Running head: SUPPORTING SELF-DIRECTED LEARNING

Supporting Self-Directed Learning with Cultures of Participation

in Collaborative Learning Environments

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Abstract

Making learning part of life is an essential challenge for addressing the complex, systemic problems occurring in a world undergoing constant change. Lifelong learning is a necessity rather than a possibility or a luxury to be considered.

Richer landscapes for learning are needed to cope with the multi-faceted needs of learners in different situations. One of the major roles for new media and new technologies is to provide opportunities and resources for *self-directed learning* to support learners of all ages to (1) engage in authentic, collaborative activities, (2) participate in social debates and discussions, (3) create shared understanding among diverse stakeholders, and (4) frame and solve personally meaningful problems.

Our research in the Center for Lifelong Learning & Design (L3D) for the last two decades has focused on supporting and nurturing self-directed learning in the context of cultures of participation with collaborative learning environments. *Cultures of participation* are grounded in the fundamental belief that all humans have interests and knowledge in particular domains and are willing and eager to *actively contribute in personally meaningful activities* [Fischer, 2002].

The paper describes three different *collaborative learning environments* (modeling the whole world in 3D, exploring urban planning problem with the Envisionment and Discovery Collaboratory, and reconceptualizing courses as seeds rather than as finished products) that illustrate our approach in addressing specific problems. The last part articulates challenges and opportunities for the future based on the insights that we have gained with our experiences so far.

The purpose of this paper is to transcend narrow frameworks for learning, to shift attention to new and different learning opportunities, and to encourage people to critically evaluate the proposed framework and developments.

Keywords

rich landscapes of learning, lifelong learning, self-directed learning, problem-based learning, cultures of participation, meta-design, collaborative learning environments, 3D-Warehouse, Envisionment and Discovery Collaboratory, Courses-as-seeds, challenges and opportunities, support versus controls, drawbacks, Massive Open Online Courses (MOOCs)

1   Introduction

Different kinds of problems require different kinds of learning approaches and different socio-technical environments supporting these approaches. Outside the classroom, much learning and problem solving takes places as individuals explore personally meaningful problems, engage with each other in collaborative activities while making extensive use of media and technologies. Many past educational systems have been built on the assumption that teaching is necessary for learning to occur [Thomas & Brown, 2011]; that teaching and learning is inherently linked [Wenger, 1998]; and that a curriculum can and should be developed to create a cultural literacy [Hirsch, 1988]. In such a culture, teachers taught learners about the world and learning was conceptualized as an isolated process of information transmission and absorption. It ignored the fact that in today's world, more and more knowledge, especially advanced knowledge, is acquired well past the age of formal schooling, and in many situations through educational processes that do not center on the traditional school [Illich, 1971].

This paper focuses on different perspectives about learning. Rich landscapes of learning are needed to cope with complex, systemic problems. They provide a theoretical framework to argue for the importance of self-directed learning and cultures of participation in which all learners can not only obtain information but can also actively contribute information. To support these approaches, collaborative learning environments are needed because outside the classroom,

much learning and problem framing and solving takes places as individuals engage with each other and use resources and tools that are available in the surrounding environment [Resnick, 1987].

2   Problems and Engagement: Making Learning a Part of Life

The 21st century brings with it a large collection of problems and challenges: environmental degradation, energy sustainability, economic disparity, and the disappearance of local cultures in the age of globalization, to name just a few. Can "ordinary" people do more about addressing these problems than reading about them in newspapers and online? Is voting for a handful of candidates every few years the ultimate in public participation?

Richer landscapes for learning creating new theoretical frameworks are needed to cope with major problems our societies are facing today including:

- problems occurring in the context of *idiosyncratic, personally meaningful activities* in which people take control of their own learning, decide what would be valuable to them and what they want to learn (illustrated by the two narratives below);

- problems of a *magnitude* which individuals and even large teams cannot solve (example: to model all buildings in the world in 3-D as addressed by "Goggle SketchUp and 3D Warehouse"; see Section 6.1);

- problems of a *systemic nature* requiring the collaboration of many different minds from a variety of backgrounds (example: urban planning problems as addressed by the Envisionment and Discovery Collaboratory; see Section 6.2);

- problems being *poorly understood and ill-defined* and therefore requiring the involvement of the owners of these problems, because they cannot be delegated to others

(example: software design problems as tackled by the open source software

developments);

- problems modeling changing and unique worlds being dependent on open, living

    information repositories and tools (example: courses-as-seeds; see Section 6.3).

The following two narratives illustrate two specific activities in idiosyncratic areas of

interest in which learners *want to learn rather than have to learn*.

