect and focus on their core competencies;

## 5.5 Weaknesses of MOOCs

MOOCs are focused on lectures (the other enrichment activities still being quite limited). The technology component makes lectures appear innovative, but this is often only a change in form, not in content; i.e., they are often stuck in “gift-wrapping” [Fischer, 1998b]. Participating in a MOOC is not too different from “traditional” teaching: teachers talk and students listen. This is *one* form of “learning” in the rich landscape of learning (see Figure 3).

While their global reach may bring people with different background knowledge together, the challenge associated with the locality of knowledge should not be underestimated. For example: a lecturer in a statistics course may use data from baseball as an example. This will be familiar to many learners in the USA, but it will be difficult to understand in Europe. Another example of culturally different ways of conceptualizing knowledge is provided by *narrative-1*.

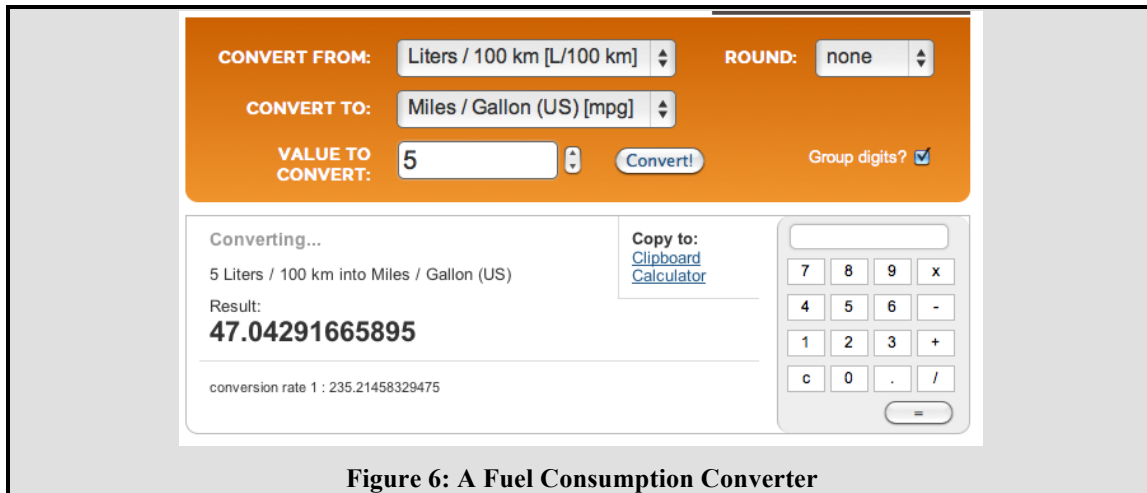
### NARRATIVE-1 — Local versus Global: The Relevance of Culturally Embedded Knowledge

The global reach of MOOCs will provide an opportunity to confront and acquaint learners with different ways of thinking (to avoid “group think” [Janis, 1972]). But the particular challenges of courses reaching beyond the borders of individual countries need to be carefully explored including: how to establish common ground and shared understanding [Clark & Brennan, 1991] and importance of locally relevant issues, needs and understanding.

For example: in a MOOC about energy sustainability, the lecturer may use the gas consumption of cars as an example. The familiar representations in the USA are miles for distance and gallons for gas whereas in many other countries kilometers and liters are used. Beyond the different measurements, the consumptions is conceptualized differently: in the USA, the amount of gasoline is fixed and the energy efficiency are measure how far a car can go with one gallon whereas in Europe the distance is fixed (one hundred kilometers) and the efficiency is measured how much gas is needed to cover this distance.

I have asked numerous people to do the transformation between the two measurements and very few were able to do it. The web (providing all kinds of gadgets as open resources; see Figure 4) provides a nice tool

(<http://www.thecalculatorsite.com/conversions/fuelconsumption.php>) — but without some conceptual understanding, this tool may not be of too much help.



**Figure 6: A Fuel Consumption Converter**

Other currently poorly understood and explored issues for MOOCs are:

- the challenges to support more *interactivity* and to avoid that this interactivity is restricted by the limitations of the current technologies available to multiple choice questions and problems which have simple right-and-wrong answers;
- the meaning and the impact of very *low course completion rates*;
- the *certification and credentialing* [Collins & Pea, 2011; Mozilla-Foundation et al., 2011] (this issue is currently explored by Coursera with its Signature Track);
- the authentication of students' contributions to avoid cheating and plagiarism [Norman, 2001] (this issue is addressed by both edX and Udacity which are partnering with Pearson VUE, a provider of testing centers, to validate students taking proctored exams); and
- the underlying business models (see Section 6.6).

## 5.6 Motivation for Participation

Why are MOOCs such a hot topic? One way to analyze this question is to explore the motivations of all the different stakeholders who are affected by the development of MOOCs: providers, teachers, students, parents, politicians, university administrators, and researchers in the learning sciences and in technology-enhanced learning.

*Providers* (see Appendix 12.1; some of them being for-profit, others being non-profit) articulate a multitude of different reasons for being involved ranging from (1) altruistic motivations such as “education for everyone”, “my aspiration isn't to reach the 1% of the world that is self-motivating — it's to reach the other 99% (Sebastian Thrun)”, to (2) addressing an exciting problem, to (3) bringing fame to their institutions, to (4) exploring a unique business opportunity.

*Professors* are interested in teaching MOOCs (<http://chronicle.com/article/The-Professors-Behind-the-MOOC/137905/#id=overviews>) based on some of the following motivations: (1) the reach and impact which they can achieve (having tens or hundreds of thousands of students in a class; the same motivation as writing a successful textbook); (2) to face a new challenge and learn from it; (3) to avoid being left behind; (4) to increase their visibility and fame (maybe successful MOOC professors of the future will be treated like movie and sport stars?); and (5) to reap new rewards and benefits (e.g. getting tenure for the reputation and social capital that they earned by teaching a highly successful MOOC).

*Learners* (being university students or working professionals) are or may be motivated to participate in a MOOC (1) based on intellectual curiosity; (2) to engage in lifelong learning; (3) to gain an understanding of specific knowledge relevant to problems which they face; (4) to exploit them as their only educational opportunities; and (5) to become members of interesting intellectual communities (maybe comparable to why people join book clubs?). As it is trivial to join a MOOC, many learners (including myself) will sign up with no intentions to ever finish a course — so that only a small fraction of students will finish the course or get a certificate has a different meaning compared to drop-out rates in current universities courses.

*Parents* (in most cases paying substantial amounts of money for the children's education) are interested to find out whether their children can get the same quality education for a fraction of the money that they have to pay for a conventional university education.

*Politicians* for public universities (or fund raisers for privates ones) will welcome any change that will reduce the financial commitments needed by universities. University administrators will similarly welcome cost savings, but many at this moment are very concerned not be left behind, and to understand the impact of these developments on their own institutions. Researchers in the learning sciences and in technology-enhanced learning are often sharply divided in their opinions about MOOCs but may also use MOOCs as very relevant development to rethink learning, teaching, and education (an attempt made with this paper).

## 6 MOOCS: Facts, Assumptions, Data, Opinions, Experimentation, Business Models, And Contributions

### 6.1 Facts and Findings

The most important contribution of MOOCs is that they have generated a discussion and self-reflection about learning and education that is long overdue and that has transcended the narrow confines of academia and scientific conference to the world at large. MOOCS have been conceptualized and discussed primarily from a financial ("Wall Street") perspective (being free") and from a technological ("Silicon Valley") perspective ("being online and reaching massive number of learners") and to a much lesser extend from a learning science perspective (an initial attempt to fill this gap made by this article).

They are applauded for giving millions of students access to the world's best teachers from elite universities in the world.

Currently, most MOOCs are

- in technical subjects like computer science, mathematics, and physics; disciplines with straightforward content in which right answers exist and whose content is little influenced by local cultures and knowledge
- of an introductory nature (thereby requiring few prerequisites)

MOOCs primarily changed the distribution method, but not the actual product (see **Error! Reference source not found.**). Most learners using MOOCs are people who already have a degree <<source>>. The number of people signing up for MOOCs has transcended 100,000 for several courses, most MOOCs have completion rate below 10 percent and the number of certificated issued (in courses that do this) is even lower. One should not overlook that a completion rate of 5% in a 100,000 students course is still 5,000 students (more student than I had in all my courses in the last 30 years).

### 6.2 Assumptions

MOOCs are currently surrounded by a large number of assumptions (which may turn out to be true or false as more evidence is gathered) including the following — MOOCs will:

- represent first class courses and provide a first-class education from elite professor coming from elite institution;
- bring the best education in the world to the most remote corners of the planet;
- help professors to improve their classroom teaching by providing them with more data what and how students in a course are doing;
- support communities among the students participants thereby expanding their intellectual and personal networks; and
- provide students with insightful feedback in case they went wrong or got stuck in a problem solving attempt.

### 6.3 Big Data and Learning Analytics

The data revolution ("Big Data") provides insight to analyze and document human behavior to an extent considered impossible a few decades ago (but feared by some visionaries [Orwell, 1950]). Google, Facebook, Amazon, Netflix, banks and supermarkets (leave alone the National Security Agency) know a lot about all person, their behavior, the information they have looked at, the stuff they have bought, and the places that they have visited.

MOOCs provide rich data sets about interactions, collaborations, and engagement that computational processes can exploit. *Learning analytics* focuses on measuring, collecting, analyzing, and reporting data about learners and their contexts. It attempts to understand the background knowledge of learners and it adds to online education as a dissemination method an important data-gathering resource. Learning analytics has its own society (<http://www.solaresearch.org/>) and its own conference series (<http://www.solaresearch.org/events/lak/>).

The following issues related to learning analytics should be pursued and investigated further:

- what are the fundamentally new aspects of learning analytics? The idea of collecting data about student behavior and actions is not new: it has been pursued with dribble files in LOGO, user modeling in intelligent tutoring systems, and artifact analysis in designing activities.
- how valuable will the insights be that learning analytics environments are able to collect and analyze? how can we infer from low-level, quantifiable events (such as material looked at, how long and how often, errors made, help requested) infer the intentions, problems encountered, and objectives of the learner?
- learning analytics will provide us with insights to understand the past and the present (“how things are”), but how much will it help us to envision and design alternatives to improve our approaches to learn and teach something (“how things could / should be”)?
- are the potential misuses and privacy violations of the data gained with learning analytics? Some MOOCs companies plan to sell data about their students to companies as part of their business model to make money.

