Analyzing collaborative contexts: Professional musicians, corporate engineers, and communities in the Himalayas

Véronique Mertl, Timothy Kieran O'Mahony, Kersti Tyson, Leslie R. Herrenkohl, University of Washington, College of Education, Box 353600, 312 Miller Hall, Seattle, WA, 98195
Email: vmertl@u.washington.edu, tko2@u.washington.edu, kersti@u.washington.edu, leslieh@u.washington.edu
Sameer Honwad, Christopher Hoadley, Penn State University, College of Education, 314 Keller Building, University Park, PA, 16802
Email: svh106@psu.edu, cmh35@psu.edu

Abstract: This paper reports on the collaborative experiences and theories of members of professional and community settings who work with others in their everyday practices. Data are drawn from interviews and field observations with professional musicians who collaborate regularly for performances, corporate engineers working in groups, and community members exchanging perspectives on sustainable practices for their village. Performing chamber music, designing a new technology-driven plane, or making decisions about sustainability in rural communities, all require sophisticated collaboration to generate ideas from multiple perspectives, problem solve, and innovate. The research we present explores the demands on the environment, the relational space, and the shifts that occur for participants in their collaborative settings. The findings from these studies emphasize the multidimensionality of collaboration and the importance of collaboration as a tool for learning and decision-making in given contexts.

Increasingly, we recognize that sophisticated collaboration is needed in situations where learning, problem solving, or design activities are required. By examining and contrasting three distinct settings where useful forms of expertise are distributed among different participants, we identify important dynamics about collaborative work. We investigate the theories about collaboration that people develop when engaged in collaboration on a regular basis in their professional or everyday lives. Data for this symposium are drawn from interviews and field observations with professional musicians who perform in ensembles, corporate engineers working in groups, and community members exchanging perspectives on sustainable water access for their village. This paper allows for a unique synthesis on the role of collaboration across contexts and illuminates the complexity of what it means to "cre8te a learning world." By juxtaposing these studies, we gain insight into how people take up new ideas in interaction with and through others and are able to explore how collaboration is a major part of the context of change and innovation.

As past research has suggested, there is a qualitative difference between the spaces that lack communication and produce a void between people's exchanges, and the collaborative spaces where ideas are heard and inform each other (e.g. Barron, 2003; Dillenbourg, Baker, Blaye, & O'Malley, 1996). We are interested in further exploring the elements that intersect and allow for productive collaborative moments in everyday "real-world" settings. We examine the role of collaboration in shifting and building knowledge. We suggest that understanding how collaborators conceptualize and frame their collaborative behavior can enrich our knowledge base for designing productive collaborative experiences in and out of school. Yet, since the quality of collaborative interaction is emergent and occasioned by multiple aspects of context, our findings suggest that collaboration is a resource that people can draw upon rather than skills that are transferred.

Comparing across collaborative communities reveals that there is a process of presenting expertise, listening to others, and "letting go" of prior conceptions in order to integrate new ideas. These collaborators all go through a shift from *knowledge establishing* to *knowledge sharing.* There is a shift in action through interaction. As John-Steiner *(2000) s*tates, "the construction of new modes of thought relies on and thrives with collaboration" (p. 7). In interviewing chamber music musicians, this shift meant bringing in their varied musical techniques and interpretations of the piece and eventually integrating ideas into a particular interpretation for performance. They described an ebb and flow as each participant, with their unique instruments, becomes part of the collaborative process. For the engineers this shift was seen through field observations when an intentional opportunity for collaborative formative assessment was designed using the Legacy Cycle of Learning (Schwartz, Lin, Brophy, & Bransford, 2000). The cycle included sharing initial thoughts, developing a plan to revise and review after receiving input from multiple perspective 'resources', and an instructive aperture for 'reporting-out' to the collaborative group. The mindset that emerged from the collaborative workshop evidenced an identity shift in which the participants enhanced their meta-cognitive understanding through collaborative juxtaposing within and across

groups. For the communities in Himalayas, members integrated indigenous and exogenous knowledge when making decisions for sustainable ecological development. The integration was seen when youth collaborated with adults to learn about indigenous knowledge. The amalgamation of our work across these three contexts allows a unique lens into the intricacies of how members engage in their collaborative setting and how people are agents for change in their communities.