Narrative-1: Costume Play (Cosplay). Shea is a young adult who has developed a deep

interest in *"Cosplay,"* a type of performance art in which participants don costumes and

accessories to represent a specific character or idea. Characters are often drawn from popular

fiction in Japan, but recent trends have included American cartoons and sci-fi as well as other

pop culture and role play. Shea spends a large amount of her free time working with a group of

friends designing and sewing their own costumes. Much of their effort is focused on preparation

for special events such as Nan Desu Kan, an annual anime convention (which has grown from

200 attendees in 1997 to 21,000 in 2010; see http://ndkdenver.org/info). These events provide an

opportunity to show off participants' work and creativity as well as to socialize with and gain

inspiration from other Cosplayers, ranging from those who purchase their costumes to those who

also design and create their own garb.

Shea's interest began when she was a pre-teen—her social group became interested in

anime, viewing Sailor Moon videos and subsequently role-playing Sailor Moon characters. This

led to other activities such as drawing new characters and costumes and writing their own stories.

Shea's own interest in writing grew through these activities, with the additional impact from her

interest in history which expanded as she strove to place some of her fictional stories in specific

historical contexts and wanted to provide as much historical accuracy as possible.

During college, Shea and her friends decided to put together her sewing skills and their design/sketching skills to create their own costumes, beginning with simple attempts for their first Nan Desu Kan. In subsequent years, much more elaborate efforts evolved into a year-round activity with a weekly sewing night. To avoid being the critical path and becoming overworked with sewing, especially as additional members joined the group, Shea taught her friends how to sew their own costumes, and she migrated to more of an advisor on many of the individual projects. In addition, resources for Cosplay activities include forums at http://cosplay.com and extensive information on sewing techniques at numerous Web locations. Much information is learned and shared at the peer level as well as with local resources, such as sewing and hobby stores.
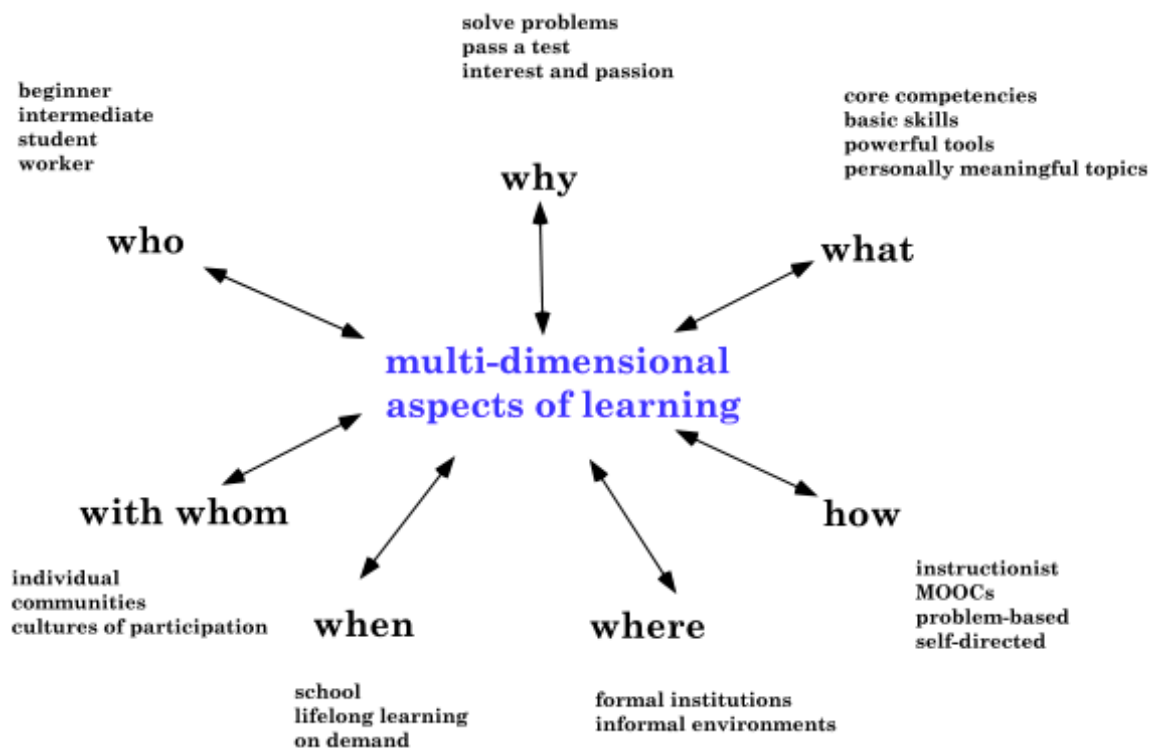
Narrative-2: Rocket Construction. "*October Sky*" (http://en.wikipedia.org/wiki/October_Sky) is an interesting film based on a true story illustrating many aspects of self-directed learning: a personally motivating event (seeing the Sputnik in the sky) serves as a source of interest in rockets and space science for boys in a coal mining town. The group pursues this interest and eventually wins the top prize at a national science fair. For all members of the group, this engagement represents a life-changing experience.