#### 6.4 Opinions: Hypes and Underestimations

Will MOOCs end up to be *elixir* or *snake oil* [Eisenberg et al., 1999]? Historical analogies may provide us with insight how to think and reflect about this question:

- in the mid 1980’es, expert systems [Bobrow et al., 1986; Davis, 1982] were promoted to be the “deus ex machina” for a large set of problems in medicine, configuration of computers, and numerous other domains. The original claims made by their advocates about them turned out to be unrealistic, mistaken, and theoretically unfounded [Winograd & Flores, 1986]— but the technologies explored in the context of expert systems (rule-based representations, inference engine, interactive transfer environments) became important components in many knowledge-based systems developed subsequently.
- in the learning, teaching, and education domain there have been claims by info-enthusiasts promising that technology would revolutionize “education” and computers will replace teachers, ..... and opposite claims by info-pessimists that that computers in classrooms foster isolation, lack of creativity, rigid (or alternatively, sloppy) thinking, an overemphasis on abstract thinking (and consequent undervaluing of real world experience).

The *hype* around MOOCs is articulated in statements like:

- “There’s a tsunami coming” — President John Hennessy of Stanford
- “2012: the year of the MOOC” — NY Times
- “Technology is remaking every aspect of education, bringing top-notch courses to the world’s poorest citizens and reshaping the way all students learn”;  
<http://www.scientificamerican.com/editorial/digital-education/>
- The \$6,600 master’s degree of Georgia Tech marks an attempt to realize the tantalizing promise of the MOOC movement: a great education, scaled up to the point where it can be delivered for a rock-bottom price.

The underestimation of MOOCs (e.g.: “*In fact, the absence of serious pedagogy in MOOCs is rather striking, their essential feature being short, unsophisticated video chunks, interleaved with online quizzes, and accompanied by social networking.*” ..... “*If I had my wish, I would wave a wand and make MOOCs disappear, but I am afraid that we have let the genie out of the bottle.*” [Vardi, 2012]) may be a dangerous mistake in response to their undeniable impact: attracting more than a 100,000 students in many classes, being a subject of discussion in all media, and creating actions by university administrators.

To understand the developments that MOOCs might take in the years to come and the “forces” that might influence these developments some large-scale changes based on the Internet can be analyzed as analogies. Amazon changed the way how people buy books (see Narrative-3 for an elaboration of this analogy). But the business model caused additional changes:

- it took advantage of Long Tail business opportunities [Anderson, 2006];

- it created a market place for e-books by creating e-readers; and
- it changed physical bookstores from stores for sales to social gathering places.

### **NARRATIVE-3 —Analyzing Analogies for Insights and Legitimacy**

As the development and broad coverage of different themes by MOOCs is still mostly yet to come, we may search for guidance and insights by analyzing other transformative developments driven by related changes in technology.

**Books and Public Libraries.** When I ask my students occasionally when they have visited our large university library the last time, they look at me as if I were from a different planet. Digital libraries, as well as developments such as Google Books Library Project and e-readers have made access to information sources available instantly at our desks, sometimes for free — and physical libraries have become gathering places, places and resource centers for studying, ...?

**Amazon** started as online bookstore but has developed in the world's largest retailer. Several interesting transformation have taken place: (1) Amazon has complemented physical bookstores rather than (completely) replacing them (2) it has established to a broader landscape how and where people buy books and how they can be read; (3) physical bookstore changed to exploit their "core competencies" (e.g.: many of them have turned from places to buy books to social gathering environments with cafes); and (4) Amazon made a larger set of books (especially books only of interest to niche communities by exploiting the Long Tail framework [Anderson, 2006]) available at almost all places in the world and made new acquisitions for book buyers immediately available via the Internet to be read on e-readers.

The analogous question to be asked for MOOCs are: (1) will MOOCs replace or complement residential courses; (2) will MOOCs contribute and in which way to a richer landscape of learning; (3) should (and if yes: how) residential, research-based university change to focus on their core competencies? and (4) will more and a greater diversity of learning opportunities (specifically for themes of the beaten path) be created by MOOCs?

Netflix caused similar changes and drove most physical movie renting stores out of business.

Newspapers complemented their printed editions with online additions or move completely online (e.g.: Newsweek).

Reflecting on these developments, and grounded in the theoretical framework outlined in Sections 2 and **Error! Reference source not found.**, this article tries to create frames of reference and argues that MOOCs will have their value and their place in a rich learning landscape and will be adequate for specific objectives.

## **6.5 Experimentation**

### **6.5.1 Identifying the Fundamental Limitations**

Learners of all ages in today's world (maybe not in a village in Africa or Nepal, but in North America and Europe) have in almost all cases more or less infinite learning resources at their disposal (see Figure 4). The fundamental limitation (as illustrated by Narrative-2) in such settings is not access to information but the interest, passion and willingness of learners to engage in serious learning activities in the context of personally meaning problems.

### **NARRATIVE-2 — Do not postulate a new learner (or teacher)**

**Background.** Herbert Simon in his book "The Sciences of the Artificial", p 141 [Simon, 1996] argued that *"the framers of the Constitution accepted very restricted objectives for their artifact principally the preservation of freedom in an orderly society. Moreover they did not postulate a new man to be produced by the new institutions but accepted as one of their design constraints the psychological characteristics of men and women as they knew them, their selfishness as well as their common sense."*

**Assumption: Learning resources are necessary — but they are not sufficient.** In today's world, most people (not everywhere: the situation is different for learners in a small village in Africa versus a town in Europe or the USA) have substantial learning resources at their disposal for a modest price or for free (e.g.: books in public libraries, Wikipedia, TED talks, free talks at universities, free lectures about health



issues, etc.) without taking advantage of them. This lack of involvement is not due to laziness, but is caused by information and participation overload.

**The big question.** What does and will motivate students and citizens to become engaged to participate in MOOCs? What will motivate teachers to offer a MOOC? In our research on cultures of participation we argued that the engagement and enthusiasm to learn and contribute is a function of the (perceived) value gained and the (perceived) effort required. People get involved in activities when they are personally meaningful to them (i.e., when they want to learn rather than have to learn), when they are rewarded for their activity (e.g., by creating an interesting artifact, framing and solving an interesting problem, learning about something they find exciting, or earning a documented qualification and reputation). Through the right kind of technologies (platforms for developing MOOCs, forums to support peer-to-peer learning, interactivity to provide feedback) we can reduce the effort to be engaged and learn something.

**The challenge** is: (1) to create socio-technical environments in which people want to learn rather than have to learn; and (2) to find out which approach in the rich landscape of learning will be best suited (e.g.: MOOCs, self-directed learning, designing, making and contributing artifacts [Anderson, 2012]) in a specific situation involving specific participants.

### 6.5.2 Data for Formative Assessment

As MOOCs become broadly available and learners have opportunities to choose a MOOCs that matches their interest, experimentation to determine the strengths and weaknesses of MOOCs can provide foundations for their further development. Data as displayed in Figure 7 provides insight “how the current MOOC world” is.

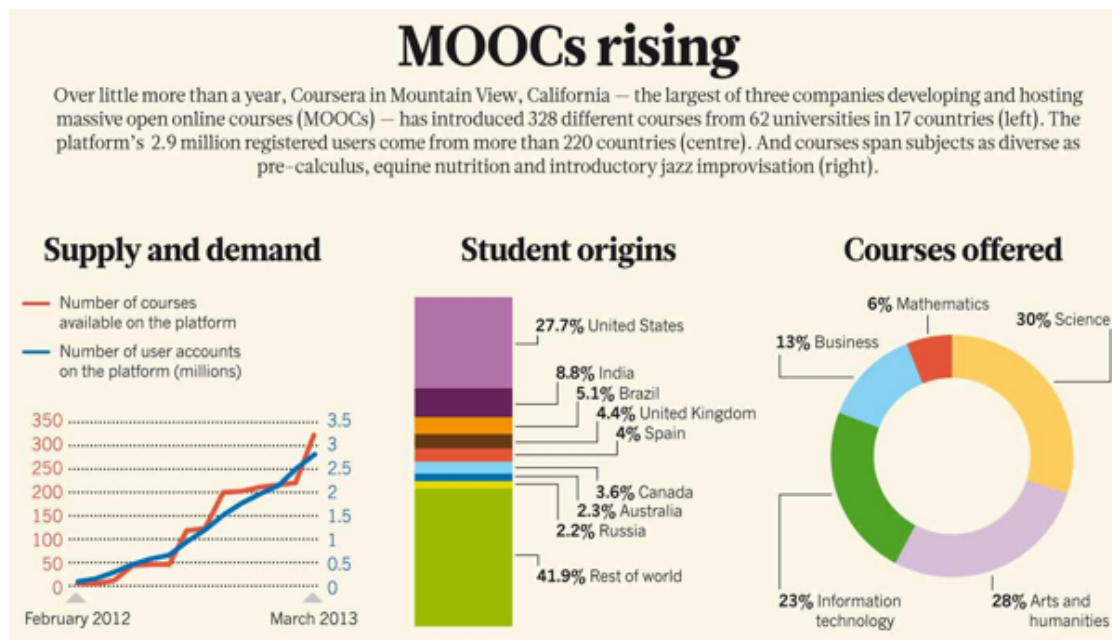


Image: Courtesy of Nature magazine

Figure 7: Data Illustrating Important Aspects of MOOCs

<<from: <http://www.scientificamerican.com/article.cfm?id=massive-open-online-courses-transform-higher-education-and-science>>>

There are many more interesting questions, assumption, and claims for which data is needed including: will MOOCs

- work best for students who are self-motivated and already fairly well educated?
- have the potential to enable learners to be autonomous learners capable of managing their learning pathways?;

- be able to establish a community feeling among the students taking the course?
- create an (further) increased appreciation and dependency for courses in which instructors are authority figures, for which objective information exists (math, physics, algorithms, ...) and the answers are known by the instructors, thereby diminishing the appreciation for courses in design and philosophy in which the answers are not known and/or do not exist?
- hinder changes and experimentation (offering limited opportunities for repurposing and remixing) based on their “high production” values and costs?

One of the often postulated advantages of MOOCs may turn out to be a mixed blessing: if people can do their work anytime, they often will not do it (in analogy to: if people live in a town with many attractions, they will not visit them, but visitors will).

We will need data from students having participated in MOOCs (we have developed an initial questionnaire to collect data of these dimensions) including:

- professors teaching the course;
- teacher-to-student interaction [Bruckman, 2013];
- student-to-student interaction, including the establishment of communities, study groups, meet-ups, and peer grading;
- the nature and value of different kind of assignments (multiple choice quizzes, essays); and
- individual students’ motivations to participate in a course, to drop it or to finish it, and personal assessments of what they have learned?

### 6.5.3 Making Certificates More Meaningful and More Valuable

Why do over 100,000 students participate in some MOOCs? One reason might be that they are intellectually curious or they face problems for which the course may provide answers? In addition students may want to acquire more qualification to be competitive for getting a certain job. In this later case, a critical challenge is how to show the world their acquired qualifications.

