



Entangled Learning: An Overview



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Acknowledgements

What was to have been a brief article drafted over the course of a week to quickly capture the essence of a new idea has become this almost book-length white paper two months later. Of the many people who deserve our thanks, Sarah Dickenson and Eric McGuirk deserve a special measure of gratitude. These members of Clemson's class of 2015 began exploring Entangled Learning through the support of the Creative Inquiry Program and became valued and trusted members of the Entangled Learning Collaborative, developing their own practices of writing and presenting about this model. Their energy, enthusiasm, insights, probing questions, tolerance for uncertainty and frustration, and insatiable curiosity inspire us.

We also thank the faculty and staff members working alongside us in our respective programs as well as our families. At the University of Minnesota Duluth, the seeds of entanglement were sown over many years through generous support for learning-centered programs, such as credit-based peer tutoring, and projects that promote reflective learning, such as open source ePortfolio. At Clemson, the Biology professor and the Community of Practice Leaders in the Supplemental Instruction program are courageous innovators whose excellent questions and ideas have helped us clarify Entangled Learning.

Paul Treuer and Laurel Whisler
May 31, 2015

Preface

We are two educators who met at our professional meetings three years ago. During our first conversation, we discovered a shared passion for putting learning theory into practice. This question challenges us: *how can higher education produce independent, self-directed, deep learners?* Through subsequent conversations and work together on presentations in the ensuing years since our first meeting, we discovered common themes and practices that provide intriguing answers to this question. Like a puzzle, multiple pieces began to fit together to form an innovative learning model we call Entangled Learning.

Paul's journey toward Entangled Learning includes supporting and encouraging children to pursue their own passions for learning. He engaged in these through homeschooling his own children and through encouraging a sense of wonder by co-authoring *Teaching Kids to Love the Earth*. In 1987, he established the Credit-Based Peer Tutoring program at the University of Minnesota Duluth, through which peers support each others' learning and become more self-directed learners, themselves. Paul began developing ePortfolio in 1997 as a tool to support student learning and collaboration. Then during his sabbatical in 2011-2012, Paul developed the cycle of deep learning, which along with a rubric for assessment, is an integral component of his article written with his colleague Jill Jenson "Defining the ePortfolio: What it is and why it matters" (2014).

Laurel's journey includes fifteen years as a librarian engaged in teaching students how to ask good questions, use technology effectively, find and evaluate information, and use the information for specific purposes. During her last four years as a librarian, Laurel began working to merge libraries with teaching and learning. She began developing vision for a library commons and had roles in the development and administration of teaching and learning centers. Since 2011, Laurel has served as Coordinator of Supplemental Instruction (SI) in Clemson University's Westmoreland Academic Success Program, where organized the SI leaders into communities of practice to facilitate their own peer-to-peer learning through collaboration and development of skills for self-directed learning.

In November 2014, we led a pre-conference workshop at the College Reading and Learning Association (CRLA) meeting, in St. Paul, Minnesota, on learning skills needed in the 21st century. The workshop explored our ideas about facilitating learning experiences around the framework to produce deep learning which Paul designed while on sabbatical. We thought once the workshop was finished, we would attend numerous sessions at the conference, and life would return to normal. But that didn't turn out to be the case. Workshop participants and colleagues pulled us into conversations about our ideas, propelling us to explore their potential even further.

Laurel's plane trip home from the conference was filled with ideas and plans for implementing some of these new ideas. After returning home, she began writing an article about using communities of practice in a peer education program; however, following Paul's suggestion that we continue our conference dialogue in earnest, a new idea began to take shape. It combined

ideas in our CRLA presentation with her work on communities of practice. By mid-December we had discovered and named a new learning model: “Entangled Learning.”

In January 2015 we began talking with students and colleagues about Entangled Learning. Soon we began to recognize that some courses were, in our new vernacular, *entangled*. Laurel teaches a course that became partially entangled during the Spring 2015 semester. It was amazing to see the look in her students’ eyes when she explained that they had latitude to decide what they wanted to learn - it was as if having choice in their learning was a totally new concept! At the end of the course, students worked together on a concept map that reviewed material from the course. Laurel shared with Paul her video of the class session, and we were amazed to recognize how easily and fluidly the students used the language and concepts of Entangled Learning as they developed, critically examined, and improved their learning with little need for instruction.

Students in the Supplemental Instruction program at Clemson provide traditional academic support in the form of leading study groups for students in difficult courses. Laurel introduced some of them to Entangled Learning, encouraging these peer leaders to view their role as coaches facilitating the group to learn how to learn the material together. After this discussion, one leader realized she already is an Entangled Learner in her other classes. Others have expressed a growing dissatisfaction with the traditional methods of academic support. They see that providing facilitated study sessions continues students’ dependency on others to structure their learning. These peer leaders see the potential of training students so that they are empowered to direct their own learning.

Faculty members are excited about the possibilities as well. The freshman Biology class examples in this paper are based on one such collaboration. The professor sought a way to support his students to effectively learn how to learn so they could persist in the highest level of Biology and be successful in other courses as well. Another professor in a different department is interested in Entangled Learning as a way of structuring learning in his course of juniors and seniors so that his goal will be achieved that they learn to collaborate effectively as small groups to solve complex problems. This is the working environment these students will find as they gain employment after graduation. A professor in another department is considering an Entangled approach to alumni-student mentoring and to building a culture of professional development within the department. Yet another faculty member is implementing something resembling deep learning design into a pre-professional seminar course, which functionally is a community of practice.