What additional opportunities would exist today to lower the threshold to support such engagement? The four boys would be able to explore a wide variety of choices and tools for learning: the available courses, lectures, or movies on sites such as iTunes U, Udacity.com, or the Khan Academy; introductory college courses in astronomy offered on OpenCourseWare sites; sites such as Instructables.com offering ideas about building and operating a rocket; articles on Wikipedia or in books recommended by the readers at Amazon.com; or niche communities that share their interests.

Even though these resources are available today, the lack of guidance, mentoring, or organization of learning may not result in many successful learning outcomes; an issue briefly elaborated further in Section 7.2 as the trade-off between support and freedom of choice in learning activities.

3   Rich Landscapes for 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 followed by brief description of the essential issues related to the different aspects.

solve problems
pass a test
interest and passion

beginner
intermediate
student
worker

core competencies
basic skills
powerful tools
personally meaningful topics

why

who

what

multi-dimensional
aspects of learning

with whom

how

individual
communities
cultures of participation

when

where

instructionist
MOOCs
problem-based
self-directed

school
lifelong learning
on demand

formal institutions
informal environments

Figure 1: 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 where general and uniform introductory courses may serve them well whereas other learners may have a very rich knowledge background and they have very specific objectives requiring more individualized instruction.

Why Learn: Different Objectives. Some people learn because they need to pass a test, or fulfill the requirements of a course in school or university; and others learn because they are passionate about some activity [Collins & Halverson, 2009] as illustrated by the two narratives in the previous section.

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 21st 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 it: (1) contextualizes learning by allowing it to be integrated into work rather than relegating it to a separate phase, (2) lets learners see for themselves the usefulness of new knowledge for actual problem situations, thereby increasing the motivation for learning new

things, and (3) 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 distributed among stakeholders coming from different disciplines [Fischer & Sugimoto, 2006]. The "Renaissance Scholar" (meaning a 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, 2013a]. Bringing people with different background knowledge and different value systems together, overcoming the biases and barriers of their separate languages, integrating different educational experiences, and eliminating the lack of reward structures will not be an easy undertaking.

4   Self-Directed Learning

In traditional classrooms in schools where knowledge transmission is from teacher to students and based on instructionist approaches, students are not required to be active learners and can be passive recipients: all the information or knowledge related to learning is automatically given through a teacher irrespective of the students' needs or problems, if they

even are in their classrooms. In such situations, learners are not motivated to learn. In contrast, if learners solve their own problems for their own sake, they try to actively acquire required knowledge and skills. Therefore, active learning happens when learners are self-directed to learn for themselves through their demands to solve authentic or personally meaningful problems.

Most learning that takes place outside of an instructionist classroom can be characterized as follows: humans are engaged in some activity (some action such as working, collaboratively solving a problem, or playing), they experience a breakdown, and they reflect about the breakdown (e.g., the piece of lacking knowledge, the misunderstanding about the consequences of some of their assumptions). Schön [Schön, 1983] called this *reflection-in-action*. Because self-reflection is difficult, a human coach, a design critic, or a teacher can help the learner to identify the breakdown situation and to provide task-relevant information for reflection. Our own work has explored the possibility using computational critics [Fischer et al., 1998] to provide some of this support when humans are not present. Critics make argumentation serve design; that is, they support learners in their own activities.

Self-directed learning can be characterized as follows:

- it is less structured than instructionist learning;

- it is in many cases a group or joint activity;

- the goal of the activity is determined by the learner who has a choice of topic, time, and place;

- the activities are self-paced; and

- it is captivating and fun and there are frequent "flow" experiences [Csikszentmihalyi, 1990].

Engagement and support for self-directed learning is critical when learning becomes an integral part of life — driven by a desire and need to understand something, or to get something done instead of merely solving a problem given in a classroom setting. A lifelong learning perspective implies that schools and universities need to prepare learners to engage in self-directed learning processes because this is what they will have to do in their professional and private lives outside the classroom.

Self-directed learning has many similarities with *problem-based learning*, an instructional method in which students learn through facilitated problem solving [Hmelo-Silver, 2004]. Both approaches attempt to motivate people to become lifelong learners and effective collaborators. Our research in self-directed learning (supporting people in choosing their own problems) conceptualizes learning independent of learning objectives and themes defined by a curriculum; thereby, emphasizes problem framing in addition to problem solving and allows people to focus on personally meaningful problems which may vary greatly rather than being defined and structured by a curriculum.