Many MOOCs courses offer (1) exams to test students’ understanding and (2) certificates (or statements of accomplishment) including possibly the scores on quizzes and exercises. These certificates are issued by the instructors of the course, and universities have been assertive that these are not grades or earned credits towards a university degree. It is unclear at this time how seriously employers or university admission committees will take these MOOCs certificates?

In order to make certificates more valuable (e.g.: by reducing cheating), Coursera is designing a signature track option (<https://www.coursera.org/signature/guidebook>) that “will give students in select classes the opportunity to earn a Verified Certificate for completing their Coursera course. Signature Track securely links your coursework to your identity, allowing you to confidently show the world what you’ve achieved on Coursera.”

To participate in Signature Track is optional and will cost between \$30-100 per course. To retain the important aspect of MOOCs to be “free”, students can fully participate in the course if they do not join Signature Track, and they will receive the standard Statement of Accomplishment if they successfully complete the free course. Coursera describes its expectation for the Signature Track as follows: “We hope that offering *verified certification for our courses* will open up many new and valuable opportunities for students, while also giving partner universities on Coursera the ability to continue to invest in providing high-quality free courses to students around the world.”

## 6.6 Business Models — MOOCs Being “Free”?

*“If you think education is expensive, try ignorance” —*  
Derek Bok (former president of Harvard University)

To sign up for MOOCs and to participate in a MOOC is free for students. Other free educational opportunities are provided by (see Figure 4):

- public libraries;
- access to OpenCourseware and similar sites providing lecture material; and
- access to open educational resources (Wikipedia, TED Talks, YouTube movies, open source repositories).

But education is not free in any society. In Germany, universities are “free” in the sense that students do not pay fees for them — because universities are supported by tax money from all citizens rather than by the fees of the students attending them. One may argue that environments created by cultures of

participation (e.g.: open source software) [Benkler, 2006; Fischer, 2011] can and should be free based as they are created by contributors who are rewarded by social capital and by gaining a reputation in a gift culture [Fischer et al., 2004] rather than being paid.

How are professors teaching MOOCs financially rewarded for their effort? In case their universities consider this as part of their jobs (and Stanford pays \$25,000 per project as seed grants for faculty to move their courses online) — what motivates university administrators to give that faculty time to MOOC students, of which 95 percent or more are not at their universities? After the initial engagement will faculty members sustain their engagement in MOOCs in case teaching a MOOC distracts them from their normal on-campus duties?

A list of eight potential business models is summarized in [Daniel, 2012]

- Certification — students pay for a badge or certificate;
- Secure assessments — students pay to have their examinations proctored (see description of Coursera's Signature Track in Section 6.5.3);
- Employee recruitment — companies pay for access to student performance records (e.g.: "3,000 students have signed up for Udacity's employer-connection program, allowing their CVs to be shared with 350 companies. Employers pay Udacity a fee for any hires made through this service.");
- Applicant screening (employers/ universities pay for access to records to screen applicants);
- Human tutoring or assignment marking (for which students pay);
- Selling the MOOC platform to enterprises to use in their own training courses;
- Sponsorships (3rd party sponsors of courses); and
- Tuition fees (illustrated by the experiment of the Computer Science Department of Georgia Tech that has decided to offer a Master Degree delivered with MOOCs (see Section 6.8 for more detail).

At this moment no convincing business models exist. Will MOOCs continue to be supported by the willingness of university administrators to participate out of fear not to be left behind and a reliance of interest, volunteer engagement, and expectation to reach fame by faculty members? Will MOOCs financially survive like other social media? Will they be able to exploit the lessons learned from Amazon and Netscape?

## 6.7 Identifying the Contribution of MOOCs to Rich Landscapes of Learning

In our research, we are exploring the following research questions (RQs):

- **RQ-1:** Are "learning about" and / versus "learning to be" and "learning when the answer is known" and / versus "learning when the answer is not known" important antinomies to explore rich landscapes for learning?
- **RQ-2:** What are the unique strength and weaknesses of MOOCs in comparison to competing approaches such as *self-directed*, *design-based*, *active collaborative learning* (SDACL) (see Figure 3)?
- **RQ-3:** what is covered by MOOCs? (being free, open, and large-scale and offering learning analytics opportunities based on very large numbers of participants); and what is not covered by MOOCs? (being focused on a traditional model of an instructionist classroom, and thereby providing little support for self-directed learning, debate and discussions, and reflective conversations).
- **RQ-4:** Can we create a synergy between MOOCs and SDACLs that will result in a transformation of learning and education to address the grand challenges of the future?

### 6.7.1 MOOCs: in which sense are they more than "gift-wrapping"?

*"Distance Learning is not classroom learning at a distance"*

Are MOOCs transformative as a new approach to learning and education, and if yes with respect to which dimension in the rich landscape of learning. They are open and "free" (as analyzed in Section 6.6), and by being online they can reach very large number of students. They employ new technology platforms to add additional services to a course.

With respect to learning science perspectives, they are focused on information delivery from knowledgeable instructors and from this perspective one can argue they are stuck in a "gift-wrapping approach" Fischer (see **Error! Reference source not found.** and [Fischer, 1998b]). They take advantage of

alternative economic models and new media, but do not fundamentally challenge and change how we perceive learning, working, and collaboration. MOOCs cannot replace in-class discussions and the involvement with professors and fellow students (based on the “very low teacher/student ratio (VLRC)” courses [Bruckman, 2013]; due to the large number of students in such courses, traditional instructor - student interactions are not feasible. An opportunity worthwhile to explore might be how MOOCs can complement the “gold standard” of learning and education as expressed by John L. Hennessy, the president of Stanford: “I expect that there will be lots of free, or nearly free, offerings available. While the gold standard of small in-person classes led by great instructors will remain, online courses will be shown to be an effective learning environment, especially in comparison with large lecture-style courses.”

A (future) objective of MOOCs is to create socio-technical environments [Fischer & Herrmann, 2011] in which students can collaborate and rely on their peers. Success in such courses will rely on a strong culture of participation [Fischer, 2011], which can promote mutual learning, emergent behavior, and reflection.

### 6.7.2 The Lecture

The lecture has been a cornerstone of teaching in higher education and presenting ideas and findings (e.g.: at scientific conferences). The *strengths* of lecturing are (1) to present a topic in a coherent fashion and (2) they scale well to large audiences. The *weaknesses* of lectures are that the active engagement of learners is limited. Lectures have their place in the rich landscape of learning. To retain one important strength (the scalability) and to simultaneously address one of their weakness (lack of active engagement and participation), new technologies such as *clickers* (as a particular student response system; <http://net.educause.edu/ir/library/pdf/ELI7002.pdf>) have been introduced to provide support for more student feedback in large classes.

Derived from the arguments articulated in this article, I claim that large lecture classes do not represent a core competency of residential, research-based universities. They will not be fundamentally different from MOOCs (e.g.: in a class with 200 students of a 75 minute duration, most students will not have the opportunity to ask a question).

It is a declared objective of MOOCs proponents that MOOCs will be able to enrich and improve the lecture model:

- “MOOC courses are ‘designed to be challenges,’ not lectures, and the amount of data generated from these assessments can be evaluated ‘massively using machine learning’ at work behind the scenes. This approach, he said, dispels ‘the medieval set of myths’ guiding teacher efficacy and student outcomes, and replaces it with evidence-based, ‘modern, data-driven’ educational methodologies that may be the instruments responsible for a ‘fundamental transformation of education’ itself”. — Sebastian Thrun, Testimony, President’s Council of Advisors on Science and Technology (PCAST)
- “Learners can control where, what, how, with whom they learn, but different learners choose to exercise more or less of that control. The goal is to re-define the very idea of a “course,” creating an open network of learners with emergent and shared content and interactions. A MOOC allows participants to form connections through autonomous, diverse, open, and interactive discourse.” — Wikipedia article about MOOCs ([http://en.wikipedia.org/wiki/Massive\\_open\\_online\\_course](http://en.wikipedia.org/wiki/Massive_open_online_course))

### 6.7.3 The Role of the Teacher

A consequence of a rich landscape of learning is that there is a corresponding need for a *rich landscape of teaching*. In instructionist settings, teachers often act as “sage on the stage” and as “omniscient high-priest” whereas in environments that support self-directed learning, learning on demand, and guided discovery learning, teachers act as guides and mentors who helps learners discover on their own by providing guidance, hints, and critiquing.

In the past in many settings the teacher and the learner role was regarded as an attribute of a person whereas in today’s world it is more productive to consider it as an attribute of a context (e.g.: with respect to the latest tricks in programming and social media, my students are my teachers and I am the learner).

An interesting question to ask is: “Why are (famous) faculty members motivated to teach a MOOC. Here are some reasons articulated in a recent survey by the Chronicle in February 2013

(<http://chronicle.com/article/The-Professors-Behind-the-MOOC/137905/#id=overview>):

- altruism (a desire to increase access to higher education worldwide);
- they do not want to be left behind in the current crazy atmosphere surrounding MOOCs (they want to be leaders instead of followers);



- they want to increase their visibility
- they hope to learn more about their classroom teaching (indicated by comments such as: *“I found that producing video lectures spurred me to hone pedagogical presentation to a far higher level than I had in 10 years of teaching the class on campus”*).

Analyzing different MOOCs (e.g.: contained in the short list given in Appendix 12.3) shows that there is a great variance of teacher roles in the currently existing MOOCs. Some of them are teaching a class with an audience in a university classroom (which is open online), others are filmed in a studio writing on a whiteboard or talking to the not-present audience.

One may also ask why teaching a MOOC may not be desirable to many teachers (including myself). It may be considered “boring”: teachers stand in front of a camera and there is no feedback, no reactions, and no bored or enthusiastic faces. As the answers and contributions of students are graded automatically, teachers also deprive themselves of the opportunity to be life-long learners by analyzing what their students have to say. I have learned a lot in flipped classroom sessions that were centered around interesting topics and in which all participants acted as informed contributors.

#### 6.7.4 The Dependency of MOOCs of Disciplines and Prerequisites

MOOCs are better suited for some topics, objective, and settings rather than for others; with respect to the framework developed in this paper MOOCs are better suited

- for “learning about” than for “learning to be”;
- for learning situations “when the answer is known” than “when the answer is *not* known”.

Disciplines in the natural sciences (physics, chemistry, mathematics, creating programs implementing existing specifications correctly) have problems that have right and wrong answers and they are more suited to be presented in an online, instructionist environment than topics in design domains, in the social sciences, and the humanities [Simon, 1996] — domains where no “right” answers exist, and alternative positions need to be articulated, explored and compared. Additionally, the challenges to assess students’ answers automatically are smaller in the former domains and the existing techniques are applicable.

