Future Learning Spaces for Learning Communities: New Directions and Conceptual Frameworks

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Abstract: This symposium presents our efforts to reconceptualize learning spaces from their traditional notions as bound and immutable to a view in which the physical and social boundaries are flexible and dynamically connected to the learning itself. We present the work from five international research centers that consider space as a multi-dimensional mediational tool that shapes, and is shaped by, the learning communities who use them. In each case, researchers will present their innovative spaces along with the learning community frameworks they use to describe and design them. Each study demonstrates specific insights regarding how to conceptualize and design Future Learning Spaces for Learning Communities.

Keywords: design, future learning spaces, learning communities, sociocultural

The various arrangements among humans, computers, and space within a particular classroom context impact the dynamics of the learning environments created. (Bielaczyc, 2006, p. 304)

The classroom is significant not just as a material location in which education research is located..., but also as a conceived or imagined space—an imagined geography of a particular kind. (Leander, Phillips, & Taylor, 2010, p. 331)

Introduction

This symposium addresses the conference theme of *Transforming Learning, Empowering Learners* by uniting two theoretical issues of vital interest in the learning sciences: Future Learning Spaces (FLSs) and Learning Communities (LCs). The timeliness of this conversation is critical given the current state of educational reforms around the globe whereby large and expensive infrastructure decisions are being made such as in renovating schools and classrooms. History has taught us that these reforms often fail to impact learning because they are based on "more of the same" instructionist pedagogies (Cuban, 2001; Scardamalia & Bereiter, 2006) or fanciful "futurist" visions of physical learning environments that are not connected to any specific pedagogical principle. While there is often a great deal of hype in popular media about new educational architectures (1), such ideas frequently overvalue the role of space without giving deep consideration to the principles of learning underlying these projects. Coherent frameworks that are based on principles derived from the learning sciences are needed to guide the construction and use of new spaces so they are used in pedagogically meaningful ways (Sawyer, 2014a).

Our combined projects can offer important contributions to the exciting and ongoing LC research within the learning sciences. As LC thinking evolves, there are new possibilities for what can be done by considering the spaces where they are situated. For example, new technologies that are reported upon in this symposium allow for distant knowledge building communities to learn from each other's collective idea threads (see Zhang & Chen). Embedded "Wallscopes" allow students to carefully observe life cycles of multiple habitats within the walls of one classroom (see Slotta, Cober, Acosta, & Moher). Pod-like furnishings and arrangements in undergraduate physics classrooms promote active learning and community-based knowledge (see Charles, Whittaker, & Lenton). Flexible walls, easily combinable furniture, and embedded screens allow for opportunistic collaboration within an emergent-design (see Ben-Zvi, Hod, Kali, & Weiss). Finally, open technology-enabled collaborative spaces allow multiple LCs to enact their practices (see Rook, McDonald, Choi, & Tietjen). Together, these projects show how LCs can be refined by considering the way space constrain or give new opportunities to certain kinds of activities and practices.

As there is greater public acceptance around the need to reshape educational spaces (The New York Times, 2013), the learning sciences has an increasingly challenging role of translating its findings to the public sphere. By deeply studying how learning communities interact with their physical environments, we hope to offer a coherent vision to guide reform, which includes the physical and locational aspects of learning. While this symposium is a small step forward in this disciplinary endeavor, it is invariably important to the goal of transforming learning and empowering learners. In the following sections, we provide a background to these issues in learning sciences research, laying the theoretical grounds to consider the five innovations in this symposium.

The future of learning and education

It is important to interpret the emergence of the LC approach and FLSs within the present cultural and historical context. Whereas knowledge and skill acquisition were once vital for economic growth in the industrial era, today's society demands that its participants have more generic problem solving and communication skills, including the ability to find and learn from various media, solve ill-structured problems and collaborate with peers. Recent advances in technologies such as smartphones and online communities have significantly extended opportunities for the development of these skills, increasingly questioning the relevance of traditional schooling (Sawyer, 2014b). It is becoming ever more important for education to customize learning, make use of diverse knowledge sources, specialize assessment, and provide opportunities for students to learn-by-doing. These new demands in an emergent innovation society have led to incompatibilities with the traditional educational system, such that many consider the current disruptions as revolutionary (Collins & Halverson, 2009).