5   Cultures of Participation

Cultures of participation can address the problems articulated in Section 2: they have unique productivity resources, unique diversity potential, and engage owner of problems which is important because ill-defined problems cannot be delegated.

5.1   Defining Characteristics of Cultures of Participation

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]. Important characteristics of cultures of participation are (examples

from which these criteria are derived are shown in Table 1 and explored in [Porter, 2008; Preece

& Shneiderman, 2009]):

- 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.

5.2   Self-Directed Learning in Cultures of Participation

The creativity potential is grounded in user-driven innovations supported by *meta-design*

environments in taking advantage of *breakdowns* as sources for creativity, and in exploiting the

symmetry of ignorance-meaning that all stakeholders are knowledgeable in some domains and

ignorant in others [Arias et al., 2000]. To increase the creativity potential of cultures of

participation requires *diversity*, *independence*, *decentralization*, and *aggregation*. Each

participant should have some unique information or perspective (*diversity*). Participants'

opinions are not determined by the opinions of those around them (*independence*). Participants

are able to specialize and draw on local knowledge (*decentralization*). Mechanisms exist for

turning individual contributions into collections, and private judgments into collective decisions

(*aggregation*). In addition, participants must be able to express themselves, requiring technical

knowledge on how to contribute; and they must be willing to contribute, and must be allowed to

have their voices heard.

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.

5.3   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") as illustrated

by the information environments created by mass collaboration in Table 1 and by the 3D

Warehouse example in Section 6.1. 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 in Section 6.2) 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].

5.4   Meta-Design: Nurturing and Supporting Cultures of Participation

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 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 users can express themselves and engage in personally meaningful activities. It is a particular instantiation of the "Scandinavian approach" to system design [Greenbaum & Kyng, 1991] and it shares many objectives with the "Maker" culture [Anderson, 2012].

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.

5.5   Establishing New Discourses: Motivation, Control, Ownership, Autonomy, and Quality

Cultures of Participation are establishing new discourses, including the following:

Motivation. Human beings are diversely motivated beings. We act not only for material gain, but for psychological well-being, for social integration and connectedness, for social capital, for recognition, and for improving our standing in a reputation economy. The motivation for going the extra step to engage in cultures of participation is based on the overwhelming

evidence of the IKEA effect [Ariely, 2010] that people are more likely to like a solution if they have been involved in its generation; even though it might not make sense otherwise. Creating something personal (such as hand-knitted sweaters and socks, home-cooked meals) even of moderate quality, has a different kind of appeal than consuming something of a possible higher quality made by others.

Culture of participation rely on intrinsic motivation for participation by providing contributors with the sense and experience of joint creativity, by giving them a sense of common purpose and mutual support in achieving it, and in many situations by replacing common background or geographic proximity with a sense of well-defined purpose, shared concerns, and the successful common pursuit of these.

Control. Cultures of participation support users as active contributors who can transcend the functionality and content of existing systems. By facilitating these possibilities, *control* is distributed among all stakeholders in the design process. There is evidence that shared control will lead to more innovation [von Hippel, 2005]: *"Users that innovate can develop exactly what they want, rather than relying on manufacturers to act as their (often very imperfect) agents."* (A similar argument surfaced in the interview with the geo-scientist described earlier). Cultures of participation erode monopoly positions held by professions, educational institutions, experts, and high-tech scribes [Fischer, 2002].

Ownership. Our experiences gathered in the context of the design, development, and assessment of our systems indicate that cultures of participation are less successful when users are brought into the process late thereby denying them ownership and when they are "misused" to fix problems in addressing weaknesses of systems that the developers did not fix themselves.

Quality. Many teachers will tell their students that they will not accept research findings and argumentation based on articles from Wikipedia. This exclusion is usually based on considerations such as: *"How are we to know that the content produced by widely dispersed and qualified individuals is not of substandard quality?"* The online journal *Nature* (http://www.nature.com/) has compared the quality of articles found in the *Encyclopedia Britannica* with Wikipedia and came to the conclusion that *"Wikipedia comes close to Britannica in terms of the accuracy of its science entries."* There are many more open issues to be investigated about quality and trust in cultures of participation, including: (1) errors will always exist, resulting in learners acquiring the important skill of always being critical of information rather than blindly believing in what others (specifically experts or teachers) are saying; and (2) ownership as a critical dimension: the community at large has a greater sense of ownership and thereby is more willing to put an effort into fixing errors.