Based on the wide reach of MOOCs, topics and problems in which local knowledge plays a smaller role (again this is more the case for problems in the natural sciences) are better suited (see Narrative 1).

To avoid the difficult problem of coping with learners from greatly varying backgrounds, most current MOOCs are classified as “introductory” requiring no prerequisite knowledge and the same level of background knowledge for all students is assumed. Figure 9 illustrates a framework for describing MOOC courses with parameters considered important to understand what the course is about, how much effort is needed, and what prerequisites may be required.

### 6.8 Universities: Finding their own Ways

Universities world-wide (administrations, faculty, and supporting organizations) are paying close attention to MOOC developments. They try to establish their own course of action by choosing between the strategies: (1) to calculate the risks of different possible actions, and comparing it with (2) the risks of doing nothing.

Some of the interesting and divergent developments are:

- **An Experiment: Master Degrees in Computer Science Delivered with MOOCs.** Georgia Institute of Technology in collaboration with Udacity will offer Master Degrees in Computer Science delivered with MOOCs which will cost students \$6,600, far less than the \$45,000 that it would on campus (for more detailed information see: <http://www.nytimes.com/2013/08/18/education/masters-degree-is-new-frontier-of-study-online.html?pagewanted=all&r=0>). A belief associated with this experiment is to increase the impact of MOOCs by offering credit and a degree and thereby establishing the next level in the evolution of MOOCs. Georgia Tech’s plan is that the MOOC courses constituting the program will be online and free for those not seeking a degree; those in the degree program will take proctored exams and have access to tutoring, online office hours and other support services. How all of this will play out (the planners expect that a profit will be made in the long run by the very large number of students enrolling in it) — but another consequence may be that the university’s own on-campus computer science master’s program will be driven out of business ([http://www.slate.com/articles/technology/technology/2013/07/georgia\\_tech\\_s\\_computer\\_science\\_mooc\\_the\\_super Cheap\\_master\\_s\\_degree\\_that.html](http://www.slate.com/articles/technology/technology/2013/07/georgia_tech_s_computer_science_mooc_the_super Cheap_master_s_degree_that.html)).



- **Amherst College: Saying No to an edX Invitation.** Most universities (based on the fear and risk of doing nothing with respect to the hottest topic of the year) were eager to team up with one of the major provider of MOOCs (and the providers have engaged in a competition that good universities should join their consortia). Amherst College (<https://www.amherst.edu/>), a small private liberal arts college, that has established its reputation with facts like “89% of Amherst classes have fewer than 30 students; the average class size is 16. The main reason for turning down edX’s offer was not for financial reasons, but because of “a number of philosophical qualms. MOOCs run counter to Amherst’s commitment to *“learning through close colloquy; they might perpetuate the ‘information dispensing’ model of teaching”* [Kolowich, 2013].
- **San Jose State University: Rejection of the Integration of an existing MOOC into the Curriculum.** A dean at San Jose State requested that Michael Sandel’s MOOC course “Justice” (bought from edX; see Section § and Figure 9) should be integrated into the curriculum of the philosophy department. This was rejected by the faculty including the following arguments in an open letter to Michael Sandel (<http://chronicle.com/article/The-Document-an-Open-Letter/138937/>):
  - *“In spite of our admiration for your ability to lecture in such an engaging way to such a large audience, we believe that having a scholar teach and engage with his or her own students is far superior to having those students watch a video of another scholar engaging his or her students.”* (comment: an argument why face-to-face interaction and personal relationship are important);
  - *A social justice course needs to be current since part of its mission is the application of conceptions of justice to existing social issues. In addition to providing students with an opportunity to engage with active scholars, expertise in the physical classroom, sensitivity to its diversity, and familiarity with one’s own students are simply not available in a one-size-fits-all blended course produced by an outside vendor.* (comment: an argument that diversity will be lost if a “standard” (high-quality) course eliminates courses that take local issues into account).

The letter articulates the concerns that the decision to buy a course was not driven by any concerns about pedagogy but was a financial decision. The letter articulates many important arguments to be taken into account in the future experimentation of MOOCs.

- **San Jose State University Suspends Online Classes.** In January 2013 San Jose State teamed up with Udacity to offer college classes for credit online. In July 2013 the university suspended the partnership just six months after it launched it because more than half the students in the first batch of online courses failed their final exams ([http://www.slate.com/blogs/future\\_tense/2013/07/19/san\\_jose\\_state\\_suspends\\_udacity\\_online\\_classes\\_after\\_students\\_fail\\_final.html](http://www.slate.com/blogs/future_tense/2013/07/19/san_jose_state_suspends_udacity_online_classes_after_students_fail_final.html)). In addition to the partnership with Udacity, San Jose State also entered a partnership with edX that is going well according to university officials. Unlike the Udacity partnership, which was designed to *replace* the classroom experience, San Jose State is using edX material only to *supplement* the classroom experience. To support a “flipped classroom” model, enrolled students are expected to review edX material before they come to class giving faculty more class time to interact with students by devoting less time to lecturing.

## 7 Core Competencies of Residential, Research-Based Universities

This articles analyzes the MOOCs movement focused on a very specific objective: by postulating a rich landscape of learning, MOOCs can serve as a forcing function to identify the core competencies of residential, research-based universities. Here is one opinion about this by Friedman [Friedman, 2013]: *“There is still huge value in the residential college experience and the teacher-student and student-student interactions it facilitates. But to thrive, universities will have to nurture even more of those unique experiences while blending in technology to improve education outcomes in measurable ways at lower costs. We still need more research on what works, but standing still is not an option.”*

This section will identify and analyze some of these core competencies (CCs) and the next section will describe how we have explored some of them in our Center for Lifelong Learning & Design (L3D).

**CC-1: Allowing and motivating learners to engage in authentic, self-directed learning activities** — this freedom to choose by the learners should be integrated with the guidance that (1) important topics should be presented, (2) a curriculum should provide coherence for all the material to be learned, and (3) a syllabus for a course should be structured to help learners to orient themselves.

**CC-2: Supporting Active Knowledge Construction.** Lecture-dominated courses often emphasize passive knowledge absorption and serve as the “reproductive organ of a consumer society” [Illich, 1971]. Educational institutions should fight this trend by cultivating “designers” by creating mindsets and habits that help people to become empowered and willing to actively contribute to the design of their lives and communities [Fischer, 2002].

**CC-3: Fostering Enculturation.** Learning about a discipline is different from become a member of a discipline. This distinction is emphasized by our differentiation between (“learning about”) and “learning-to-be” (see Figure 3) and provides the main rationale for our Undergraduate Research Apprenticeship Program (see Section 8.2.2).

**CC-4: Framing Problems.** Students should have opportunities not only with solving problems, but how to frame problems. To do so, they must have engaged with problems for which they have some ownership.

**CC-5: Coping with wicked, ill-defined problems.** Most problems encountered by learners in schools and universities have right or wrong answers (e.g.: in mathematics, physics, and the natural science in general and in most MOOCs) and the students expect that the instructor knows the answer to these problems (evidence for this was provided with a comment by a student in one of my faculty course questionnaires: “The least I expect is that the instructors knows the right answer” whereas I had tried to argue and illustrate that for the problem discussed there was no “right answer” [Rittel & Webber, 1984; Sandel, 2009]).

**CC-6: Grounding learning in a distributed cognition perspective.** Our students will live in a world in which pervasive, mobile computing, always-on and reliable Internet access, and a sufficient level of digital literacy can be assumed to exist. Most cognitive activities in people’s life outside of schools are intimately intertwined with cognitive tools [Resnick, 1987] whereas in school, many activities (e.g.: remembering facts, closed book exams) are taught and examined for the unaided mind and our scientific understanding is focused on memory, attention, perception, action, and thought, unaided by external devices [Norman, 1991].

**CC-7: Emphasizing collaborative learning and communication skills.** The power of the unaided individual mind is highly overrated. Although society often thinks of creative individuals as working in isolation, intelligence and creativity result in large part from interaction and collaboration with other individuals. Learning environments in which working together is regarded as cheating will not promote a mindset among learners to appreciate and exercise collaborative activities which are essential for “learning when the answer is not known”.

**CC-8: Giving Degrees.** Brown and Duguid (p. 214 in [Brown & Duguid, 2000a]) argue that one of the university’s core competency is to give degrees. One of the major unresolved issues for MOOCs is how to provide certificates that are valued (see Section 6.5.3).

**CC-9: Creating lifelong relationships between institutions and learners.** One of the fundamental objectives that universities can establish is to use the four or more years that students spend on campus to establish a lifelong relationship. This relationship should not be reduced to alumni who give occasionally money to universities but should include intellectual relationships in which working people can engage in lifelong learning activities and students can learn from the experience of the people out in the world (this idea is contained in CU’s Norlin charge to graduates (<http://commencement.colorado.edu/traditions/>): “I bid you farewell only in the sense that I pray you may fare well. You go forth but not from us. We remain but not severed from you”).

The current practices in universities often do not focus on these objectives — but doing so would allow them to focus on core competencies to complement what MOOCs may be able to contribute to a rich landscape of learning. I strongly believe that teaching a class in a residential university with more than 100, a 150 or 200 students [Fischer et al., 2009] is not fundamentally different from a MOOC (even if clickers as student response systems are used to make a class slightly more interactive).

## 8 Exploration of Specific Learning Landscapes in the Center for Lifelong Learning & Design (L3D)

### 8.1 Conceptual Frameworks

Our educational activities/approaches in Center for Lifelong Learning & Design (L3D) are focused on creating a new understanding of design, learning, and collaboration interacting with each other as fundamental human activities, and on how to support them with innovative computational media.

#### 8.1.1 Lifelong Learning: Making Learning a Part of Life

A theory of lifelong learning must investigate new frameworks for learning required by the profound and accelerating changes in the nature of work and education. These changes include (1) an increasing prevalence of “high-technology” jobs requiring support for learning on demand because coverage of all important concepts is impossible; (2) the inevitability of change in the course of a professional lifetime, which necessitates lifelong learning; and (3) the deepening (and disquieting) division between the opportunities offered to the educated and to the uneducated.

Learning and education should be a distributed lifelong process by which one learns material as one needs it. New conceptualizations of learning are needed to circumvent the difficult problems of *coverage* (i.e., trying to teach people everything that they may need to know in the future) and *obsolescence* (i.e., trying to predict what specific knowledge someone will need or not need in the future). Learning should be part of living, a natural consequence of being alive and in touch with the world, and not a process separate from the rest of life [Rogoff & Lave, 1984]. What learners need, therefore, is not only instruction but *access* to the world (in order to connect the knowledge in their head with the knowledge in the world [Norman, 1993]) and a chance to play a meaningful part in it. Table 1 contrasts and summarizes different aspects of school learning and lifelong learning [Fischer, 2000; Resnick, 1987]. In formal learning environments, learning is often restricted to the solution of well-defined problems. Lifelong learning includes these approaches but also transcends them by supporting learning in the context of realistic, open-ended, ill-defined problems. Figure 8 provides an overview of some of L3D’s research efforts over the last three decades to contrast, frame, explore, and support the specific perspectives enumerated in Figure 1.