The potential inherent in Entangled Learning is not strictly a Clemson phenomenon. Only minutes into a conversation with a colleague at another university, Laurel and she were talking about potential collaborations across universities. Paul discovered a colleague who wants to establish a center where faculty members can meet together in their communities of practice. Colleagues from another campus of his University visited his student support center recently and quickly became intrigued with the idea of Entangled Learning because it provides a cost-effective source of academic support.

Entangled Learning is poised to go viral.

Why do we think such a bold statement is credible? We are already seeing it happen. We are watching Entangled Learning grow quickly before our eyes! Students, faculty, and other colleagues recognize that it addresses crucial issues in education such as learning agility for life, educational costs, and professional development. Students, especially, realize it fits into their preference for social networking and taking ownership of their own learning.

The ideas in this paper are the preliminary thoughts we have developed over the last six months of exploring this model. We share them to invite conversations as we continue to refine and polish the ideas. As initial implementations are done at Clemson and we meet with colleagues and friends to deepen our understanding of Entangled Learning, we intend to revise this paper for publication.

We invite you to join the Entangled Learning movement, refocusing the educational conversation at all levels, formally and informally, on learning in self-directed communities of practice. Great challenges lie ahead in the not-so-distant future. To effectively meet these complex global challenges, our society needs learners who know how to find their own answers by working together in rigorous learning.

Paul Treuer and Laurel Whisler
May 31, 2015

Introduction

Upon finishing a lecture on the carbon cycle presented to a class of 150 undergraduate students, a General Biology professor acknowledges a group who call themselves *The Green Team*. She shows the class a question this team recently submitted to her through the group's learning portfolio: "What is the easiest way of understanding the energy dynamics of the carbon cycle?" She admits to the students that the thermodynamics of the carbon cycle was a challenge for her in graduate school; she then shares the way in which she was able to learn and remember carbon cycle energy flow through a series of short anecdotal stories.

This Biology professor ends each class session by recognizing and responding to several questions or comments related to the course content submitted by one of the 25 study groups. Through this method of responding to posted questions, the professor becomes aware of where students struggle; at the time her explanations are given, she gives tacit approval to the efforts of the study groups. She also becomes aware of how energetically the students are engaged; their curiosity and collaborative energy inspire her.

The way her students learn Biology has shifted compared to how this professor studied when she was an undergraduate. Unlike the focus on individual achievement in her day, she acknowledges a growing acceptance on the part of her students towards collaborative, peer-to-peer learning. She embraces this shift because it addresses a major concern she shares with many of her fellow academics: increasing engagement and quality of learning while maintaining or reducing cost. She reads articles in *Chronicle of Higher Education*, listserv posts by other science educators, and books about education that call for reform and innovation to re-engineer the educational landscape so that it provides agile, reliable, and relevant education. The Biology instructor knows she lives in a time that will continue to produce rapid change; her students must become equipped with the capacity for directing their own learning and developing collaborative networks so they can address challenges that lie ahead. She is convinced that Entangled Learning is a promising answer.

The professor greets her students in the General Biology class on the first class day by announcing their class is *entangled*. She explains:

"Entangled means that in this course you will be expected to direct your own learning, asking and answering your own questions, as you collaborate with each other to learn the material. You will develop connections with other students as a means to learning the material. You will actually design your own learning activities. "I am here to frame your learning of General Biology and support you with resources in response to inquiries from you and your team members as you determine how you want to learn the material in this course. I will provide resource materials, collaboration suggestions, and grading incentives. I will provide training to help you get started with learning as a community and with knowing how to find answers to your questions. If you get stuck, coaches are available to guide your thinking about how you can successfully work with your peers to overcome the

challenges. In these ways, your work in small groups will enable you to discover and apply ways to **learn how to learn** General Biology. Your learning not only will be more active and engaging, but it will make more efficient use of your time. Focusing on learning effectively how to learn will benefit you by establishing combined learning and collaboration skills that you will use throughout your university education and your career.”

The professor goes on to say that her hope is that students enrolled in her class develop lasting friendships in their entangled General Biology study groups that grow to form learning networks, extending throughout their undergraduate studies and beyond. The greatest gift she can give her students, she explains, is the means to direct their own learning. This includes skills and personal connections to collaborate effectively. Because the field of Biology is changing so quickly, she states, it is necessary for graduates to further their own learning throughout their careers.

“If I had known about this [Entangled Learning] earlier, in my freshman year, my college career would have been better. It would have been less stressful, and I would have been more motivated. If someone had said, “What do you want to learn?” I would have been more motivated to put more effort into learning the material.”

- Evelyn Frederick, 2015

Students enrolled in her class discover what we hope you will realize from reading this paper; it is easy to entangle learning. Whether a student, a teacher, or a lifelong learner *of any age*, this paper provides you with an overview of entangled learning that, combined with implementation guidelines and practical tips, can be used to enhance learning around any subject.

Whereas the Biology professor described above is fictitious, Evelyn Frederick is not. She became aware of Entangled Learning Spring semester 2015, when it was introduced for the first time at Clemson University. She is now a Senior who participates in a community of practice for peer educators. Her quote, above, reflects what other Clemson students have expressed, that Entangled Learning is a promising model for learners of all ages. The model is summarized on the next page and explained in detail in this paper.

Entangled Learning: A Summary

Entangled Learning is self-designed learning characterized by individuals who engage as equals in practice-based collaborations to grow and deepen their knowledge and skills.

Entangled Learning Design is the driver.

- Individuals decide what they want to learn and how they will learn it within the context and support of their community of practice.
- Design creates movement and interaction with the other spheres, any one of which activates learning.

Practice-based learning is the typical entry.