6   Examples of Collaborative Learning Environments in Different Application Domains

This section describes three different *collaborative learning environments* illustrating different challenges and opportunities for learning and engagement to support specific aspects of a rich landscape for learning. The theoretical framework articulated in Section 3 does not dictate or provide recipes for effective learning environments but creates frames of references and perspectives for guidance, design, reflection, and experimentation with self-directed learning and cultures of participation.

6.1   Collaborative Efforts in Large Scale Projects

Table 1 provides an overview of a sample of environments created by cultures of

participation with unique features with one of them (SketchUp and 3D Warehouse) described in

some detail.

Table 1: Environments Created by Cultures of Participation with Unique Features

Site	Objectives and Unique Aspects
Open Source	a success model of decentralized, collaborative, evolutionary development
Wikipedia	web-based collaborative multilingual encyclopedia with a single, collaborative, and verifiable article; authority is distributed (http://www.wikipedia.org/)
iTunes U	courses by faculty members from "certified institutions"; control via input filters; material can not be remixed and altered by consumers (http://www.apple.com/education/itunes-u/)
YouTube	video sharing website with weak input filters and extensive support for rating (http://www.youtube.com/)
Encyclopedia of Life (EoL)	documentation of the 1.8 million known living species; development of an extensive curator network; partnership between the scientific community and the general public (http://www.eol.org/)
SketchUp and 3D Warehouse	repository of 3D models created by volunteers organized in collections by curators and used in Google Earth (http://sketchup.google.com/3dwarehouse/)
Scratch	Learning environment for creating, remixing, and sharing programs to build creative communities in education (http://scratch.mit.edu)
Instructables	socio-technical environment focused on user-created and shared do-it-yourself projects involving others users as raters and critics (http://www.instructables.com/)
PatientsLikeMe	collection of real-world experiences enabling patients who suffer from life-changing diseases to connect and converse (http://www.patientslikeme.com/)
Ushahidi	tools for democratizing information, increasing transparency and lowering the barriers for individuals to share their stories; originated in the collaboration of Kenyan citizen journalists during crises (http://www.ushahidi.com/)
Stepgreen	library of energy saving actions, tips, and recommendations by citizen contributors for saving money and being environmentally responsible (http://www.stepgreen.org/)

SketchUp, 3D Warehouse, and Google Earth: Sharing 3D Models. Google is

interested in modeling the whole world in 3D and uses Google Earth for exploring this world

(see Figure 2 for an example). This objective cannot be achieved by a development team at

Google alone. The most feasible approach is engaging the whole world in this major undertaking

by developing and supporting cultures of participation. To do so poses a number of challenging

problems for participants acting as active contributors. They need to learn (1) *SketchUp*, a high-

functionality environment for 3D modeling (http://sketchup.google.com/), and (2) the

mechanisms of how to share 3D models by uploading them from SketchUp to the 3D Warehouse

and (3) how to download models from the 3D Warehouse and from SketchUp and view them in

Google Earth if the models have a location on earth. In order to motivate and empower enough

people, we have explored in close collaboration with researchers from Google new learning

mechanisms for SketchUp to allow users who want to contribute to learn doing so by reducing

the "thickness" of the input filters.

The *3D Warehouse* (http://sketchup.google.com/3dwarehouse/) is an information

repository for the collection of models created by all users who are willing to share their models

containing ten thousands of models from different domains. It supports *collections* to organize

models and supports ratings and reviews by the participating community. It lets viewers connect

with the owners of models. It has *weak input filters* such as content policies, mechanisms to

ensure the quality of user contributions such as tagging and ratings, and an *emerging set of*

output filters such as search support and different sorting algorithms. It is integrated with

SketchUp as the design environment and *Google Earth* as a viewing environment which has the

capability to show 3D objects that consist of users' submissions and were developed using

SketchUp. Figure 2 shows the downtown area of the city of Denver in 3D. We are assessing the

effectiveness of different reward structures in motivating users to participate in the collaborative

effort in modeling the whole world, including recognition by the community by featuring the

best models in Google Earth.

Figure 2: Downtown Denver in 3D

6.2   The Envisionment and Discovery Collaboratory (EDC)

The EDC [Arias et al., 2000] representing a *socio-technical environment* is a long-term

research platform that explores conceptual frameworks for democratizing design in the context

of framing and resolving complex urban planning by bringing together participants from various

backgrounds in face-to-face meetings. The knowledge to understand, frame, and solve such

problems does not already exist, but is constructed and evolves during the solution process. The

EDC incorporates a number of innovative technologies, including table-top computing, the

integration of physical and computational components supporting new interaction techniques,

and an open architecture has proven to be an ideal environment to study and support meta-design

and social creativity by making all voices heard.