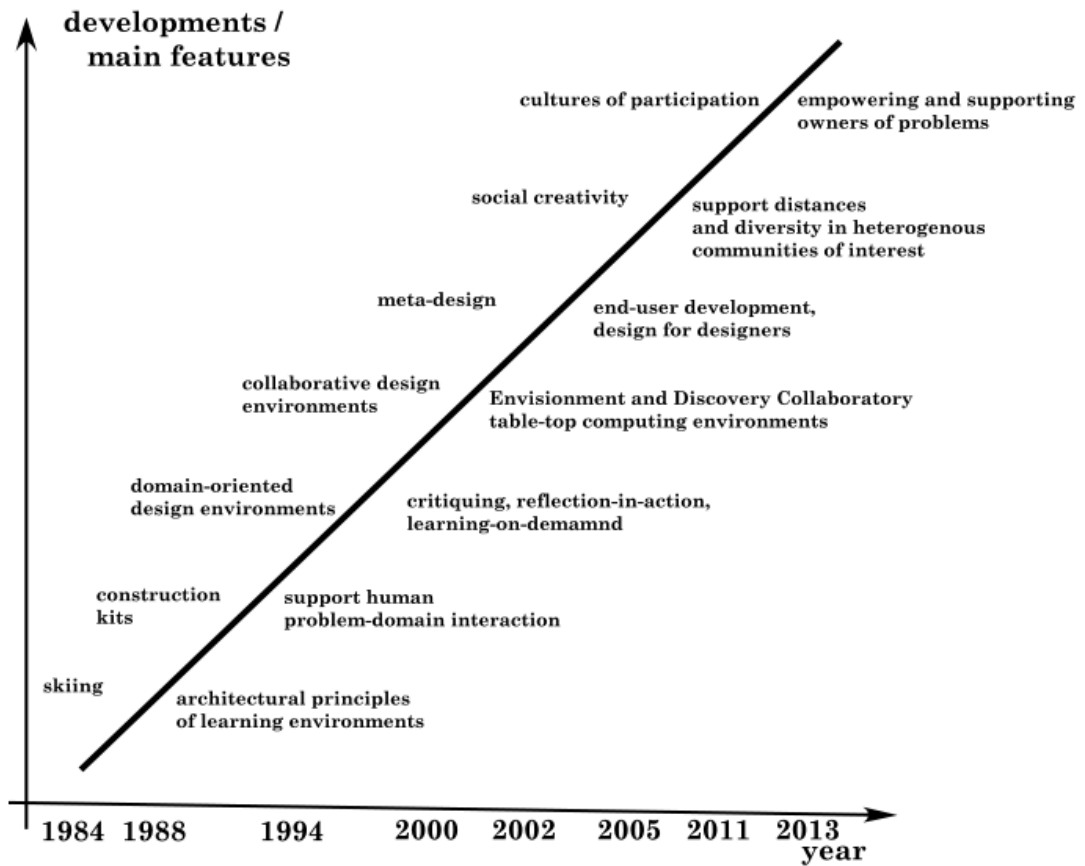


Figure 8: An Overview of our Long-Term Research Agenda

Lifelong learning is a continuous engagement in acquiring and applying knowledge and skills in the context of self-directed learning activities and should be grounded in descriptive and prescriptive goals, for example:

- learning should take place in the context of *authentic, complex problems* (because learners will refuse to quietly listen to someone else's answers to someone else's questions) [Bruner, 1996];
- learning should be embedded in the pursuit of *intrinsically rewarding activities* and learning is affected as much by *motivational issues* as by cognitive issues [Csikszentmihalyi, 1990];
- learning is *highly tuned to the situation* in which it takes place (providing the rationale for developing domain-oriented design environments that support human problem-domain interaction);
- *informal learning activities* are equally important in lifelong learning and in formal learning activities [National-Research-Council, 2009]; research on the nature of everyday, practical, real-world intelligence and learning provides a basis for understanding what distinguishes practical from formal intelligence [Resnick, 1987; Rogoff & Lave, 1984; Scribner & Sachs, 1990];
- learning often takes place without teaching and *learning and teaching are not inherently linked* [Illich, 1971; Wengert, 1998];
- *learning-on-demand* needs to be supported because change is inevitable, complete coverage is impossible, and obsolescence is unavoidable [Fischer, 1991];
- *organizational and collaborative learning* must be supported because the individual human mind is limited [Arias et al., 2000];
- mindsets, skills and processes that support *learning as a lifetime habit* must be developed [Gardner, 1991] and lifelong learning is more than training and more than school learning [Fischer, 2000].

### 8.1.2 Cultures of Participation

A whole new range of web-based tools and services now provides learners with the opportunity to create their own digital learning materials, personal learning environments, and social networks. What are the implications for the design of learning materials, workplace training, and accreditation of learners?

In the past, the design of most media emphasized a clear distinction between producers and consumers [Benkler, 2006]. The rise in *social computing* (based on social production and mass collaboration) has facilitated a shift from *consumer cultures* (specialized in producing finished artifacts to be consumed passively) to *cultures of participation* (in which all people are provided with the means to participate and to contribute actively in personally meaningful problems) [Fischer, 2011]. *Cultures of participation* can provide unique productivity resources, unique diversity potential, and engage the owners of problems which is necessary because ill-defined problems cannot be delegated.

Our current educational institutions often treat learners as consumers, fostering a mindset in students of “consumerism” rather than “ownership of problems” for the rest of their lives. As a result, learners, workers, and citizens often feel left out of decisions by teachers, managers, and policymakers, denying them opportunities to take active roles. The framework of cultures of participation has led to developments such as *courses-as-seeds* (see Section 8.2.1), in which teachers create seeds and learners evolve and enrich the seeds by being active contributors.

Important characteristics of cultures of participation are:

- people will participate in personally meaningful problems;
- potentially only a small number of participants will contribute, but all must believe and have the means when they are motivated to contribute;
- extensive support mechanisms are required to create low barriers for creating and sharing contributions with others;
- to become viable and be successful, it is critical that a sufficient number of participants take on the more active and more demanding roles;
- to encourage and support *migration paths towards more demanding roles*, mechanisms are needed that lead to more involvement, motivation, and facilitate the acquisition of the additional knowledge required by the more demanding and involved roles; and
- reward structures (reputation economies, accumulation of social capital) are important to motivators for people to contribute.

Cultures of participation are related to other conceptual frameworks, specifically to *communities of practice* [Lave, 1991; Wenger, 1998] and *expansive learning* [Engeström, 2001; Engeström & Sannino, 2010].

Cultures of participation complement and transcend communities of practice with their focus on exploiting the creativity potential of *communities of interest* [Fischer, 2001] by supporting the integration of multi-dimensional expertise. They address new frontiers for expansive learning as postulated by [Engeström & Sannino, 2010]:

*Perhaps the biggest challenge for future studies and theorizing in expansive learning comes from the emergence of what is commonly characterized as social production or peer production [Benkler, 2006]. In social production or peer production, activities take the shape of expansive swarming and multidirectional pulsation, with emphasis on sideways transitions and boundary-crossing.*

**Social Distribution and Epistemological Distribution in Cultures of Participation.** Cultures of Participation can contribute to different kinds of contributions to create new kinds of artifacts and learning opportunities.

*Social distribution* makes activities more fun, more motivating, and by sharing the burden of coping with large problems (“getting the job done effectively and more quickly”). In such settings, contributors can work individually and the work to be done is modularized into objects and activities doable by one person. This enables production to be incremental and asynchronous, pooling the efforts of different people, with different capabilities, who are available at different times [Benkler, 2002]. The heterogeneity of the community allows contributors with diverse levels of motivation to collaborate by contributing modules of different sizes, whose production therefore requires different levels of expertise and motivation [Preece & Shneiderman, 2009].

*Epistemological distribution* is required to support people in coping with systemic problems that are tightly coupled and transcend the individual human mind [Arias et al., 2000]. These problems are tightly coupled and cannot be modularized in parts that individuals can solve independently. Face-to-face environments supported by table-top computing environments (as illustrated by the Envisionment and



Discovery Collaboratory) are best suited to deal with such problems, as distances between contributors creates significant barriers to the frequency and richness of communication and to reconcile ambiguities [Olson & Olson, 2001].

### 8.1.3 Meta-Design

*Cultures of participation* are facilitated and supported by a variety of different technological environments (such as: the participatory Web (“Web 2.0”), table-top computing, domain-oriented design environments); all of them contributing in different ways to the aims of engaging diverse audiences, enhancing creativity, sharing information, and fostering the collaboration among users acting as active contributors and designers. They democratize design and innovation [von Hippel, 2005] by shifting power and control towards users, supporting them to act as both designers and consumers (“prosumers”) and allowing systems to be shaped through real-time use.

*Meta-design* [Fischer & Giaccardi, 2006] is focused on “design for designers.” It creates open systems at design time that can be modified by their users acting as co-designers, requiring and supporting more complex interactions at use time. Meta-design is grounded in the basic assumption that future uses and problems cannot be completely anticipated at design time, when a system is developed. At use time, users will invariably discover mismatches between their needs and the support that an existing system can provide for them. Meta-design contributes to the invention and design of socio-technical environments in which humans can express themselves and engage in personally meaningful activities.

Meta-design allows significant modifications when the need arises. It reduces the gap in the world of computing between a population of elite high-tech scribes who can act as designers and a much larger population of intellectually disenfranchised knowledge workers who are *forced* into consumer roles.

Meta-design supports cultures of participation as follows:

- *Making changes must seem possible:* Contributors should not be intimidated and should not have the impression that they are incapable of making changes; the more users become convinced that changes are not as difficult as they think they are, the more they may be willing to participate.
- *Changes must be technically feasible:* If a system is closed, then contributors cannot make any changes; as a necessary prerequisite, there needs to be possibilities and mechanisms for extension.
- *Benefits must be perceived:* Contributors have to believe that what they get in return justifies the investment they make. The benefits perceived may vary and can include: professional benefits (helping for one’s own work), social benefits (increased status in a community, possibilities for jobs), and personal benefits (engaging in fun activities).
- *The environments must support tasks that people engage in:* The best environments will not succeed if they are focused on activities that people do rarely or consider of marginal value.
- *Low barriers must exist to sharing changes:* Evolutionary growth is greatly accelerated in systems in which participants can share changes and keep track of multiple versions easily. If sharing is difficult, it creates an unnecessary burden that participants are unwilling to overcome.