While the learning and education that will take place in the future is still a matter of some conjecture, learning sciences research on FLSs and LCs are closely connected with this developing trend, and can help guide the complex transition through a rigorously advanced body of knowledge. Whereas classrooms have traditionally been seen as immutable containers for the transmission of knowledge, today issues of space have entered learning sciences research to support the new demands on education and learning. Likewise, innovations in educational thinking over the past several decades have led researchers and practitioners to develop coherent classroom designs that capture the large ideas of a new theory of learning (Brown & Campione, 1994). Together, FLSs and LCs offer two key interrelated perspectives that stand at the heart of the disruptions in education and which have the potential to transform learning and empower learners for the 21st century innovation society (Facer, 2014).

Learning communities

One of the useful ways that learning scientists have approached the problem of re-conceiving and re-designing education has been by adopting sociocultural perspectives of learning. Rooted in Vygotskian thought, this perspective views learning as mediated by cultural and historical tools that individuals internalize as they are socialized throughout their lifespan (Wertsch, 2007). Educational researchers have extended this view by considering learning as a matter of transformational participation in certain ways of knowing (Rogoff, 1994), such as in the practices or discourse of particular communities (Lave & Wenger, 1991). In this perspective, the design of educational content and learning environments moves beyond the domain of transmitted content.

LCs, which are a translation of these theoretical ideas into practice (Bielaczyc & Collins, 1999), have been a long-standing interest of the learning sciences (2). Early studies advocated LC models as a means of transforming classrooms to be relevant for contemporary society (e.g., Brown & Campione, 1994; Scardamalia & Bereiter, 2006). In addition to establishing a culture of learning that emphasized collective knowledge building, these LC models valued contributions of diverse members, advanced collective knowledge, emphasized learning how to learn, and developed mechanisms for sharing the community's knowledge (Bielaczyc & Collins, 1999). Based on the LCs framework and spurred by emerging collaborative technologies, the past 20 years has seen a

proliferation of exciting ideas and models. These have come about within various educational settings like schools (e.g., Herrenkohl & Mertl, 2010; Hogan & Corey, 2001), universities (Fischer, Rohde, & Wulf, 2007; Hod & Ben-Zvi, 2014), professional settings (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006), informal settings (3), and more recently online (e.g., Kafai & Fields, 2013; Kidron & Kali, 2015; Resnick et al., 2009).

Learning spaces

Along with new conceptions of pedagogies, activities, and assessment practices that have come with LCs, space has gained relevance as a mediator of social configurations and interactions for students' transformation of participation (Jordan & Henderson, 1995). One line of research that has emerged is the exploration of how physical arrangements are designed meaningfully to foster students' trajectories from vernacular discourses and peripheral participation to authentic discourse and practices (Roth et al, 1999).

This increased focus on socio-materiality has come as part of a growing recognition that space is only one among the ubiquitous mediating structures that support the development and distribution of cognition in complex relationships (Pea, 1993). Instead of treating learners and their contexts separately, research on learning spaces emphasizes space within the other situationally related tools such as activity, social or epistemic norms, assessment, and learning trajectories. This integrated view of space and the mutual fertilization of mediators within learning ecologies is one of the greatest opportunities and challenges of coming to theorize the role of space in learning.

An additional factor is the concept of learning space itself. While space is often considered as the physical or locational aspects of a room (e.g., Moher et al., 2015), there is also recognition that space is socially constructed. Meaning, space can be seen as not just a material object in a learning environment, but as an "imagined geography" (Leander, et al., 2010, p. 331). The idea behind a "fun space" or even "future learning space" are examples of the type of ongoing negotiation around this idea. New mobilities of learning due to the changing social spaces afforded by new technologies make such conceptions increasingly relevant (Leander, et al., 2010).