In our research with the EDC during the last decade in fostering and supporting cultures of participation within collaborative design activities, we have observed:

- Each urban-planning problem is *unique*: it has to take into consideration the geography, culture, and population of specific locations.

- More creative solutions to problems can emerge from the collective interactions with the environment by *heterogeneous communities* (such as *communities of interest*, which are more diverse than *communities of practice*).

- Boundary objects are needed to establish common ground and establish shared understanding for communities of interest.

- Participants must be able to naturally express what they want to say.

- Interaction mechanisms must have a "low threshold" for easy participation and a "high ceiling" for expressing sophisticated ideas.

- Participants are more readily engaged if they perceive the design activities as personally meaningful by associating a purpose with their involvement.

Obstacles to the further investigation of the above observations rest with the difficulties of democratizing the design of the EDC [von Hippel, 2005] by providing more control to the participants. Currently, EDC developers have to customize the system at the source-code level to reflect the specific characteristics of the city and its urban planning problems. As urban planning deals with ill-defined problems, the domain- and context-specific knowledge is sticky, tacit, and difficult to transfer from local urban planners to the EDC developers. Figure 3 illustrates how the EDC supports problem framing and problem solving activities by bringing individuals who share a common problem together in face-to-face meetings. The EDC supports reflection-in-action [Schön, 1983]: the horizontal table represents the action space and the vertical displays represent

the reflection space. A problem is discussed and explored by providing participants with a shared

construction space in which they interact with computationally enhanced physical objects that

are used to represent the situation. Computer-generated information is projected back onto the

tabletop construction area, creating an augmented reality environment. This construction in the

tabletop environment is coupled with information displayed on a vertical electronic whiteboard

relevant to the problem currently being discussed. A key aspect of the EDC that makes it a

critical and unique component (and sets it apart from other environments such as Google 3D

modeling environment) is the need and emphasis on the *collaborative construction of artifacts*

rather than the sharing of individually constructed items.

Figure 3: Face-to-Face Collaboration in the EDC

6.3   Courses-as-Seeds: Nurturing and Supporting Communities of Learners

A culture of participation perspective for learning and education is focused not on

delivering predigested information to individuals, but providing opportunities and resources for

learners to (1) engage in authentic activities, (2) participate in social debates and discussions, (3) create shared understanding among diverse stakeholders, and (4) frame and solve personally meaningful problems. It is grounded in the fundamental belief that all humans have interest and knowledge in one or more niche domains and are eager to *actively contribute* in these contexts.

Over the last decade, we have reconceptualized and reinvented our teaching activities and grounded them in socio-technical environments in which (1) communities of mutual learners act simultaneously as learners and as active contributors (based on the assumption that being a teacher or a learner is not an attribute of a person but an attribute of a context); (2) peer-to-peer learning is supported and teachers act as "guides on the side" rather than as "sages on the stage"; and (3) courses are considered as seeds rather than finished products [Fischer, 2002].

Courses-as-seeds [dePaula et al., 2001] is an educational model that explores meta-design in the context of fundamentally changing the nature of courses taught in universities. Its goal is to create a culture of informed participation [Fischer & Ostwald, 2005] that is situated in the context of university courses transcending the temporal boundaries of semester-based classes. The major role for new media and new technologies from a culture-of-participation perspective is not to deliver predigested information and non-changeable artifacts and tools to individuals, but rather to provide the opportunity and resources for engaging them in authentic activities, for participating in social debates and discussions, for creating shared understanding among diverse stakeholders, and for framing and solving personally meaningful problems.

Over the last decade, our teaching objectives and practices have increasingly tried to reconceptualize learning in courses from a cultures-of-participation perspective. Our courses are using wikis as course information environments (for examples see: *http://l3d.cs.colorado.edu/ ~gerhard/courses*). Traditionally, the content of a course is defined by the resources provided by

instructors (such as lectures, readings, and assignments), but, in courses-as-seeds, the instructor provides the initial seed rather than a finished product. By involving students as active contributors, courses do not have to rely only on the intellectual capital provided by the instructors but they are enriched on an ongoing basis by the contribution of all participants.

Courses-as-seeds represent a *community-of-learners* model [Rogoff et al., 1998] and explores new middle ground between *adult-run* and *children-run* education. All participants are active and the more skilled partners (experienced teachers and coaches) can provide leadership and guidance. The learners have opportunities to become responsible and organize their own learning, exploit their previous interests, and sustain their motivation to learn by having some control over their contributions.