Prior research has looked at how participants may be more or less expert in the necessary facets of the collaboration task, more or less knowledgeable about one another, and in different relationships of power or solidarity (e.g., hierarchical or heterarchical groups). When research is focused on *task demands*, the way a collaborative task is constructed is found to influence outcomes (e.g. Johnson, Johnson, & Stanne, 1998). Prior relationships (Jones, 2002) and relative status of collaborators (Chizhik, 2001) also influence the success of a collaboration. While those who examine the context within which the collaboration occurs have found these findings to be important, they have also found that by manipulating the pre-existing environment, levels of collaborative success can be altered. Literature on improving collaboration has emphasized scripts for interaction (e.g. Rummel & Spada, 2005), changing perceptions of collaborators (Cohen, 1994), or assignment of roles (Herrenkohl & Guerra, 1998) with the expectation that these interventions might work productively across situations. This literature on improving collaboration focuses primarily on the cognitive skills and individual needs. It assumes that knowing 'how' will lead to enacting those 'skills' in a collaborative engagement. Our work extends the research on collaboration by looking at the complexity of how people collaborate within professional and community settings. Learning about collaboration by designing collaboration that is prescribed differs from understanding where it is emergent or a part of everyday "naturalistic" practice. For the professionals and community members in our research, there are no roles or scripts, and, yet, the participants speak to collaborative moments that unfold in their work as they seek innovative solutions and practices.

Past studies, employing video analyses of collaborative interactions, highlight how outcomes of collaborations can be highly variable, differing between groups working on the same task even when the composition of the groups are similar with respect to prior knowledge (Barron, 2000, 2003; Stevens, 2000). The research points to the importance of conceptualizing both the relational and the cognitive aspects of joint work, particularly as they relate to the larger social context, including institutional constraints (Barron, 2003) and practices for organizing joint work (Stevens, 2000). We theorize that in collaboration, collaborators use meta-collaborative knowledge for managing their interactions and monitoring the development of their shared problem space. Our findings confirm that our participants are highly aware of affective and relational aspects of collaborative learning, and that these components influence their decision making within specific contexts. For example, in their interviews, the participants in the performing arts highlight, in particular, the *meta* and *relational* aspects of collaboration in their theories of collaboration. Then, through analysis of interactions in both the corporate and rural community settings we see how *relational* aspects and elements of *design* afford collaborative engagement. All three data sets reveal that intentional collaboration requires aspects of: 1) the *meta* - perspective-taking (seeking to understand the orientation of the other), the establishment and regulation of joint attention, and a willingness to align one's goals and efforts with others'; 2) the *interpersonal* aspects, which include maintaining resiliency and persistence when faced with problems and presuming positive intent to contribute on the part of collaborators; and 3) *design* or the use and repurposing of tools for sharing knowledge. Elements of all three – meta, interpersonal, and design- are present in each data corpus, yet each study affords a particular perspective on the nuances and multidimensionality of collaboration in everyday settings.

Perspectives on collaboration: Musicians' emergent relational dynamics in the context of contemporary chamber performance

In this study we investigate the theories new-music, chamber musicians hold on collaborative dynamics in the context of their musical practice. This ethnographically-based study focuses on expert designers of collaborative environments and participants in those environments, and explores how such individuals think about collaboration, design for collaboration, participate in collaborative environments, and support collaboration of others. Professional chamber musicians' success depends on their ability to work with others for productive rehearsals and performances and the potential to work with colleagues again for future performances. This cycle affords the potential for a successful chamber-music career. Therefore, the ability to collaborate with colleagues remains central to the profession. Furthermore, musicians who focus their career on performing contemporary (or new-music) works are situated in a context where innovation and adaptability are central. Performing new music means premiering pieces from current-day composers who often compose pieces with unfamiliar or new rhythms, harmonies, gestures, and techniques. These 'cutting-edge' sounds are not only new to audiences, but require innovative techniques and

interpretations on the part of the instrumentalists. By exploring "the music of our time," as a participant states, these performers are asked to become what Hatano & Inagaki (1986) have termed *adaptive experts* in their domain. As adaptive experts, they are learning to be efficient and innovative through collaboration. Therefore, collaboration impacts and is linked to adapting expertise for these musicians, where innovation and efficiency happens with others and through others. Ultimately, the goal of our work is to better understand the ability to engage other people for help and advice in distributed efforts and the ability to adapt to new and changing group dynamics.