*Defining the role of meta-designers:* They should use their own creativity in developing socio-technical environments in which other people can be creative by a shift from determining the meaning, functionality, and content of a system to encouraging and supporting users to act as designers. They must be willing to share control of how systems will be used, which content will be contained, and which functionality will be supported.

Meta-design allows significant modifications when the need arises. It reduces the gap in the world of computing between a population of elite high-tech scribes who can act as designers and a much larger population of intellectually disenfranchised knowledge workers who are *forced* into consumer roles.

## 8.2 Specific Developments

During the 20-year existence of the Center for LifeLong Learning & Design (L3D), we have formulated, explored, and assessed different aspects of the “rich landscape for learning,” as outlined in Figure 3. Here, we briefly describe the relevance of these previous research activities to the proposed research.

### 8.2.1 Courses-as-Seeds

Courses-as-seeds [dePaula et al., 2001] is an educational model that explores meta-design and cultures of participation to fundamentally change the nature of courses taught in universities. Traditionally, the

resources provided by an instructor such as lectures, readings, and assignments define the content of a course. By involving students as active contributors, courses do not have to rely only on the intellectual capital provided by an instructor. Our courses are conceptualized based on the *seeding, evolutionary growth, reseeding model* (SER) [Fischer et al., 2001] and are supported with wiki-based course information environments in which the instructor provides the initial seed rather than a finished product and the content of a course evolves over time through contributions of the students. In such an environment, learners are not just passive recipients of knowledge, but active contributors.

The “basic philosophy” behind our courses-as-seeds model (examples are documented at: <http://l3d.cs.colorado.edu/~gerhard/courses/index.html>) can be summarized as follows:

- the teacher acts a meta-designer [Fischer & Giaccardi, 2006];
- the *seeding, evolutionary growth, reseeding* (SER) model is supported with innovative media [Fischer et al., 2001];
- the courses represent an attempt
  - “to overcome the impoverished conception that a course provides a learning experience in which an omniscient teacher explicitly tells or shows presumably unknowing learners something they presumably know nothing about” [Bruner, 1996];
  - to explore and exploit the opportunity based on the assumption that digital kids are used to controlling their own learning and pursuing their own interests [Collins et al., 2009];
  - to reconcile the classroom as a community of mutual learners [Rogoff et al., 1998], in which the roles of the teachers and learners are not assigned to specific persons, but to specific *contexts*; the teachers act as “guides on the side” rather than as “sages on the stage” and learners are given many opportunities to be active contributors [Fischer, 1998a];
  - the course community is nurtured and supported to become a *culture of participation* [Fischer & Giaccardi, 2006]
- self-evaluation contributed to the final grade based on the objective that students should acquire skills to assess their own contribution and their own performance;
- the topics of our courses (e.g.: “Designing the Information Society of the Next Millennium”, “Foundations for Human-Centered Computing”, “Design, Creativity, and New Media”) are better suited to the courses-as-seeds model with students as active contributors; these subject areas are focused on problems for which instructors can provide simple answers, but instead are complex, vague, and open-ended problems

The goals of these courses are:

- to engage students in actively exploring technology projects of *personal interest in a self-directed way*, contributing knowledge derived from their own work;
- to support *peer-to-peer learning* and the *emergence of a community* by providing opportunities and rewards for participants to learn from each other in discussions and by working on collaborative course projects;
- to provide opportunities for *transdisciplinary collaborations* by supporting *horizontal* (e.g., students from different disciplines) and *vertical* (e.g., undergraduates, graduates, post-docs, professionals) integration (see arguments for the integration in [Khan, 2012]; and
- to explore the *unique possibilities that computational media* can have in impacting and transforming these activities by transcending „gift-wrapping“ and „techno-determinism“ in order to create true innovations.

In the context of these courses, we have explored the following aspects to establish a rich landscape for learning and gathered experiences how our course participants reacted to them:

- we used *Wiki-technology for the course environment* and in it we retained (1) all documents created in the course (lecture notes by the instructors, reading material, assignments, student answers to the assignments, feedback by the teaching assistants to the assignments, project reports (initial, intermediate, and final), questionnaires, etc.) were collected in the course environments and (2) all electronic communication between all participants
  - *rationale for this activity*: to support the “courses-as-seeds” model; to create an external information repositories documenting all the intellectual activity going on during the course;

- *reactions by students and lessons learned*: the course environment was overall regarded as a positive artifact for the course; specific aspects (e.g.: how to organize decentralized contribution into a coherent structure need to be supported to make it a truly useful environment);
- the students were asked to *establish a profile* about themselves
  - *rationale for this activity*: to support the emergence of a community among the students; to be able to ask peers for advice and help for specific topics indicated as their respective expertise in their profiles;
  - *reactions by students and lessons learned*: most students show limited interest in developing a good profile of their interests and their knowledge backgrounds; some students argues that these profiles would be redundant to their existing profiles in social networks in which they participated;
- the course activities were organized to support a “*flipped classroom*” approach; the students read papers and answered assignments related to the papers to prepare themselves for the next class meeting;
  - *rationale for this activity*: to allow the instructor to spend less time lecturing and more time in discussion with the students during the actual class meetings;
  - *reactions by students and lessons learned*: the actual classroom meetings definitely profited greatly from this approach; the assignments that “forced” the students to read articles or solve small problems were important extrinsic motivators (in the first few courses, we relied on the intrinsic motivations of the students to study the article and this assumption was too optimistic for most students);
- the students were encouraged to *read and comment on the answers provided by their peers* (and deposited asynchronously in the course environment) and the class was divided in *contributors and summarizers/analyzers* (the latter group looking at all the answers given by the contributors with the objective to identify major themes and controversies)
  - *rationale for this activity*: support peer-to-peer learning
  - *reactions by students and lessons learned*: students claimed that they suffered from a “participation overload”; they argued that they had than enough to do with doing their own part and showed little interest what the other students had to say
- the instructors *analyzed the answers from the students* and used the most interesting and controversial issues (1) to seed the classroom discussions and (2) to modify their presentations to the interests of the students
  - *rationale for this activity*: to tailor the course material to the interests and needs of the students; provided an opportunity for the instructors to learn from their students;
  - *reactions by students and lessons learned*: this was highly appreciated by the students;
- the course environments associated with our courses over the last decade (<http://l3d.cs.colorado.edu/~gerhard/courses/index.html>) are kept available and open for *ongoing use and evolution* of course material after the course has finished
  - *rationale for this activity*: the material and ideas covered in a course should not primarily be useful to pass a test but at least some aspects should be relevant for the students’ lives after the course (their professional need, their emerging new interests); students should both be able to consult the material indefinitely and to contribute additional ideas that they might encounter in the future and that they consider relevant to the topic of the course;
  - *reactions by students and lessons learned*: students (asked at the end of the course) were not overly optimistic that they would return to use existing information for their needs and to contribute more information to the course environment; we tracked the course environment and very few students returned to them after the class was finished;
- most parts of the course environments have been *open for everyone* in the world who is interested — but the courses were not actively announced and promoted to the world at large
  - *rationale for this activity*: to provide learning opportunities for people who were interested in the themes of the courses;
  - *participation and reactions by outside participants and lessons learned*: we did not track the access by external participants, we do not know how many “lurkers” looked at our material; without creating awareness and support for external participants, external participants only became aware by “accident” of our course material — so external participation remained at a negligible level.

A few more lessons were learned from our courses-as-seeds approach that could and should influence the further developments of rich landscapes of learning in general and of MOOCs specifically. The courses tried to facilitate *peer-to-peer* learning); this objective led to student reactions such as:

- “why should I learn from a peer when the faculty member knows the answer so much better”?
- “why should I pay fees if the teacher is not willing to provide me with the answer?”

The course evaluations provided us with insights that different students react differently to different ways to learn; this findings is best illustrated by the answers of two students who participated in one of our courses:

- **Student-1:** *“I will not ever take a course of this nature again in my undergraduate career, and I hope to find a more structured graduate program with an adviser that is more forthcoming. I will reinforce my strengths by continuing to study in the method that I have developed over the past 15 years. I will redirect my weaknesses by avoiding unstructured class environments.”*
- **Student-2:** *“When I signed up for this class I had no idea what it was going to be about. Once I started understanding the material, however, I was extremely thrilled and interested to be a part of one of the most progressive courses on campus. I’m not sure what specifically to say except that I rank this class in the top three that I’ve taken at CU. The self-directed nature of the work ensured that I wouldn’t be bored or unchallenged, and the interplay between all of us was a lot of fun. After four and a half years in college, I can honestly say that this is one of the first courses where I was treated as an adult, a fact which means more to me than I can describe.”*

These comments indicate the importance of mindsets that students form over time about their educational experiences. The answer from Student-1 should surprise us (as she/he indicated her/himself with “to study in the method that I have developed over the past 15 years”) because many students are exposed to instructional classrooms for most of their education.

### 8.2.2 Undergraduate Research Apprenticeship Program (URAP)

The *Undergraduate Research and Apprenticeship* (URA) program of the Center for LifeLong Learning and Design (L3D) at CU Boulder (<http://l3d.cs.colorado.edu/urap/>) engages undergraduate students in a real research environment and research activities. The underlying philosophy of the URAP is based on the fundamental objective of complementing “learning about” with “learning to be” (see Section 4). The URA program has been in place for more than a decade and the participants have been financially supported by Research Experiences for Undergraduates (REU) grants from the National Science Foundation.

The research teams in L3D (focused on specific funded research projects) are interdisciplinary by nature and include undergraduate apprentices, Ph.D. students, post-docs, research scientists, faculty, and industry partners from various fields. Each apprentice has a personal mentor (in most cases a PhD student) and will work on on-going projects. Our model emphasizes a long-term working relationship in which apprentices receive close guidance at first, but over time are expected to engage in more self-directed research and to serve as mentors for younger apprentices.

While our URA program was small in numbers, it attracted some of the best students at CU. One of our students was the recipient of the “Junior Nobel Prize” (<http://web.mit.edu/invent/iow/patterson.html>).

Another student had the following to say: *“I found the experience and the amount I learned working with people at L3D to be incredibly valuable. That kind of experience in many ways is more valuable than any set of classes”* — and is supporting the ongoing URA program with a monthly donation since he started working. The program can also be considered as a success for the PhD students acting as mentors who were able to prepare themselves for their later live as a faculty member or a mentor of a research team. The URA program can be considered one component defining the core competencies of residential, research-based universities.

### 8.2.3 Identifying and Supporting Different Engagement Levels by Learners

Our learning environments (see Figure 8) support different learning strategies (including: quick hints and fixes to proceed, support for reflection-in-action, tutorials contextualized to tasks and users, and support for design and tinkering; see Table 1) and learners can choose which of these strategies fit their needs best in the context of specific engagements. In self-directed learning environments, learners need *both* enough *freedom* to choose what to learn and how to learn *and* enough *guidance* to explore and construct useful knowledge.