The courses-as-seeds model represents a system of values, attitudes, and behaviors that differ radically from the traditional educational culture in which courses are conceived as finished products and students are viewed as consumers. Courses-as-seeds creates a culture based on a *designer mindset* that emphasizes habits and tools that empower students to actively contribute to the design of their education (and eventually to the design of their lives and communities).

7   Challenges and Opportunities

Our attempt to explore rich landscapes of learning emphasizes that different approaches complement rather than replace each other. Self-directed learning and cultures of participation will not mark the end of the lecture, but they are important alternatives to end the monopoly of the lecture. This section briefly discusses some challenges and opportunities associated with self-directed learning and cultures of participation.

7.1   Making Learning a Part of Life with Self-Directed Learning

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 2 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 self-directed learning in the context of realistic, open-ended, ill-defined problems.

Lifelong learning is a continuous engagement in acquiring and applying knowledge and skills in the context of self-directed problems and should be grounded in descriptive and prescriptive goals such as:

- learning should take place in the context of authentic, complex problems (because some learners will refuse to quietly listen to someone else's answers to someone else's questions);
- learning should be embedded in the pursuit of intrinsically rewarding activities;
- learning-on-demand needs to be supported because change is inevitable, complete coverage is impossible, and obsolescence is unavoidable;

- organizational and collaborative learning must be supported because the individual human mind is limited; and

- skills and processes that support learning as a lifetime habit must be developed.

Table 2: A Comparison of Different Conceptualizations of School Learning and Lifelong Learning

	School Learning	Lifelong Learning
emphasis	"basic" skills	learning as a fundamental aspect of life
problems	given; well-defined focus on problem solving	constructed; ill-defined focus on problem framing and problem solving
new topics	defined by curricula, assigned-to-learn, decontextualized	arise incidentally, need-to-know, on demand, contextualized
structure	pedagogic or logical structure	interests, problems, work activities; learning often takes places without teaching
cognition	knowledge in the head; individual cognition; general learning	distributed; use of tools and external information resources; shared cognition; situation-specific competencies
Roles	expert-novice model; teacher and learner = f{person}	reciprocal learning; teacher and learner = f{context}
teachers	expound subject matter ("sage on the stage")	engage in guided discovery learning ("guide on side")
learners	consumers	active participants
Mode	instructionism (knowledge absorption)	design; making; constructionism (knowledge construction)
drawbacks	decontextualized, not situated	important concepts are not encountered

7.2   *A Challenging Design Trade-Off: Support versus Freedom of Choice*

Self-directed learning provides learners with the freedom to pursue personally meaningful questions (two specific examples are provided by the narratives in Section 2). This creates the fundamental challenge of addressing the dual objective of giving learners enough *freedom* to become active in the process of pursuing personally meaningful problems, and giving them enough *guidance* so that their activity results in the construction of useful knowledge and artifacts and support when they encounter breakdowns. Teachers can provide guidance much

more easily in an instructionist classroom in which they discuss problems and present knowledge
with which they are familiar. This familiarity may not exist when learners engage in their self-
directed learning activities.

The same trade-off between support versus freedom of choice governs the distinction
between two computational learning environments:

- *intelligent tutoring systems* [Anderson et al., 1995], in which the problem is given by the
  teacher or the system, and

- *interactive learning environments* (such as LOGO [Papert, 1980]), in which tools are
  provided that allow learners to explore problems of their own choice.

Intelligent tutoring systems can provide substantial more support because the designers of
the environments know (at design time) the types of problems the learners will work on (at use
time). In interactive learning environments, little support is given when a learner is stuck since it
supports autonomous learning. In order to support self-directed learning, they need to be
augmented with mechanisms (such as domain-oriented design environments, critiquing systems,
and context-awareness) that can offer help and support for learners who get stuck or who do not
know how to proceed when the information needs to be contextualized to the task at hand and to
the learner's needs and interests [Fischer et al., 1998].

7.3   Drawbacks of Cultures of Participation

Cultures of participation open up unique new opportunities for mass collaboration and
social production, but they are not without drawbacks. One such drawback is that humans may
be forced to cope with the burden of being active contributors in *personally irrelevant activities*
that can be illustrated with "do-it-yourself" societies. Through modern tools, humans are
empowered to perform many tasks themselves that were done previously by skilled domain

workers serving as agents and intermediaries. Although this shift provides power, freedom, and control to customers, it also has forced people to act as contributors in contexts for which they lack the experience that professionals have acquired and maintained through the daily use of systems, as well as the broad background knowledge to do these tasks efficiently and effectively such as companies offloading work to customers.