We interviewed 14 professional new-music, chamber musicians to understand their theories on collaboration and working with others. The open-ended interviews afford an understanding of how collaborative processes have developed over time from the perspective of the collaborator. At the time of our data collection, these professional musicians were rehearsing in ensembles on a daily basis in preparation for a new-music concert at an internationally renowned venue in the Northeast of the United States. Rehearsals and performances were video-recorded. For the purposes of this paper, we focus on the interview data where professional musicians shared their perspectives on collaboration and narratives on their collaborative experiences. Framed in a socio-histo-cultural tradition (e.g. Hutchins, 2002; Rogoff, 2003), our findings suggest that musicians believe that successful and enduring collaborations occur due to a multiplicity of factors that fall within *meta-communicative knowledge*, *inter-subjectivity*, and *environmental properties*. This helps us understand the complexity of collaborative dynamics, the interrelated aspects within a context, and the dimensions that remain pivotal for successful collaborative outcomes. These three interrelated dimensions parallel Rogoff's (2003) argument for an analytical framework on learning and development that foregrounds the individual, interpersonal, and contextual planes of analysis.

On an individual plane, the musicians speak to *meta-communicative knowledge*, which includes an awareness and monitoring of between-person states of engagement, strategies that facilitate joint attention and encourage mutual understanding, and strategies that elicit ideas from collaborators. For example, musicians demonstrate the ability to notice when the attention of a partner wanders and to reengage it. They ask others for their opinions and input and broadcast a joint solution so that the entire group is aware of the technical or interpretive musical ideas. Overall, there is a recruitment of distributed cognitive resources of the group to monitor solutions and elicit innovative ideas (Hutchins, 2002). On an interpersonal dimension*, inter-subjectivity* includes a resiliency and persistence in the face of interpersonal or problem-based challenges. Musicians display a willingness to build and elaborate on co-members ideas (even when communication proves ineffective), to elicit ideas from others, and try to clarify or incorporate them into common ground. *Environmental properties* include the use of conversational and technical tools to capture ideas, and working within the cultural norms and community practices of music.

Within these three foci, the musicians theories of collaboration point to two main types of collaborative models in their theoretical constructs (White & Frederiksen, 2005): (1) A multidimensional model (the context, the resources, the technologies) that includes, and places into relationship, the many factors at play in achieving productive collaboration and (2) two different process models - one that includes the developmental trajectory of a person who is becoming a professional musician and a second that discusses the process of preparing for performances, from the initial invitation to the performance.

Our analysis shows that from a multidimensional model, the importance of networks, including an accrued history with other musicians, technical and interpretive skills, professionalism (being on time, practicing), and the nature of interactions, including communication, humor, power dynamics, perspective-taking, and listening are all factors identified as essential by the musicians. From a process model, they report on individual past experiences and perspectives that inform the context, yet the musicians' collaborative theories are intricately situated in the norms and expectations of what it means to be a musician (i.e. the need to practice, the set up of rehearsals, and the demands on time). Furthermore, interpersonal relations remain central as musicians negotiate technical and interpretive perspectives on the music. For example, Anika, an oboist, describes the process as one of negotiation,

> *"A rehearsal is to establish an understanding of the musical work as to want to represent it. And so each person might have a certain concept when they come into it, but then you have to kind of present your ideas. In some sense decide and then it makes a total different piece. That's what a rehearsal accomplishes. And not only is that accomplished through words, spoken words, but also through the musical phrases. You make a phrase and someone hears it and follows it or supports your- that kind of thing."*

In this quote we see meta-communicative knowledge (having a concept), inter-subjectivity (presenting and acknowledging ideas), and environmental influence (within a rehearsal space; the use of verbal and musical language) converging in Anika's experience. These three interrelated foci of analysis help reveal the dynamic in collaboration that leads to a process of *knowledge sharing* to build innovative musical practice or as Anika states ,"a total different piece."

Kara, a vocalist, adds to our understanding of the collaborative experience through her focus on the interplay between the technical and interpretive aspects of the music as a means to get to the creative side of collaborating:

> "*…you feel comfortable enough with your part, how it works with the other parts to the extent that when you get to performance, you can sort of play with it a little bit and be more spontaneous with it. So you spend a lot of the time being exact and exact and exact and then get it into a situation where it's exact and it's all together and then it can loosen up and become a little bit more individual."*

Once she feels comfortable with her part, Kara points to "letting go" of the exactness in order to allow space to innovate and spontaneously express interpretation. Both musicians, in these examples, point to the importance of being prepared prior to the rehearsals and the need to negotiate both the technical and interpretive aspects of the music. By examining collaboration through the multidimensional and process models revealed by these musicians, we begin to develop a more detailed picture of collaboration. Beyond identifying factors, our analysis reveals the weight attributed to each and the possible relationships or interactions among these factors – individually, interpersonally, and contextually.