Symposium structure

To put into practice some of the common ideas that the contributors seek to present, this symposium will be organized as an interactive poster session so that participants can be active and develop collective knowledge (e.g., Kali et al., 2015). The format of the session will include an introduction, led by the session co-chairs, which describes our framework to consider five diverse, international lines of research on FLSs for LCs. Following this, contributors will briefly describe their research to the participants, who will engage in interactive discussions around each poster. The co-discussants will then provide their perspectives, which will be followed by a moderated whole group discussion. To support this session, we will create a shared online space, consisting of linked Google documents where participants will add and discuss their ideas.

Interconnecting the knowledge spaces of different communities for sustained knowledge building

Jianwei Zhang and Mei-Hwa Chen

Real-world knowledge-creating communities achieve productivity through sustained inquiry and progressive discourse by which ideas are continually developed, refined, and built upon, giving rise to more advanced conceptualizations and deeper goals (Sawyer, 2007). Such efforts are further supported by interactions across communities that work as an interconnected intellectual field (Csikszentmihalyi, 1999). Educational efforts to create LCs for knowledge building need to enable similar social and cognitive dynamics sustained over long periods of time (Engle, 2006). This research aims to create socio-technological spaces that connect the knowledge of different communities across classrooms and school years. Existing designs of collaboration across LCs rely on directly sharing the original online discussion space—a single layer sharing. However, doing so proves difficult (Laferrière et al., 2012), as it requires students to read the messy and lengthy discourse of others to understand their progress, causing high cognitive and collaboration load (Dillenbourg & Bétrancourt, 2006).

This project adopts a multilevel design to create a macro-level, cross-community knowledge space on the top of the discourse spaces of different local communities. The macro-level knowledge space is enabled by the platform of Connecting Idea Threads of Youth (CITY) developed on the basis of Idea Thread Mapper (ITM), a Web-based tool to trace conceptual trajectories in long-term online discourse (Chen et al., 2013). CITY interoperates with Knowledge Forum (Scardamalia & Bereiter, 2006) and other tools for collaborative discourse. As members in each community engage in sustained discourse in their protected online space, they review their unfolding idea threads, each of which consists of a set of idea contributions that address a shared theme or problem

(Zhang et al., 2007). Organizing distributed discourse entries into timeline-based idea threads helps to make the collective progress visible for reflection. Different communities then select and publish productive idea threads for cross-community sharing and build-on. Social interactions in CITY allow members to discover, follow, comment, cluster, and adopt the idea threads from different communities for mutual learning and dynamic idea contact.

A series of design-based studies have been conducted in Grade 3-6 classrooms (Zhang et al., 2013, 2014, 2015). Students engaging in collaborative reflection on unfolding idea threads were able to develop more connected and sustained discourse to address deepening issues. They further compared their own idea threads with those of other communities. Doing so helped them to better monitor their advances and weak areas, examine diverse perspectives, and adopt helpful questions, ideas, and inquiry resources to enrich their discourse.

Knowledge construction in the instrumented classroom: Supporting student investigations of their physical learning environment

James D. Slotta, Rebecca M. Quintana, Alisa Acosta and Tom Moher

We present research that leverages the physical classroom space to support a knowledge community in a classroom (e.g., Brown & Campione, 1996; Scardamalia & Bereiter, 2006). Our pedagogical model, known as Knowledge Community and Inquiry (KCI), builds on the foundation of knowledge communities, with an added major emphasis on scaffolded inquiry (Slotta & Linn, 2009). The present research was conducted within an instructional environment referred to as Embedded Phenomena for Inquiry Communities (EPIC; Slotta, Tissenbaum, Lui, & Zukowski 2012), where KCI was applied as a pedagogical model to develop a knowledge community for elementary students to investigate Embedded Phenomena. In EPIC classrooms, students work collaboratively (i.e., in small groups) and collectively, sharing information and solving problems. Interactions, including the exchange of data and theories, are carefully designed to support the growth of collective knowledge concerning the EP under investigation, as captured in various representational forms.