More experience and assessment is required to determine the design trade-offs for specific contexts and application domains in which the *advantages* of cultures of participation: such as extensive coverage of information, creation of large numbers of artifacts, creative chaos by making all voices heard, reduced authority of expert opinions, and shared experience of social creativity, will outweigh the *disadvantages*: accumulation of irrelevant information, wasting human resources in large information spaces, and lack of coherent voices. The following research questions need to be explored:

- Under which conditions is a *fragmented culture* with numerous idiosyncratic voices representing what some might characterize as a modern version of the "Tower of Babel" and others as refreshingly diverse insights, better or worse than a uniform culture which is restricted in its coverage of the uniqueness of local identities and experience?

- If all people can contribute, how do we assess the *quality and reliability* of the resulting artifacts? How can curator networks effectively increase the quality and reliability?

- How can we avoid the problem of *participation overload* (potentially being a more serious problem than information overload)? Being an active contributor requires more effort and more time than being a passive consumer. Active contributors are often domain professionals, competent practitioners, discretionary users, and engaged citizens — all of them experiencing numerous demands on their time.

7.4   Massive Open Online Courses (MOOCs)

<u>M</u>assive, <u>O</u>pen, <u>O</u>nline <u>C</u>ourses (MOOCs) are receiving world-wide attention as a means to revolutionize education. The interest and hype around MOOCs are reflected by phrases such as "Most Important Educational Technology in 200 Years" and public attention has moved beyond academic circles. Most of the discussions surrounding MOOCs have been grounded in economics and technology, with few considerations coming from the learning sciences. MOOCs are

- *"massive"* because they are designed to enroll tens of thousands of students (and have done so in numerous cases);
- *"open"* because anybody 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;
- *"course*," referring not only to content delivery (as it was the case with MIT's Open Courseware) but including all aspects (lectures, forums, peer-to-peer interaction, quizzes, exams, and credentials) associated with courses.

Over the last few year, 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.

There are currently two major developments: (1) *cMOOCs* focusing on knowledge creation and generation; and (2) *xMOOCs* focusing on knowledge transmission and delivery (they are getting most of the attention). A description and overview of currently existing MOOCs is provided at http://www.mooc-list.com/.

Important potential *strengths* of MOOCs are:

- an innovative, new effort which is shaking up all learning institutions (they changed the distribution method, but in many cases not the actual product);

- generated a discussion that transcends the narrow confines of academic circles;

- making the knowledge of some of the world's leading experts from the best universities available to anyone free of charge;

- attracting and affecting large numbers of people;

- experimentation with different approaches (e.g.: standalone versus hybrid course, course with fixed time duration versus courses to be taken anytime, etc.); and

- serving as a forcing function for residential, research-based universities to reflect and focus about their core competencies

Important potential *weaknesses* of MOOCs are:

- by being focused on, lectures they provide often only a change in form, not in content (the new technology component makes lectures appear innovative, but the additional enrichment activities are still quite limited). Participating in a MOOC is not too different from "traditional" teaching: a teacher talks and students listen (an approach that we characterized as "gift wrapping" [Fischer, 1998]);

- they by their very low teacher/student ration are no substitute for intensive, interactive, small-group learning situations;

- they are unable to create the classroom as a community of mutual learners, in which the roles of the teachers and learners were not assigned to specific individuals, but to specific contexts; the teachers acted as "guides on the side" rather than as "sages on the stage" and learners were given many opportunities to be active contributors;

- the instructionist nature of most xMOOCs is not well suited to aspects of learning that grow out of longer-term mentored relationships and self-directed learning--i.e., settings in which learners of all ages take advantage of new learning opportunities made available by innovative technologies in pursing their own personal interests; and

- they provide little support for self-directed learning and cultures of participation. Interesting questions to ask based on these developments are [Fischer, 2013b]:

- *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).

MOOCs enrich the landscape of learning opportunities and they have the potential to reduce the digital divide by providing education for everyone. They challenge residential, research-based universities to reflect, define, and emphasize their core competencies: moving away from large lectures with learners listening to teachers towards active learning environments characterized by personal attention - from teachers and opportunities for participation, and thereby looking beyond the simplicities of information to the complexities of learning.

8   Conclusions

People are different, with different wants and needs specifically with respect to learning. New media provide the foundation for socio-technical environments in support of rich landscape of learning. The research activities documented in this paper are focused on creating frames of reference to assess the strengths and weaknesses of different approaches to learning with a focus on self-directed learning and cultures of participation in the context of collaborative learning

environments. These approaches enable learners to control their own learning allowing them to decide what they consider important and valuable and what they want to learn rather than have to learn.

The future of why, what, how, when, where, and with whom people learn is not out there to be discovered, but it needs to be designed. The learning sciences and the designers of new, theoretically grounded socio-technical environments should consider this objective a "grand challenge" of their research agenda.

Acknowledgements

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