- Practice is a culture that integrates a community's knowledge base of actions, methods, values, and perspectives. It is developed over time through social interaction and mutual engagement in a particular pursuit.
- Practices emanate from actions that are inspired by one's passions, aligned with one's values, and fed by one's understanding.
- Practice-based learning is personal engagement with the community's pursuit of new knowledge and skills around shared application of that knowledge.

Social learning is the context.

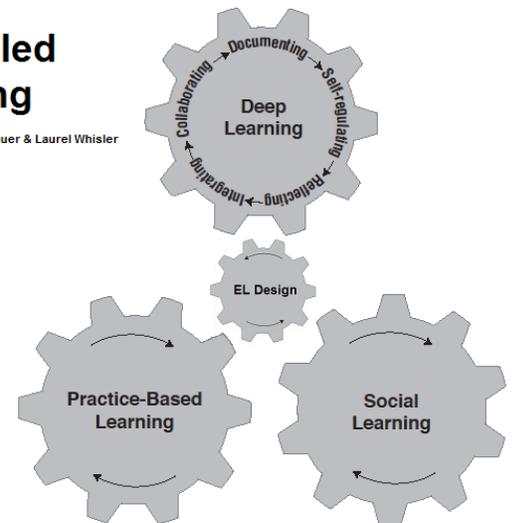
- Learning is a cognitive process that occurs through interaction with other people.
- Communities of practice are the means for social learning.
- Community members engage in inquiry into their practice as a means for learning.

The **cycle of deep learning** provides rigor.

- Documenting: Individuals assemble and share with community members evidence of knowledge and skills germane to their learning goals and practice.
- Self-Regulating: Individuals are aware of, and exercise control over, their behaviors associated with desired learning outcomes. Behaviors are practiced.
- Reflecting: Individuals contextualize and validate the meaning and significance of their learning consistent with their personal and community goals and values.
- Integrating: Individuals synthesize their knowledge and skills through applications to real-life and theoretical situations within their practice and in other practices.
- Collaborating: Individuals participate in community of practice as a means to ask questions and discover new knowledge relative to their common practice. In this way the cycle continues as new learning designs are used to discover answers to new questions.

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Why Entangled Learning is Important

Learning is becoming a lost art in the unique context of the 21st century. The importance of measuring learning and increasing accountability has had the detrimental effect of increased pressure to shape education so that children can pass standardized tests. Common core curriculum purports to teach concepts but is itself under fire. High-achieving students appear to get by with minimal effort and often enter college without the skills for self-directed learning. Underprivileged students are being left further and further behind as the chasm between the haves and the have-nots widens inexorably.

Educators are challenged to address downward trends in learning engagement (number of hours students study outside of class) and in learning comprehension (performance on standardized tests that compare students around the globe). Derek Bok, president emeritus of Harvard, writes,

Despite the favorable opinions of undergraduates and alumni, a closer look at the record...shows that colleges and universities, for all the benefits they bring, accomplish far less for their students than they should. Many seniors graduate without being able to write well enough to satisfy their employers. Many cannot reason clearly or perform competently in analyzing complex, non-technical problems, even though faculties rank critical thinking as the primary goal of a college education...Most have never taken a course in quantitative reasoning or acquired the knowledge needed to be a reasonably informed citizen in a democracy. And those are only some of the problems (2006, p.8).

Higher education is in serious fiscal trouble. Its current business model is outdated. Costs to students are prohibitively expensive, as reflected by a level of debt that is unconscionable. And, perhaps more compelling than all else, higher education is unable to keep up with the educational needs of its students at a time in which knowledge is rapidly changing. The report card for higher education is abysmal. Bok suggests that change is unlikely to occur with a business as usual stance. "So long as professors continue to teach conscientiously in their accustomed way and colleges keep up with the competition in facilities, tuition, and financial aid, no one need fear any immediate consequences for failing to do their best to lift the quality of teaching and learning to the highest attainable level (2006, p. 313).

The need for education reform is paramount; it is compounded by the fact that funding for education is unable to keep up with demands for better quality. Calls for innovation are widespread and urgent. Reform conversations at all levels of education raise the following critically important questions: How do we "re-engineer" the educational landscape so that it provides agile, reliable, and relevant education in times of rapid change? What can students and teachers do differently to engage themselves successfully and productively in high quality education in times of acute need for more, not less, learning. How can this be done with less, not more, cost?

Bok's answer is for reform led from the top administrative levels. The authors of *The Innovative University* (Christensen & Eyring, 2011) cite the need for "evolutionary adaptation" of the DNA of universities to cope with rapid changes taking place nationally and globally. "The things we've seen in our exploration of higher education's past and current competitive realities indicate the need for most traditional universities to genetically re-engineer themselves (p. 379)." These authors boldly lay claim to the direction for this reengineering. "The student-centered university is the exception today. In the future, no other kind is likely to succeed (pp. 351-352)." Similar conversations concern K-12 education. Controversies about common core and standardized testing arise through competing ideas about reform, measuring learning, and innovating to prepare students more effectively for their future in society

Numerous educators have described what it means to be student-centered. Barr and Tagg in their seminal article, *From Teaching to Learning* (1995), called it the Learning Paradigm, in which "Instead of fixing the means - such as lectures and courses -- the Learning Paradigm fixes the ends, the learning results, allowing the means to vary in its constant search for the most effective and efficient paths to student learning."

In *The New Culture of Learning* (2011), Thomas and Brown imagine a learner-centered environment in which learners shape their own experience in response to their information and problem-solving needs.