**Table 1: Different Learning Strategies**



Level	Description	Strengths	Weaknesses
<b>Fix-It Level</b>	fix the problem by giving a solution without detailed understanding; primarily performance support	keep focus on task; learning does not delay work	creates little understanding
<b>Reflect Level</b>	explore argumentative context for reflection (“reflection-in-action”)	understanding of specific issues	piecemeal learning of (disconnected) issues
<b>Tutorial Level</b>	provide contextualized tutoring (not lecturing on unrelated issues)	systematic presentation of a coherent body of knowledge	substantial time requirements
<b>Tinkering and Design Level</b>	transcend the information given; act as contributor, not only as consumer	cope with change and new situations	substantial learning effort may be required

The socio-technical environments that we have constructed to support self-directed learning address the following challenges:

- to identify the goals and objectives of learners in their self-directed learning activities;
- to create linkages to relevant and contextualized information that might exist in the systems;
- to offer support at different levels and let learners choose among the levels;
- to contextualize tutoring episode dynamically to the work learners have been engaged in and to relate it to the preexisting understandings that they bring with them;
- to empower learners to act as informed participants contributing their own information rather than being restricted to exploring existing information.

## 9 Future Developments

**Challenges and Opportunities for MOOCs.** The challenges and possible further improvements needed are numerous — among them are the following:

- more varied and sophisticated ways to assess and evaluate the *ideas, answers, and other externalizations* of the students to enrich the “back-talk of the situation” [Schön, 1983] including:
  - enhanced and more *powerful automated tools* (improved version of critiquing systems [Fischer et al., 1998] and an extended analysis based on diagnostic modeling as pioneered by Brown and Burton [Brown & VanLehn, 1980; Burton & Brown, 1982]);
  - exploring human assessment at scale with peer assessment and self-assessment (<http://hci.stanford.edu/research/assess/>)
- *personalized education*: The massive scale of MOOCs provides the opportunity to collect unprecedented volumes of data on students’ interactions with learning systems.
- *hybrid education*
  - models of *blended learning* use online tools strategically and selectively and try to find the best mix between face-to-face and online education;
  - make the *flipped classroom* a reality by encouraging students to watch a MOOC lecture before they come to class allowing that class time is used for more discussions and less lecturing;
  - our experience with the flipped classroom approach has been successful (<http://l3d.cs.colorado.edu/~gerhard/courses/>) but it also has taught us some important lessons: the approach requires more engagement and time from the students and the instructor

**Keeping the Positive Contributions of MOOCs Alive.** The most important contributions made by the ideas and developments centered around MOOCs is that they have started a broad based conversation about how online technologies can help students on and off campus that has caught the attention not only of academics but of administrators, business leaders, politicians, and citizens.

**A Warehouse for MOOCs.** With MOOCs developed rapidly all over the world, there will be (1) a very large number of MOOCs available in the future; (2) these MOOCs will be focused on specific themes; and



(3) they will be of different quality. To cope successfully with the high functionality environment will make a *warehouse* (with more functionality than simple aggregator sites) a necessity. Curators will be need to organize this space to help providers and consumers to retain a understanding which course already exists, which ones are missing, and which ones meet the idiosyncratic needs of individual learners.

**Creating Synergistic Relationships between MOOCs and Self-Directed, Design-Based, Active, Collaborative Learning (SDACL).** The *basic assumption* underlying this article can be summarized as follows: MOOCs are well suited and can be successfully employed in settings focused on “learning about” and learning when the answer is known” whereas SDACLs have their strengths in settings focused on “learning to be” and “learning when the answer is not known”. Different socio-technical environments are needed to foster, support, and ultimately integrate key features of these different approaches. Table 2 contrast and summarizes different aspects of MOOCs and SDACLs.

**Table 2: Contrasting MOOCs and SDACLs**

MOOCs	SDACLs
Massive (scaling up to very large numbers is possible and supported and is advertised as the major strength of MOOCs)	Personal interactions are best facilitated with small numbers of participants (scaling up is a major challenge)
Open (open for learners as consumers)	Community (open for learners as active contributors)
Online	Collaboratories (focused on face-to-face with remote participation made possible)
Courses as fixed, pre-planned entities	Courses-as-seeds (requiring and supporting cultures of participation)
Global	Local
Learning about	Learning to be
Learning when the answer is known	Learning when the answer is not known
Knowledge transmission	Collaborative knowledge construction and sense making
Emphasis and focus is on teaching, curriculum, covering content	Emphasis and focus is on learning, passion, intrinsic motivation
Role of teacher: sage on the stage, providing information, promoting superstars among professors	Role of teacher: guide on the side, asking questions, situated in local communities

An interesting challenge for the future is to create synergistic relationships between MOOCs and SDACL learning environments by taking advantage of the best of both worlds: the large scale impact of MOOCs and the SDACL emphasis on self-directed, active, collaborative learning. In discussions with my colleagues Michael and Ann Eisenberg, we have been discussing a MOOC-based version of their SDACL-based course “Things That Think” (<http://l3d.cs.colorado.edu/~ctg/Courses.html#id2>). This is a laboratory course in which teams of students create cyber-physical objects (i.e., “computationally-enriched” tangible objects) for education; the course introduces students to (1) working with embedded computing systems, (2) designing physical objects with devices such as a laser cutter and 3D printers. Over the years Michael and Ann Eisenberg have taught “Things That Think” numerous times and students’ have designed many interesting artifacts.

Integrating this course with techniques of MOOCs illustrates the most difficult obstacles to both evolving MOOCs beyond pure lecture delivery, and re-thinking project and laboratory courses for the next generation of higher education. Some particular challenges are:

- making learning webs a reality and allowing large number of people with similar interests to collaborate in niche communities [Collins et al., 2009];

- creating a deeper understanding of fundamental concepts such as “blended learning”, “flipped classrooms”, and “cultures of participation” (by supporting meta-design and end-user development) [Fischer, 2011] ; and
- developing computationally enhanced feedback for self-directed learning activities (expanding our research in critiquing [Fischer et al., 1998]).

## 10 Conclusions

MOOCs promise to change and enrich higher education by providing accessible, flexible, and affordable university courses for free or at a low cost for learners who are interested in learning. MOOCs can occupy a unique dimension in a rich landscape of learning and learning teaching (see Figure 4). As a major contribution, MOOCs created a new interest and dialogue about learning, teaching, and education — not only in academic circles but in the public as a whole. My vision articulated in this article how MOOCs will influence learning and education is briefly summarized in Narrative-4.

### **Narrative-4: My Vision How MOOCs Will Influence Learning and Education**

A fundamental contribution of MOOCs is that they created a broad discussion about the future of learning, teaching, and education transcending narrow academic circles. The analysis of the movement so far has been primarily focused on economic (“Wall-Street”) and technological (“Silicon Valley”) perspectives.

This paper attempts to create frames of reference grounded in the learning sciences to envision MOOCs as one component of a rich landscape of learning. In doing so, MOOCs can serve as a forcing function to reflect about the *core competencies of residential, research-based universities* in covering aspects of learning which cannot be easily addressed by MOOCs. Lots of *experimentation* (grounded in theories derived from the learning sciences and informed by empirical analysis of MOOCs and related activities) is required to determine the shape of a rich landscape of learning serving the needs of our societies in all parts of the world in the years to come.

There is no single way forward as argued by Bruner [Bruner, 1996] (e.g.: “*Education is never neutral, never without social and economic consequences*”, p. 12) and “*schools don’t exist in nature*”, p 173). These conflicting goals make the “Grand Challenge” problem centered on “rich landscapes of learning, technology enhanced learning, and MOOCs” much more complicated than other Grand Challenge problems (for example: the Grand Challenge problem for High Performance Computing is a much simpler problem for the following reasons: clear objectives (more power, more storage, more bandwidth) could be defined and objective measurement of the progress towards these goals could be established).

Lots of experimentation will be needed to better understand the trade-offs between different design options associated with rich landscapes of learning. Will residential and online education be allies or enemies? Will MOOCs replace (some) universities or will they complement and enrich residential education? Can we get insights from Learning Analytics in the context of online courses that can be applied in classrooms at residential universities, where such data may be more difficult to obtain? Will MOOCs have the potential in breaking down “educational elitism” and reduce the “digital divide”? Will courses taught by elite professors from elite institutions lead to first class courses and education or will there be evidence why this assumption will not hold?

The future of learning and education is not out there to be discovered (as Columbus discovered America) — but it has to be *designed*. While economic and technological perspectives are important dimensions, a learning science perspective is needed to determine the vision to be pursued, the questions to be asked, and the frames of reference to be established.

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## 12 Appendices

### 12.1 Overview of MOOCs Providers

The three major players for xMOOCs at this point are:

- *edX*, a project of MIT and Harvard (<http://www.edxonline.org/>);
- *Coursera*, offering free courses for everyone by an alliance between a large number of universities (<https://www.coursera.org/>);
- *Udacity*, a private company (<http://www.udacity.com/>).

Interesting *complementary developments* (covering a very large number of topics) are:

- the *Khan Academy* that advertises its role as “*Watch. Practice. Learn almost anything for free with over 3,100 videos*” (<http://www.khanacademy.org/>);
- *iTunes U* (organized by Apple) supporting the design and distribution of courses to allow students to “*learn anything, anywhere, any time*” (<http://www.apple.com/education/itunes-u/>).

A comprehensive list is provided by TechnoDuet (a blog including a focus on technology enriched education) at:

<http://www.technoduet.com/a-comprehensive-list-of-mooc-massive-open-online-courses-providers/>

The main characteristics of the three major players are (all the numbers given will constantly change — they are provided only as crude approximations):

- **edX**
  - courses have start times
  - Harvard and MIT invested \$60 Mio to start edX
  - edX’s agenda is to improve, not supplant, classroom education (“*Online education is not an enemy of residential education, but an inspiring and liberating ally.*” — Susan Hockfield, former president of MIT)
  - MIT and Harvard are using MOOCs as an experimental space to learn how to educate their on-campus students more effectively
  - number of students: approx. 400,000
  - non-profit
- **Udacity**
  - courses start anytime and are self-paced
  - focus on computer science and mathematics (allows them to present a fairly uniform interface to students )
  - collaboration with Georgia Tech on their Master program
  - job placement is part of the Udacity ‘s approach
  - number of students: approx. 350,000
  - for profit
- **Coursera**
  - courses have start time
  - largest number of courses
  - organized as a “hub” (more than 30 colleges have signed up to offer courses in collaboration with Coursera)
  - their courses spans a wide range of content including humanities and arts courses. In response, it has developed an online peer grading model, although this has received criticism due to game playing and inappropriate behaviour by some course participants. The bigger problem Coursera faces is that its courses are poorly-adapted versions of content originally developed elsewhere by its partner institutions, lured in by fears of missing the boat and by Coursera’s promised revenue sharing model.
  - number of students: approx. 1.4 million

- for profit

## 12.2 International Developments

### European Developments

EMOOCs 2014 (<http://www.emoocs2014.eu/>) is a conference to gather European actors involved in the MOOCs phenomenon, from policy makers to practitioners and researchers (it is the follow-up of the MOOC Summit 2013). The goal of the summit is to develop synergies among European universities around themes such as student assessment, MOOC accreditation, platform interoperability or joint research initiatives.