We employed the WallCology EP as the setting for whole-class inquiry, targeting life sciences topics of biodiversity and population ecologies (Moher et al, 2008). Over several weeks, 42 students from two grade-5/6 classes observed a digital ecosystem consisting of dynamic animations of insects and vegetation, visible through display monitors called "Wallscopes.". The ecosystem comprised four differentiated but interconnected habitats, one on each wall of the classroom, which varied in terms of environmental conditions (temperature, light and humidity). In our EPIC activity, students made observations about the morphologies and behaviors of organisms to determine their life cycle relationships. Constructing a representation of the lifecycles of any species was a challenging task; it was not always clear which organism belonged to which species (e.g., does the adult form of the "green bug" hatch from the white egg or blue egg?). It required careful observation (and maybe a bit of luck) for students to actually "see" life events like laying and hatching unfold. Additionally, since each monitor displayed a different habitat, students at one monitor see something different than students at another monitor, necessitating the sharing of observational data across various locations in the room, and over time.

The goal of EPIC is to create a more powerful means of sharing and working with such observations, by aggregating individual or group inquiry actions, encouraging teacher and students to attend to interesting patterns in the data, revealing gaps or conflicts in the collection, where more work is needed. The present paper analyzes the role of various visualizations of aggregate knowledge in supporting patterns of discourse within the community.

Designing active learning spaces to foster collaboration

Elizabeth S. Charles, Chris Whittaker, Kevin Lenton, and Michael Dugdale

Giving serious consideration to changing the instructional paradigm to more active student participation, universities and colleges have begun to invest in the redesign of learning spaces (e.g., Beichner et al., 2007; Dori & Belcher, 2004). Often referred to as active learning classrooms (ALCs), the architecture and furnishings intentionally use pod-like arrangements of 4-10 students to promote small group collaboration and multiple technologies for intra- and inter-group sharing. In doing so, ALCs call for the leveraging of grounding activities (Clark & Brennan, 1991) and devices that support the indexical referring made possible through shared perceptual spaces (Roschelle & Clancey, 1992). What is often overlooked in these scenarios of designing ALCs is the planning for the adoption of such pedagogical innovations by the users, instructors and students alike. In short, the move toward distributed authority systems puts new demands on students and instructors. It challenges students to take on a sense of collective responsibility (Scardamalia, 2002) and shared epistemic agency (Damşa,

Kirschner, Andriessen, Erkens & Sins, 2010), while requiring instructors to take up new pedagogical practices (Lasry, Charles & Whittaker, 2014).

Our contribution is based on the work of a cross-institutional researcher-practitioner team made up of learning scientists and physics instructors, at the college level in Quebec. Members of the team have been directly involved in designing and fostering the effective use of ALCs over a six year period. Using reflexive methodologies of action research and design-based research, the team has studied processes involved in adopting and effectively using ALCs to promote learning and change instructional practices. In particular, our action research has documented the development of LCs to support changing practices for instructors. Our current design research involves comparing the implications of the three primary models of ALCs within the college network. Differences between the ALCs models hinge on the types of perceptual spaces they provide the student groups (public vs. private, networked vs. singular, interactive vs. static) and the flexibility of the group configurations (fixed tables vs. flexible tables). These studies expand our understanding of how ALCs function and the roles student LCs play in determining how resources within these new spaces are used. For this session we will draw commonalities derived from these diverse case studies and suggest guidelines that support meaningful joint-activity mediated by the physical space and pedagogical commitment.

Design of a future learning space based on learning community principles

Dani Ben-Zvi, Yotam Hod, Yael Kali, and Patrice L.Tamar Weiss

We have been involved in a long-term design-based research study that has examined various aspects of our LC, situated within the Educational Technologies Graduate Program at the University of Haifa. The distinguishing principles of this LC include a (1) design for enculturation; (2) emergent-design; and (3) humanistic orientation. As a significant part of a recent Israeli Science Foundation Center of Excellence grant, we have been engaged in a large-scale project to design and construct a new facility to house our program, giving us the opportunity to scrutinize the relationship between LCs and FLSs. Below we describe three space innovations that correspond to our LC design.