When we think about what a new educational environment might look like in the twenty-first century, we can imagine a number of things. Imagine an environment that is constantly changing. Imagine an environment where the participants are building, creating, and participating in a massive network of dozens of databases, hundreds of wikis and websites, and thousands of message forums, literally creating a large-scale knowledge economy. Imagine an environment where participants are constantly measuring and evaluating their own performances, even if that requires them to build new tools to do it. Imagine an environment where user interface dashboards are individually and personally constructed by users to help them make sense of the world and their own performance in it. Imagine an environment where evaluation is based on after-action reviews not to determine rewards but to continually enhance performance. Imagine an environment where learning happens on a continuous basis because the participants are internally motivated to find, share, and filter new information on a near-constant basis (pp. 106-107).

Thomas and Brown focus on the collective as the core unit of education. Learning and working together in a variety of equal roles, members of the collective become resources to each other.

In the new culture of learning, people learn through their interaction and participation with one another in fluid relationships that are the result of shared interests and opportunity. In this environment, the participants all stand on equal ground – no one is assigned to the traditional role of teacher or student. Collectives are defined by active engagement with the process of learning. Collectives derive their strength from participation. They are well designed to facilitate peer-to-peer learning. Collectives

contain an almost infinite set of resources. Almost every difficult issue we face today is a collective, rather than a personal, problem (pp. 50-51).

The authors quoted above are educational leaders who characterize the 21st century as a time with a unique set of powerful challenges and opportunities in which a new model of learning is necessary.

What is needed is a learning model that is capable of providing a better education for all citizens at reduced funding levels. It must be a model that is agile and responsive enough that it can produce learning around rapidly changing disciplines of knowledge and skills. Most importantly, it must produce learners who contribute to solving complex problems. Entangled Learning is a promising answer that addresses these concerns; it meets the criteria of scalability, cost, agility, and learning application.

Through Entangled Learning, individuals are engaged in structured, self-directed, peer-to-peer groups in which they help one another develop deep learning around a specific interest in which they are simultaneously engaged in practical applications of that learning. Entangled Learning provides a framework in which rigorous learning takes place as learners design their own learning activities to pursue their own questions, interests, and developing expertise. Ultimately, Entangled Learning produces self-directed learners.

In terms of cost, Entangled Learning becomes less expensive as more learners become entangled. The greater the number of trained, practicing learners within a community, the greater the potential for developing and discovering new knowledge and skills. Secondly, Entangled Learning is, by definition, agile. It is responsive to contemporary learning needs because participants direct learning around their own questions, needs, and wants. This agility is addressed by Entangled Learning in the most important way possible; it produces lifelong learners who have skills and networks to continue learning beyond their formal education. Finally, Entangled Learning unleashes a massive wave of potential energy. Because Entangled Learning combines practice with learning, there is an enormous amount of activity that can be applied to solving challenges with which we are faced.

Imagine the human effort that can be applied by high school students alone who are interested in understanding the causes of climate change and how social action can address those causes. Through Entangled Learning all learners are expected to identify their own practices in the context of their own lives. Climate change is far from being the only important issue, but through Entangled Learning, action is inherent in a learning model that is relevant to each person's life, and germane to the needs of their families and communities.

Any educational model that rewrites the DNA of our educational systems must take into consideration the economic divide in which the well-to-do get the best education. This divide along economic lines is serious because it creates greater burden by propagating a growing class of citizens who take from, rather than contribute to, the well being of their communities. Entangled Learning addresses this problem directly by providing the means by which anyone,

regardless of wealth, can further their learning. Once participants become proficient in the skills associated with Entangled Learning, they are capable of producing their own learning.

Entangled Learning is critically important at this time because it produces learners who have the vision and means to direct and document their own deep learning within and outside formal educational settings. It provides the potential for a business model that is sustainable, and a learning model that is effectual for individuals irrespective of income, age, class, or status. Finally, it offers the means for individuals and their communities to address challenges that will improve their well-being and enhance the common good.

Defining Entangled Learning

Entangled Learning sounds, by its name, like tangled string. It may look tangled to the casual eye, but on closer scrutiny it is more like a fractal array. These fractal patterns evoke thoughts of a new model for learning that makes more sense, is inherently more useful, and is far less costly, than our current learning model. The current learning model was designed to keep people in their dutiful and productive places during a period of rapid economic growth associated with the industrial revolution. This learning model is one that requires order, obedience, adherence to a mechanistic worldview, and high cost.

A new learning model for the 21st century needs to foster learning at a time when civilization is spinning rapidly as a result of multiple factors, not the least of which is ubiquitous communications, economic instability, and environmental stress. A new learning model is needed to serve the purpose of educating as many people as possible during a period of rapid changes in what needs to be learned, decreasing resources, and increasing distractions.

Entangled Learning springs from the desire to network with other individuals as an essential part of learning. Learning is social. *The New Culture of Learning* (Thomas & Brown, 2011) vividly illustrates students' networking culture as they become drawn into discovery that deepens their learning beyond the lecture. In their book, the authors characterize the 21st century as a time when young people, especially, are eager to connect with one another to play, to be creative, and to learn. Social networks are their preferred ways of exchanging information and knowledge. The authors demonstrate that peer-to-peer learning is emerging as a preferred way of learning in this setting. Nonetheless, a conceptual framework is needed to guide learning so that it is deep and meaningful. Deep learning (Entwhistle, 1997) moves beyond the minimum requirements as learners engage in critical reflection and integration. Deep learning engages individuals in rigorous practices of knowledge creation.

The name of our model relates to networks of learners and to this spirit of playfulness and creativity. While working together on a challenging project, we drew upon the imagery of Schrödinger's cat, a thought experiment in quantum physics, to express frustration at the simultaneous possibilities for success and failure of an initiative. The experiment refers to qualities that quantum particles exhibit as they interact, particularly that they influence the characteristics of other particles. ("Schrödinger's cat," n.d.; "Quantum entanglement," n.d.) The connection with our model is that learners influence each other as they learn together.