### FutureLearn

FutureLearn (<http://futurelearn.com/>) is a private company owned by the Open University (OU). The company builds on the OU's expertise in delivering distance and open learning to hundreds of thousands of people and combining this with online and mobile technology and the best of the social web to reinvent the learning experience.

They have learners from over 140 countries registered on their website. They will offer online courses from some of the world's best universities for free, enabling everyone, everywhere to enjoy learning throughout their lives.

Their aim is to increase access to higher education for people around the world by offering a diverse range of high quality courses and content from great universities, educators and institutions across multiple platforms. Their partners are: the British Library, the British Council, the British Museum, 21 top UK universities, and 2 International Partners.

## 12.3 Examples of Courses

**Descriptors of MOOC Courses for Cataloging and Comparison Purposes.** Figure 9 illustrates with two specific courses the attributes used to characterize MOOCs (an extensive list using this scheme is provided at: <http://www.mooc-list.com/>).

<b>Course Title:</b> ER22x: Justice (edX)	<b>Course Title:</b> Introduction to AI (Udacity)
<b>University / Entity:</b> HavardX	<b>University / Entity:</b> Udacity
<b>Instructor:</b> Michael Sandel	<b>Instructors:</b> Peter Norvig and Sebastian Thrun
<b>Categories:</b> Humanities, Law	<b>Categories:</b> AI, Robotics, Vision
<b>Start Date:</b> Mar 2nd 2013	<b>Start Date:</b> Self Paced Course - Start anytime
<b>Length:</b> 20 weeks	<b>Length:</b> self study
<b>Estimated Effort:</b> from 2:00 hours a week to a lifetime	<b>Estimated Effort:</b> self study
<b>Prerequisites:</b> No	<b>Prerequisites:</b> Yes
<b>Recommended Background:</b> No. Only an interest in thinking through some of the big ethical and civic questions we face in our everyday lives.	<b>Recommended Background:</b> You should have understanding of probability theory comparable to that at our Introduction to Statistics class
<b>Certificate:</b> Yes, Free Certificate	<b>Certificate:</b> Yes, Free Certificate
<b>Peer Assessments:</b> No	<b>Peer Assessments:</b> No
<b>Team Projects:</b> No	<b>Team Projects:</b> No
<b>Exam:</b> Yes, Free Exam and/or Final Project	<b>Exam:</b> Yes, Free Exam and/or Final Project
<b>Video Lectures:</b> Yes	<b>Video Lectures:</b> No
<b>Textbook / Materials:</b> Yes, Free Textbook or	<b>Textbook / Materials:</b> No Textbook or Materials

Materials	
Forum: Yes	Forum: Yes
Country: USA	Country: USA
Language: English	Language: English
More info / Sign Up:	More info / Sign Up:
URL: <a href="https://www.edx.org/course/harvard-university/er22x/justice/571#sthash.SeOhlnsJ.dpuf">https://www.edx.org/course/harvard-university/er22x/justice/571#sthash.SeOhlnsJ.dpuf</a>	URL: <a href="https://www.udacity.com/course/cs271">https://www.udacity.com/course/cs271</a>
Tags: Justice Law Philosophy Politics	Tags: Artificial Intelligence, Robotics
Already taken this course? Please rate it.:	Already taken this course? Please rate it.:

**Figure 9: Illustrating the Description of two MOOC Courses**

from <http://www.mooc-list.com/>

**A sample of courses illustrating *different aspects of MOOCs* are:**

- “Artificial Intelligence”, by Peter Norvig and Sebastian Thrun (Udacity) — this course was the initial success story for xMOOCs as 1600,000 students signed up for it
- “Machine Learning”, by Andrew Ng (Coursera) —
- “Justice”, by Michael Sandel (edX)
  - Justice is a critical analysis of classical and contemporary theories of justice, including discussion of present-day applications. Topics include affirmative action, income distribution, same-sex marriage, the role of markets, debates about rights (human rights and property rights), arguments for and against equality, dilemmas of loyalty in public and private life. The course invites students to subject their own views on these controversies to critical examination.
- “Connectivism and Connective Knowledge 2011”, by Stephen Downes and George Siemens — a cMOOC course (<http://cck11.mooc.ca/>)
  - Connectivism and Connective Knowledge is a twelve week course that will explore the concepts of connectivism and connective knowledge and explore their application as a framework for theories of teaching and learning. It will outline a connectivist understanding of educational systems of the future.
- “ThinkTank – Ideal City of the 21st Century”, by Daniel Libeskind — a course offered by Leuphana Digital School in Lüneburg, Germany (<http://www.mooc-list.com/course/thinktank-cities-leuphana>)
  - Participants will be working in multi-disciplinary teams. Leading scholars and experts will guide and support teams in creating their own vision of an ‘Ideal City of the 21st Century’. Become a part of this exciting new opportunity to join people from across the world and conceive and design YOUR IDEAL CITY!
- “Learning Creative Learning (MIT)”, by Mitchel Resnick (MIT Media Lab) (<http://mas712.media.mit.edu/>)
  - Learning Creative Learning is an introduction to ideas and strategies underlying the design of new technologies to support creative learning experiences, with special focus on technologies from the MIT Media Lab’s Lifelong Kindergarten research group. Students will analyze learning technologies, discuss underlying educational ideas, examine design principles, and create new prototypes and applications. (Grading is pass/fail). This semester, for the first time, we will open the course to online participants. We will provide online participants access to course materials, including videos of portions of the course (both live-streamed and archived), and with opportunities to participate in online discussions around course readings and activities. Online participants will not receive any credit or credential for their participation, and they will not receive feedback or grades from the course staff.

- “Power Searching with Google”, by Dan Russell (Google)  
<http://www.google.com/insidesearch/landing/powersearching.html>
  - Sharpen your search skills — Join a free course to help you become a better searcher. Knowing how to find answers on Google is an important skill in today’s digital age. Taught by Google’s Search experts, this online class will help you search smarter, so you can find the information you need — even in the most challenging situations. You’re not alone! We provide plenty of opportunities to connect with our search experts and other Power Searching participants. Upon passing the course, we’ll email you a printable certificate so you can show off your Power Searcher status!

## 12.4 Selected Publications, Commentaries, and Presentation about MOOCs

The number of publications and opinion pieces about MOOCs (not only in scientific journals, conferences, symposia but also in the broadly available media such as the New York Times, Time, ...) has been growing rapidly and surveys about this publications are also appearing. A good starting point is provided by the article about MOOCs in Wikipedia with over 120 up-to-date references ([http://en.wikipedia.org/wiki/Massive\\_open\\_online\\_course](http://en.wikipedia.org/wiki/Massive_open_online_course)).

I will mention a very small number of articles which I found personally interesting and which have influenced the writing of this article.

### Recent Overview Articles

- Scientific America (2013, August): Learning in the Digital Age (Special Report);  
<http://www.scientificamerican.com/editorial/digital-education/>
- Yuan, L., & Powell, S. (2013) *MOOCs and Open Education: Implications for Higher Education (a White Paper)*, available at <http://publications.cetis.ac.uk/2013/667>
- Wikipedia, (2013), Massive open online course,  
[http://en.wikipedia.org/wiki/Massive\\_open\\_online\\_course](http://en.wikipedia.org/wiki/Massive_open_online_course)
- Online Learning and the Future of Residential Education — A Summit hosted by MIT and Harvard University Cambridge, MA, March 3 and 4, 2013;  
<http://onlinelearningsummit.org/prematerials.html>

### Interesting Opinion Articles:

- Bates, Tony (2012): What’s right and what’s wrong about Coursera-style MOOCs  
<http://www.tonybates.ca/2012/08/05/whats-right-and-whats-wrong-about-coursera-style-moocs/#sthash.i756gScp.dpuf>
- Daniel, J. (2012), Making Sense of MOOCs: Musings in a Maze of Myth, Paradox and Possibility, <http://tinyurl.com/ak8qvdy>
- Amy Bruckman (2013): VLRCs (MOOCs): The Aggravating and the Important (VLRCs = Very Low teacher/student Ratio Courses); <http://nextbison.wordpress.com/2013/03/12/vlrcs-moocs-the-aggravating-and-the-important/>
- Rolf Schulmeister (2012): As Undercover Students in MOOCs (in German); <http://www.campus-innovation.de/node/618> and <http://lecture2go.uni-hamburg.de/konferenzen/-/k/14447>

### Articles from Representatives associated with Providers

- Andrew Ng (2013): Learning From MOOCs;  
<http://www.insidehighered.com/views/2013/01/24/essay-what-professors-can-learn-moocs>
- Peter Norvig (2013: Massively Personal — How thousands of online students can get the effect of one-on-one tutoring; <http://www.scientificamerican.com/article.cfm?id=how-to-make-online-courses-massively-personal-peter-norvig>
- Daphne Koller (2012 — TED Talk): What we’re learning from online education;  
[http://www.ted.com/talks/daphne\\_koller\\_what\\_we\\_re\\_learning\\_from\\_online\\_education.html](http://www.ted.com/talks/daphne_koller_what_we_re_learning_from_online_education.html)



## Controversies

- An Open Letter to Professor Michael Sandel From the Philosophy Department at San Jose State U.; <http://chronicle.com/article/The-Document-an-Open-Letter/138937>
- Amherst College faculty vote against joining edX; <http://tech.mit.edu/V133/N23/edX.html>
- University Suspends Online Classes After More Than Half the Students Fail;  
[http://www.slate.com/blogs/future\\_tense/2013/07/19/san\\_jose\\_state\\_suspends\\_udacity\\_online\\_classes\\_after\\_students\\_fail\\_final.html](http://www.slate.com/blogs/future_tense/2013/07/19/san_jose_state_suspends_udacity_online_classes_after_students_fail_final.html)
- F is for Failure; Or, Don't Invest Your Pension in MOOCs Yet;  
<http://chronicle.com/blognetwork/tenuredradical/2013/07/f-is-for-failure-or-dont-invest-your-pension-in-moocs-yet/>