Shift in Action: Mediated Collaborative Mosaics Dance with Adaptive Expertise in an Informal Learning Ecology

This paper describes findings from a mediated collaborative intervention (N=65), conducted by members of academia and an aerospace company, to explore ways to enhance workers' learning in environments where change and innovation are the norm. Many of these companies face an almost never-ending skills gap and are in need of people who view the need for new learning as something that is positive rather than negative (Bransford, 2007; Mead, Stephens, Richey, & Bransford, 2007; Robinson & Stern, 1997; Rogers, 2003; Schwartz, Bransford, & Sears, 2005). In these processes, employees' individual skills and their ability to share and generate knowledge within their communities and social networks increasingly play a crucial role (Ackerman, Pipek, & Wulf, 2003). We explore how understanding the way collaborators conceptualize and frame their collaborative behavior and thereby enrich our knowledgebase for designing productive collaborative experiences in formal and informal settings.

These companies often find themselves in dynamic and turbulent environments. As a result, organizations are required to learn continuously and to reinvent their processes and products on-the-fly. One way to begin to address change and innovation in organizations is to help people view themselves as "adaptive experts" (Hatano & Inagaki, 1986)—where a preparation for future learning is an important part of expertise. Especially important is the idea that "lifelong learning" involves much more than the simple addition of new skills and knowledge to one's existing repertoire. In companies where workers are used to knowing how to do their routine task and hence are seen as "masters of their trades", the change of role from being a "routine expert" to becoming an "adaptive expert" can be a difficult transition to make (Bransford, 2007; Levy, 2004; National Academy of Engineering, 2005). The quality of collaborative interaction is emergent and occasioned by multiple aspects of context, our findings in the aerospace workplace suggest that collaboration is a resource that people can not only draw upon but also can improve over time and between contexts.

Research suggests that adaptive expertise is a "habit of mind" developed over time, and that the best combination for developing adaptive expertise may be "guided-inquiry" designs where learners first invent or generate their own ideas followed by timely interventions to provide directed guidance (e.g., Schwartz, Bransford & Sears: 2000). For example, Martin and colleagues (Martin et al., 2007; Martin, Rayne, Kemp, Hart, & Diller, 2005) have studied the use of STAR.Legacy (Schwartz, Lin, Brophy, & Bransford, 2000), an inquiry method that blends individual and group instruction for developing adaptive expertise among bioengineers. In the Legacy learning Cycle, learners are given a complex problem to solve (Bransford, Vye, Bateman, Brophy, & Roselli, 2004; Hmelo-Silver, Duncan, & Chinn, 2007). This research focused on a "STAR.Legacy" collaborative-iterative design that encouraged a blend of both individual and group discussions as opposed to traditional lecture. We found that in the aerospace workplace a collaborative stance involved a process of presenting expertise, including intentional listening to fellow workers and peers, and "letting go" of prior conceptions, and preconceived ideas in order to integrate new schemas. We were able to document (using interviewing techniques and extensive video analysis) how the aerospace engineering collaborators all went through a shift from knowledge-establishing to knowledge-sharing as a consequence of identity establishment in a new work situation that was unfamiliar and potentially stressful.

Martin et al. (2005) showed that bioengineers who learned concepts related to stem cell ethics in the context of Legacy Cycle showed greater flexibility in their thinking on transfer problems than learners whose

original context for learning was lecture-based. We suggest that this flexibility was not only evidenced in the collaborative problem-solving endemic to the Legacy Cycle, but it was this flexibility that afforded the participants a relatively easy shift from knowledge-establishing to knowledge-sharing. Subsequent research by Martin (Martin et al., 2007) also suggests that the Legacy Cycle design promotes another defining characteristic of adaptive experts—their metacognitive thinking. They found that learners are more reflective about the importance and utility of problem-relevant resources if they have first tried to invent a solution prior to receiving these resources. This fits research suggestions that invention-first helps create a "time for telling" information that enhance learning with understanding and hence later flexibility of use (Schwartz & Bransford, 1998). This study also outlines how participants enhanced their metacognitive understanding through collaborative juxtaposing within and across groups (Dudertadt, 2008; Laschka & Pernpeintner, 2001; MacPherson, 2006; O'Mahony et al., In press; Rogers, 2003) and fits adroitly with literature on identity and self-esteem in and outside the classroom (Alexander, 2003).