The [Supplemental Instruction (SI)] group that I had during the Fall of 2013 was probably the best, hardest working group I have had the pleasure of working with during my career as an SI leader. The sessions were packed most of the time and the students loved working together so well that I barely worked all semester. Had entangled learning been known about during that semester, how I approached that group would have been drastically different. The group I had this semester came in small numbers and had one, maybe two, "regulars". The fall 2013 had 5 or 6 regulars that came to every session, and this created an optimum environment for

entangled learning. In retrospect, the group was already exhibiting many characteristics of an EL [Entangled Learning] group--the collaboration and self-regulation, mostly-- but I was limited by the SI model. By incorporating reflection and documentation, I could have set the ball rolling that would have made them better learners than SI could have. - Eric McGuirk (2015)

Entangled Learning is a model of self-designed learning in which people work collaboratively to learn in an area of interest in ways that they find work best. Entangled learners are empowered to ask their own questions and design their own learning in communities engaged in discovery around a question, a problem, or a pursuit. In this model, students are not only generating knowledge around an area of learning, they are also exploring relationships, discovering how to support each others' learning, and linking their learning to shared values as they develop a culture of practice within their community of learners.

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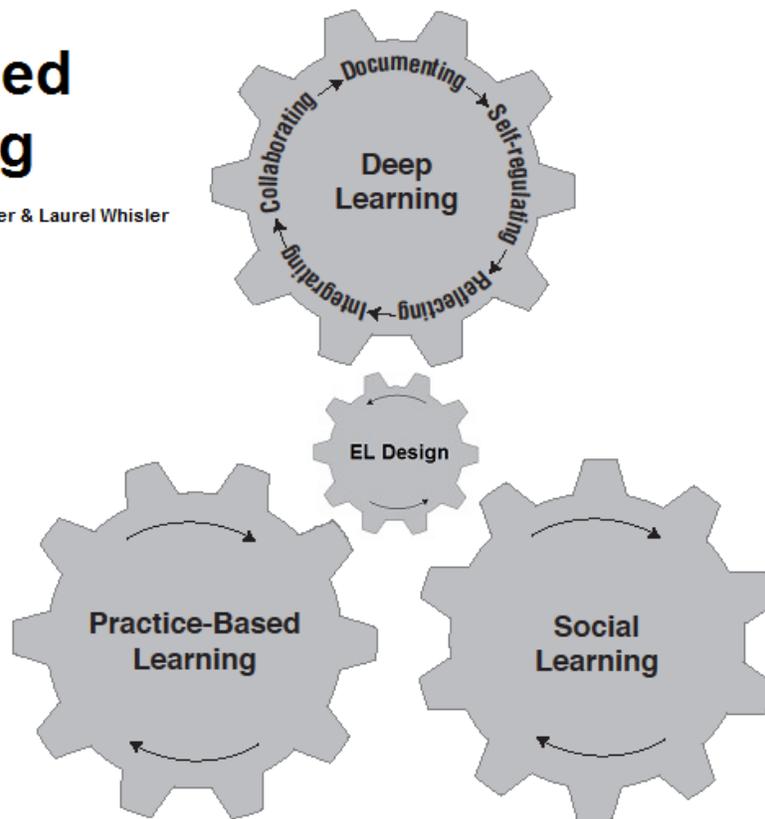


Figure 1. Entangled Learning Interlocking Spheres Diagram

The Entangled Learning model is illustrated for simplicity as engagement of three spheres -- practice based-learning, social learning, and deep learning -- driven by entangled design (figure 1); however, the movement and interplay among these components is far from mechanistic. Depending on the context, any one of these spheres influences the design, which in turn affects the process of learning.

Developing expertise in one sphere activates learning in another. Questions that grow from practice activate the design sphere. Participation in communities of others who are themselves engaged in inquiry spins the spheres more closely together. Entangled Learning is an interconnected, unorderly, unpredictable system of growing expertise through developmental adventures in learning as all three spheres rotate in their orbits around each other. These spheres sometimes draw nearer one or both of the others, and sometimes draw further away, yet all are held together by the integrity of the learning environment. In this way, questioning prompts knowledge creation, in both tacit and explicit realms, which in turn prompts more questions. Learning builds upon itself, and learners become more adept at asking good questions, engaging in activities and developing skills of authentic learning in a practice. Just as one section of a fractal image (figure 2) may appear disorderly excerpted from the full context of its design, phases of Entangled Learning can seem to be disorderly when considered apart from the individual's full "landscape of learning" (Wenger-Trayner & Wenger-Trayner, 2015b).

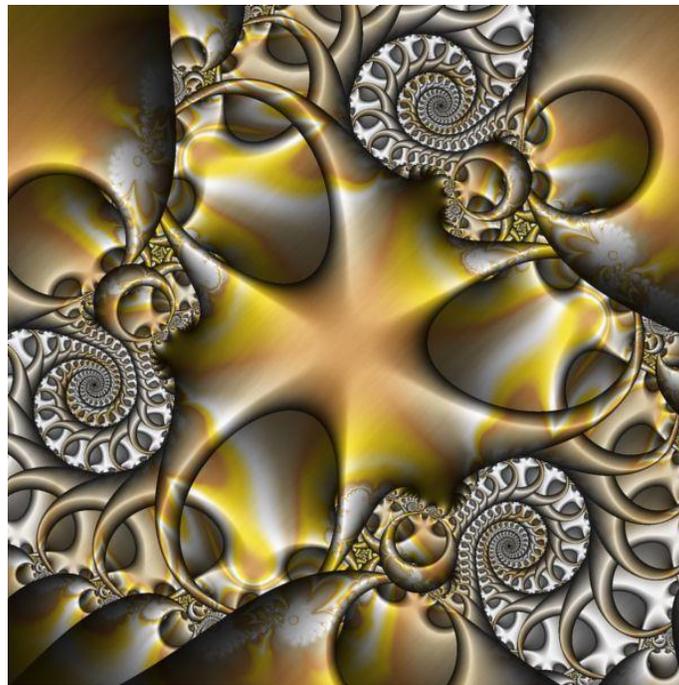


Figure 2.