To support *enculturation* of scientific practices, the space is designed to provide students opportunities to learn-to-be as well as to learn about content. Therefore, we coordinate between the processes and content of learning. For example, students study about LCs as they participate in one. We have accordingly designed part of the FLS to include research facilities, giving graduate students direct access to authentic practitioners to foster the enculturation of research practices (Hod & Sagy, 2015).

Flexibility is a key design aspect of the space based on the *emergent-design principle*. Our FLS will employ an innovative design called learning niches, which are noise-reducing partitions that fold in and out of the walls such that small groups of students can meet in private, with minimal interference from others but quickly be reconfigured to support interaction with the whole class. Other ways that we support flexibility are with easily moveable and combinable furniture, and an any-to-any communication system supported by embedded multi-touch screens, allowing for individuals or groups to collaborate with others via video, either inside or outside the FLS.

One unique aspect of our LC is its *humanistic orientation.* By this, we mean extended efforts to get to know one another, such that group dynamics (Hod & Ben-Zvi, 2015) and transformative changes in identities and long-held learning practices are challenged and negotiated (Gee, 2001; Hod & Ben-Zvi, 2014). To support the creation of a safe space so that students can engage in such intimate processes within a university setting, one of our main principles was to design the space with plants, rugs, a coffee bar, and warm colors to give it an inviting feeling. Likewise, we have repurposed several unused outdoor spaces with wooden decks and comfortable seating.

Facilitating bridges of practice among multiple learning communities

Michael M. Rook, Scott P. McDonald, Koun Choi, and Phil Tietjen

The Krause Innovation Studio on the campus of Penn State University is a technology-enabled and bring-your-own-device learning space designed to facilitate group collaboration and serendipitous learning interactions. The Studio also supports pedagogical innovation through staff consultations with faculty on learning theory, tools, and affordances of space. The Studio is arranged into learning pods and spaces; each pod/space is designed to facilitate sharing work via large screens. The Studio's design is grounded in communities of practice (Wenger, 1998), and it specifically considered how LCs form and are sustained (Rook, Choi, & McDonald, 2015). In the four years of the Studio's existence, the research team has collected iterative sets of data to investigate how LCs develop in the less goal-driven, open and collaborative spaces of the Studio. These data include: interviews with stakeholders

during the design and construction of the space; spatial use data (e.g., seating sweeps) collected over three years; and most recently phenomenological interviews focused on users' experiences of the space. The data collected thus far combine to provide an opportunity for our team to characterize the emergent and nascent aspects of an LC in an FLS designed to facilitate bridges of practice among multiple LCs.

The complexity of investigating informal, open and intentionally collaborative spaces has led the research team to explore multiple methods and a variety of theoretical frameworks to understand how several, overlapping LCs enact their practices. Initial research led to the characterization of design principles describing the learning theory-driven design decisions during the Studio's development: learning spaces should scaffold authentic practices; allow for multiple representations of learning; and be pedagogically responsive (Rook et al., 2015). These design principles are empirical and theoretically grounded in ideas about LCs.

The iterative studies also have provided us with two preliminary themes around how learners use the space. First, learners engage in a joint enterprise of knowledge construction (Wenger, 1998). However, unlike in traditional classrooms, joint enterprise in a FLS designed to support multiple learning communities does not necessarily map onto shared goals in the same way; instead, knowledge construction involves local goals, potentially as idiosyncratic as each LC in the space. Second, learners have a shared repertoire of practices including, but not limited to: tacit interactions, spontaneous meet-ups, and a shared sense of agency in how learners choose pods/spaces. We will present these themes with exemplars and inform the shared discussion by contributing an understanding of how multiple LCs interact within a shared, open, and goal-diverse learning space.

Endnotes

(1) Some examples can be found here: http://www.techinsider.io/the-13-most-innovative-schools-in-the-world-2015-9
(2) See lc.edtech.haifa.ac.il/injls for a list of articles within the *Journal of the Learning Sciences* that use LC frameworks.
(3) www.computerclubhouse.org

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