The norms of training seemed to shift from "don't get caught not knowing something" to "these are great questions and they're pushing all of us to be more exact". From our perspective, these are the kinds of norms that help develop adaptive expertise. Importantly, these norms emerged from the collaborative dance that ensued between individuals who were distanced geographically from each other, culturally ethnically and professionally at the start of the day, but through interactions with each other and the subject matter, closed this distance at the end of the day. The structure of the workshop also affected participants' interactions with the instructors. In the lecture condition, most questions were asked by the instructors and answered by individual participants. There were few incentives and opportunities for participants to learn about one another's jobs and special areas of expertise, and to discuss issues from their different perspectives. In contrast, the challenge-based discussions prompted by the STAR.Legacy design generated numerous questions that appeared to create opportunities for further discussions that had the potential to help everyone continue to learn once they left the workshop. Thus, knowledge of 'whom in one's group knew what' seemed particularly useful to sustaining and accelerating new learning once employees left the workshop and returned to their jobs. The development of robust "social networks" is an important aspect of "preparation for future learning" views of transfer—views that are often not emphasized in more traditional work on transfer effects (Bransford & Schwartz, 1999; Schwartz, Bransford, & Sears, 2005). This finding seems similar to the emergent results of collaboration descriptions of musicians' interactions where relations with colleagues influence future performance opportunities. The aerospace engineers working in their informal learning environment place particular emphasis on this in their collaborative interactions. These latter collaborators would appear to agree with unfolding literature that describes the idea that 'who you know' is more valuable in today's competitive work environment than 'what you know'. Furthermore, a notion of how to navigate the intricate social and corporate corridors of knowing seems to be a skill of major consequence for individual survival and advancement (Axelrod, 2007; Barron, 2003; Bransford, 2007; Council-on-Competitiveness, 2004; Eraut, 2004).

One of the key points of adaptive expertise and adaptive organizations is that they help people continue their future learning. The use of social networks is a powerful way to enable such learning. For people in the Legacy group, there were indeed reports of interactive follow-ups to learn more information about composites, but they were selective in the sense that not everyone interacted with everyone else from their course. Still, even a single addition to one's social network can make a great difference in productivity and opportunities for new learning.

By leveraging this kind of technological platform and pedagogical framework, this research is positioned to extend the initial design beyond the constraints of traditional learning modalities and, further, to connect students and knowledge in formal or informal environments—in part through establishing strong social connections and, in part, through the use of ubiquitous and easy to access technologies. Still, the company colleagues with whom we work agree strongly that a key to making all this work is to establish a culture of collaboration within a mindset of "adaptive expertise" where successful performance is seen as a combination of knowing who knows what and being willing to learn new things. Without this kind of change in assumptions of what it means to be competent, it can be difficult for people to take the risks that put them in positions to learn new things. This work adds to the research on collaboration by looking at the complexity of how adults collaborate within professional work settings. Learning about collaboration by designing collaboration that is prescribed enhances that understanding where it is emergent or a part of everyday "naturalistic" practice. For the professionals and community members in our research, there are emergent roles and scripts, and we show that the participants speak to collaborative moments that unfold in their work as they seek to make meaning with innovative solutions and practices.

Designing appropriate computer-supported collaborative learning for environment sustainability in the Himalayas.

Indigenous people in the world have struggled to keep their unique approaches to life and traditional

knowledge systems intact with the advent of industrialization and more recently globalization. They have adapted and blended their values, beliefs and practices to subsist in mainstream society (Rogers 2003). Most of this knowledge has its roots deep in a place and thus is extremely localized. We believe this knowledge plays a very important role in conservation and sustainability practices within an area.

The problem of sustainability and conservation in the Himalayan region has been a growing concern over the last few decades. In her book, Ancient Futures: Learning from Ladakh, Noebrg-Hodge (Norberg-Hodge, 1991) describes a Himalayan culture where the traditional customs that contributed to sustainability are being replaced by more modern practices. Thus Ladakh represents a smaller version of the global environmental crisis. As learning scientists, we need to approach the problem in a manner that aims to transform the way our students interact with the community and environment. The cultural and traditional practices specifically focused on conservation in the area need to be taken into consideration, meaning there is a significant need to respect indigenous knowledge. We would also need to help learners' link ideas from ecology and formal science knowledge to their own lives, potentially requiring significant conceptual change. Finally, any educational initiative on sustainability would need to help learners negotiate different worldviews and value systems about development and livelihood. These initiatives call for an understanding of how members of these communities collaborate to establish and share indigenous and exogenous knowledge.