"Brazed Metal III, Convergent Orbit Trap 5" image used by permission and created by the Fractal Science Kit fractal generator at <http://www.fractalsciencekit.com>

Social learning and practice-based learning, are drawn from what Etienne Wenger (1998) calls communities of practice. These groups form around an area of mutual passion for inquiry in a particular area of activity activity. Community members develop relationships as they form into a network of learners who mentor and support each other as they discuss their learning. The shared approach they take, which forms a culture of values, activities, methods, and body of knowledge, is their practice (Wenger-Trayner & Wenger-Trayner, 2015a).

Thus, the first questions to be asked are: what is your **practice** (area of activity)? What are you doing that you want to learn more about? Is it studying Biology, feeding the hungry in your community, developing a community garden to promote civic engagement, improving flow in fluid dynamics? What are your practices, and what questions are you asking about them?

In this respect, Entangled Learning is a radical departure from the traditional educational model in which students are taught multiple subjects in preparation to undertake professional and social practices at a later time. Practice is not recognized, nor is it encouraged, except in superficial ways, in the traditional education. In contrast, Entangled Learning builds on practice.

Students of all ages are capable of being engaged in meaningful practice. The fact that our current public education system largely excludes engaging children in practice of any kind, beyond homework and the arts, is a disservice not only to those individuals, but also to the communities in which they live. Nonetheless, Entangled Learning is built on the premise that all learners are engaged in meaningful practices as a prerequisite for learning. By meaningful, we emphasize the importance of selecting practices that interest the individual and, at the same time, contribute to the well-being of their communities. The value we see in Entangled Learning is that human potential will be unlocked once people imagine that they can engage in practices that contribute to stronger, more just, and healthier communities.

The nature of collaboration is the second distinguishing characteristic of Entangled Learning. In contrast to traditional education where, at best, students are allowed to collaborate on certain assignments or projects, or in restricted settings such as tutoring centers, Entangled Learning is built on the **social** structure of communities of practice. These are communities in which individuals work as peers to discover new knowledge and skills together.

Individuals establish what they want to learn in the context of their common practice, collaborate to discover and develop knowledge and skills, keep track of their learning, monitor their progress - both the behaviors that contribute to their learning and what they are learning about learning - and develop skills for facilitating collaboration. By learning in community, group members become accountable to each other and build trust through doing their part (Laloux, 2014, pp. 80-83). As learners meet together they bring to their gathering a body of knowledge that they share, discuss, and elaborate on to create new knowledge (Nonaka & Konno, 1998). They also contribute information to a collective and manage it to build the knowledge base of the community (Wenger, 2004).

Inherent in the Entangled Learning model, and integral to the success of this model, is the development of collaborative learning skills. Training on these skills have begun for many individuals at a very early age through social networking. Increasingly rigorous training and the sharing of best practices will further contribute to the development of these skills.

The nature of peer-to-peer collaboration will change from one practice to another. Therefore, these learning skills will not be defined by set curriculum or cookie-cutter formulas. The

dynamic nature of Entangled Learning is, in large part, a result of each group's ingenuity to identify how they will work together to further learning around areas in which they are most interested in learning.

Social learning is the ability to learn from others by imitating and watching. It also includes cooperation and working together... collaborative group learning is the participants working together to explain concepts and discover how to solve problems. Lecturing may have the "watching" aspect, but it does not provide the opportunity for imitating and cooperation and working together. [Study] sessions provide these aspects of social learning... I have seen first-hand the benefits of these aspects of social learning... Being able to work together makes a huge difference in actually understanding the material, as one person understands one part of a problem while someone else understands another concept. By the end, everyone understands both parts. - Polly Payne (2015)

While learning can and does occur in communities of practice without structured learning skills, the deep learning cycle describes the process by which rigor is built into Entangled Learning. Because each group designs its own learning collaborative, as noted above, there is tremendous variability between each community of practice. However, to ensure the learning is on track to be at, or above the quality of traditional education, a framework is in place to guide each communities' learning design.

The contrast between the traditional learning model and Entangled learning in this regard is stark. Whereas in the traditional learning model the teacher, academic departments, and institutions assume responsibility for designing learning activities and documenting knowledge acquisition, in Entangled Learning the communities of practice members assume these responsibilities. This can be the most transformative component of Entangled Learning! The groups not only **design** their own learning activities, but they also **document** their learning, thereby owning the growth of their learning through the development and ownership of learning artifacts. Entangled Learning can exist within courses, in which case design occurs on two levels: the instructor designs the framework that identifies the purpose, expectations, activities, and evaluation criteria of the course, and the entangled communities design their approach to meeting the expectations within the context of the purpose and evaluation criteria.

If we are in control of how we learn, we are more likely to enjoy our learning and be more motivated. - Katherine Whisler (2015)

That individuals and groups manage their own evidence of learning, a central component of the deep learning cycle, adds value to their learning process. Developing habits and discipline for documenting learning with authentic evidence develops in individuals and groups explicit and tacit knowledge that can be leveraged to generate new knowledge and skills. Thus, well documented learning is capable of propelling individuals and groups to engage in deeper, more advanced levels of learning.