In June 2006 we chose participatory video (PV) to support the knowledge-building community approach to help the children of Kande village, India and Chaughari and Dalchowki village in Nepal to collaborate with their community members to learn about local/indigenous knowledge. Although during the intervention the children operated the video cameras, and decided on the questions to be asked, there was extensive involvement from local adults that initiated the process of expanding the influence of the project to the larger community. PV allows the participants to choose the questions that would be asked and also lets the participants visually share perceptions and perspectives of their place and culture. Thus putting less emphasis on the use of language and the participant's ability to express themselves verbally. PV has advantages in the development context; videocameras can capture views of nonliterate members of the community, and cameras also require little power. The cameras themselves can be mailed away for repair, and the postal system provides an effective, albeit slow, way of getting rich data from place to place. It is reminiscent of pre-Internet Computer Supported Collaborative Learning projects such as the Electronic Quills project which connected rural schools in Alaska via mailed floppy disks (Bruce & Rubin, 1993).

The PV approach allowed students to collaborate with the larger village community in understanding environmental issues. For example, in Kande village in India the students asked one of the members of the women's group about their biggest concern for the area. The conversation was as follows:

Student (male): what about the problems of the district (county)?
Woman: the biggest problem is that there is no paved road in our area
Student (male): do you think getting a road will point you in the direction of development? Do you think there are disadvantages to building a road?
Woman: Well there are some disadvantages as the land would be affected thus agriculture will suffer.

The students later while watching the video passionately discussed the issue of the road. The students disagreed with the adults on this issue. They felt that the road would bring in problems like excessive alcohol consumption in their village, as accessibility to the wine shop would be easier with the road (alcoholism is a pervasive problem in many towns in the area). PV allowed questions to be raised and differences to be surfaced between the child and the elder.

Additionally, PV allowed students to turn information about the environment into actionable knowledge that aligned with indigenous values. In the Chaughare village in Nepal, students conversed with a 72-year-old woman. The woman pointed out evidence of a major flood that had taken place fifty years earlier and discussed how the flood had harmed the village. Students asked questions about deforestation in the region, leading naturally to a conversation about the future.

Student (male): I have come from the school down there and I will be asking you a few questions. In the earlier days what did the forests look like? Were they very dense?
Woman: Earlier we used to get 4-5 bundles of grass in a day, now we barely manage to get even one! Where is the jungle? These days if you set out to get grass at 6 am, you can just find enough for 1 bundle by 4 pm.
Student (male): People have to work so hard for just one bundle of grass these days.
Woman: Yes.
Student (male): In the earlier days one person could rear many animals…
Woman: Yes in those days one person could rear two buffalos on his own, today it is difficult for even two people to rear one buffalo!

Student (male): What you mean is that the condition of the forest today is really bad as compared to the earlier days.

Later in this transcript, we see that the student is able to connect local information with school-based knowledge about the environment (for instance, that deforestation can lead to erosion), leading to a desire for action and opening the possibility of a community-based dialogue.

Thus we are pursuing sustainability education through the knowledge building community approach. The knowledge building community approach has known to support a deep conceptual reorganization in students to foster learning and progress for adult professionals (Scardamalia, 2003), and to assist in connecting remote communities (Bruce & Easley, 2000).

We believe that knowledge-building communities with computer supported collaborative learning can be an important link between community concerns and education. We also recognize that the technology used in this region has to have a structure in which there is economic, political, cultural, and spiritual space for the community (Riedijk, 1982). Sustainability and land-use literature suggests this approach may result not only in learning outcomes, but also in important ecological outcomes. In his review of social power struggles around derelict landscapes, Miles (2000) suggests that environmental destruction takes place within a context and a value-structure. We propose that community-based environmental stewardship, aided by appropriate information and communication Technologies (ICTs), will counteract unsustainable land and development processes, not so much because negative economic and social forces go away, but because local community/cultural attitudes will shift and hopefully converge across diverse local constituencies, imbuing the landscape and its resources with new, or renewed, value.

In conclusion, research on professional musicians, aerospace engineers, and village community members help us understand the multidimensionality of collaboration – the interrelated meta, interpersonal, and design elements. Yet, each study provides a particular perspective on the nuances of collaboration in the relational space, the environment, and in the participants' shifts to sharing and constructing knowledge in everyday settings. This research has important implications for how we understand collaboration as a resource for innovation and how we design for collaborative environments in learning contexts.

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