Tracking one's **self-regulating** behaviors and awareness of the learning process while engaged in the practice provides grist for self-assessment of whether or not the individual is developing habits that propel learning. Documenting **self-reflection** in the context of individual values and goals captures learning at that point in time. Having the documentation permits critical reflection at a later time. Comparing what the person has learned with what is known or with what knowledge and solutions are necessary to address a challenging problem enables the person to validate their learning. It becomes a form of self-credentialing and critical assessment. Documenting an individual's ability to transfer conceptual learning and practical skill development from one context or practice to another demonstrates proficiency at **integrating** learning. Finally, collecting records around **collaboration** illustrates an individual's ability to participate collaboratively in a community of learners to ask questions, discover new knowledge, and continue the process with new questions as learning goals are fulfilled. (Jenson & Treuer, 2014).

When I first heard the whole "documentation concept" and my instructor stressed how critical it is to learning, I wasn't sure that I completely agreed. I'd gotten along just fine throughout my academic career without going back and taking an analytical lens to my work. As a requirement for my course, I decided to give it a try, and a whole new world was opened up to me...I started doing session evaluations after each SI session, which typically consisted of what went well, what could have gone better, and how I am going to improve in the future. Not only did this provide mental closure for me after sessions, but also made me accountable for my future performance as a leader. - Abby Stephan (2015)

To summarize, Entangled Learning exhibits these characteristics somewhere along a gradient: it is practice-based, social, and self-designed for deep learning. It can be integrated into any traditional educational setting, but the intention is that individuals can use this model in any learning environment. Entangled Learning is peer-to-peer learning within a community of practitioners. Members of the community participate as equals. Roles distribute responsibility and ownership in the learning process and rotate so everyone has opportunity to participate in those roles. The community structures their own learning, identifying together their needs and goals. Members collaborate using a set of skills that provide structure and activate their learning. Anyone can participate in Entangled Learning within a community of practice - specialized training is not required. Prior expertise in the subject is not required, though the community of practice may include people who contribute particular expertise.

But there are some things that Entangled Learning specifically is *not*.

Although we stated earlier that the practice is of interest, Entangled Learning it is not a club or a group of hobbyists. While developing social relationships is integral to Entangled Learning, the interactions drive learning in practices that contribute to the well-being of society. While hobbyists, such as a group of quilters, learn from each other while engaged in their practice, the impetus for their meeting is doing their practice while socializing. Likewise, a club meets to pursue the organization's mission and goals. The members are heavily engaged in their

practice, but the learning that accompanies their meetings is not the main emphasis of their gathering.

It is not academic assistance. The model is intended to be used by all learners rather than for identified groups with specific characteristics. Unlike many traditional forms of academic support, Entangled Learning does not employ peer leaders or external peer facilitators who plan student learning. Even when all works well and the participating students negotiate the session agenda, the orientation of the traditional support program is that the students don't direct their own learning -- someone decides what they think is most helpful and invites (hopefully) the students to negotiate. This mediator of learning holds unequal power and is not a component of the process for Entangled Learning. Individuals have agency in their own learning and decide for themselves the mode of learning.

It is not a directed study session or an instructor-designed extension of the classroom. Instructors may link the classroom with entangled study groups, possibly by posing a concept for the groups to determine how to model, prove, apply, or test for validity. Showing in the classroom the value the instructor places on the study groups provides motivation and incentive to participate, but the majority of the time spent in entangled study groups should be planned and designed by the learners themselves. Having tutors or other external facilitators active as guides for the study session negates the entangled nature of the model, for the students are not self-directed, and their learning is not self-designed. The matrix in Appendix B differentiates Entangled Learning from characteristics of academic support and traditional courses or programs.

But neither is it merely an *ad hoc* study session of students in a course. Entangled students make a commitment to each other and to participating in their practice of learning how to learn. They build study materials together and maintain them in shared file space. They hold each other accountable to doing their part. Members think about their process of learning, reflect on the effectiveness, and propose new methods to adapt to changing learning needs. They also collaborate, which is more than merely asking each other questions as in a drill or recitation.

Entangled Learning is not simply a redundant concept of learning in communities of practice. Entangled Learning involves more rigorous, intentional, and structured learning than communities of practice might normally undertake. Whisler's article "Communities of practice for peer educators (2015)" presents a case study that describes learning, mentoring, and knowledge creation within communities of practice as applied in peer-to-peer learning. While the participants became engaged in significant learning experiences and developed meaning and identity within their practice, their learning lacked overall design and intentional, systematic integration of the deep learning cycle.

Entangled Learning works from the stance that the group are learners seeking knowledge together. Power is equally shared. Individuals in the Entangled Learning group are developing expertise together. Everyone is on an equal level of knowing. Even when someone is more skilled or knowledgeable, they work with others to discover their answers. Learning is

enhanced through a learning dialectic between the needs and assets of its diverse members. In the social learning in an Entangled Learning community, members share freely and support each other freely, thus building the strength of their collaboration. The values statements they agree upon at the beginning of their entanglement guide their interactions, and any member can point back to those so that the group members facilitate their own interactions.

Designing Entangled Learning

Perhaps the most exciting component of Entangled Learning for participants is design. Designing learning is the act of identifying what and how the community of practice will learn together; it is the act of building knowledge as a group and developing a section of the “landscape of practice (Wenger-Trayner & Wenger-Trayner, 2015b).” Design is not, however, static. While design begins with intention, it must be open to change that results from growing awareness of one’s learning and responds to the learning of the community. In this way design is cyclic, iterative, intentional, and responsive. Understanding how one’s design should change to deepen or shift the focus of learning is part of the learning process itself. This is tacit knowledge that is created through documenting, reflecting, and evaluating, in the context of the ever-shifting space created by the evolving knowledge base of the community and their individual learning. In this way, practice, social learning, and deep learning drive periodic changes in learning design. For now, we will focus on establishing the initial design.

In stark contrast to traditional education in which teachers develop curriculum for imparting their knowledge to students, in Entangled Learning members of the group determine learning goals and how they are going to go about developing desired knowledge. In contrast to traditional education where the fixed layout of the classroom is the usual setting, through Entangled Learning, members of the group determine optimal learning spaces as part of their learning design. The setting can be anything from someone’s living room to a coffee shop, the campus library learning commons, or through Skype sessions.

There is no required design in Entangled Learning! Each community of practice discovers how they are going to develop knowledge and expertise for themselves. The emphasis is on exploring and discovering new ways of learning. The most exhilarating aspect of Entangled Learning can be discovering a new and unexpected way of learning. Design is guided by decisions about space and activities that the group determines will produce their desired learning. Therefore, each group asks itself how it wants to design and implement its own learning. Because each group has a unique set of members, design decisions take into consideration assets, needs, and wants of its members.

The rule of thumb for Entangled Learning is to *design outside the box*. Anything that produces desired learning is fair game. In this chapter three general resources are described that may inform learning design. A concept that shows enormous promise for Entangled Learning, called *ba* (Nonaka & Konno, 1998), creates a solid platform for knowledge creation for groups of individuals within educational and professional settings. Another process, called backward design (Wiggins & McTighe, 2005), offers a conceptual model for identifying learning objectives, projecting what evidence would indicate the objectives have been met, and then describing activities and processes that lead to developing the evidence. Finally, six frames (Bruce, 2008) or lenses are described through which individuals can ask questions of the world to guide one’s learning. These inform learning design within a practice, within a program, and within one’s own landscape.

Ba as a Platform for Entangled Learning

The concept of “*ba*” is of Japanese origin; it translates into the English word “*place*.” Proposed by the Japanese philosopher Kitaro Nishida in the 20th century, *Ba* is considered to be a shared space (literally and figuratively) for emerging relationships in which tacit knowledge inherent in each person becomes a platform for knowledge creation to take place. Nonaka and Konno (1998) explain that when knowledge is made explicit by communicating it through any kind of media, it is made distinct from the existential context and becomes information. Thus within this virtual, physical, and mental phenomenological space, tacit knowledge becomes explicit information which is used to create new knowledge (pp. 40-41).

“Knowledge...is intangible, boundaryless, and dynamic, and if it is not used at a specific time in a specific place, it is of no value. Therefore, the use of knowledge requires the concentration of the knowledge resources at a certain space and time....*Ba* is the platform for the “resource concentration” of the organization’s knowledge assets and the intellectualizing capabilities within the knowledge creation processes. *Ba* collects the applied knowledge of the area and integrates it. Thus, *ba* can be thought of as being built from a foundation of knowledge (p. 41).”

The concept of *ba* fits well as a driver for Entangled Learning because they both share a common premise. Everyone contributes to, and participates in, the process of knowledge creation. The role of the individual in the group is essential as each member transcends their own limited perspective through their contributions to the collective knowledge. Thus, *ba* is soundly based in social learning theory. Secondly, *ba* is based in practice. It is through the application of knowledge and skills that tacit knowledge is shared between individuals. Practice is, in this way, fundamental to *ba*, as it is to Entangled Learning. Finally, the process of turning tacit knowledge into explicit knowledge is accomplished through sharing. The Entangled Learning process of documenting and sharing authentic evidence of learning is integral to *ba* as a means of managing knowledge. In the end, *ba* is a means of building and managing knowledge assets. This is the ultimate purpose, too, of Entangled Learning.

Whereas there are multiple levels of *ba*, depending on the complexity of the organization within which it resides, the scope of Entangled Learning is the individual and his/her learning collaborative. The task of managing knowledge within organizations, such as universities is outside of the scope of this article, and in this sense serves to distinguish Entangled Learning from *ba*. In particular, the SECI (socialization, externalization, combination, and internalization) model’s emphasis on knowledge creation in an organization from tacit to explicit and back to tacit (Nonaka & Konno, 1998; Nonaka, Toyama, & Konno, 2001) shifts focus away from knowledge creation for the learner’s edification. The learning-centered nature of Entangled Learning is of paramount importance.

Entangling Learning Through Backward Design

Many guides exist for suggesting methodologies of designing learning. One that relates well to Entangled Learning is presented in Wiggins and McTighe's *Understanding by Design* (2005); it is called "backward design (p.17)". Backward design begins with identifying goals or asking questions. It is here, where learners pose their question, that design ties into practice. The learner describes the relevance of the learning goal or question to practice. The next step in backward design is to determine what evidence would validate that the desired learning has been achieved. Being attentive to evidence drives documenting and critically reflecting. Finally, with the question and acceptable evidence identified, backward design says it is time to plan the learning activities. The group then participates, either as groups or as individuals in the learning activities, documenting that learning through the cycle of deep learning.

Three things resonate with us about this model as we consider its validity for self-directed learning. The first is that design begins with inquiry - asking a question. It may be a topical question: What are the best techniques for growing potatoes in this climate? Or it may be an overarching or essential question: What foods can we grow and what methods can we use to produce the highest quantity of healthy food while taking greatest care of the ecosystem? Whatever the question, it must be relevant to the practice. The second aspect we value is that design proceeds by asking what evidence demonstrates, documents, or validates the learning. Having an idea of valid evidence suggests approaches to take to pursue the questions. Finally, the third component that speaks to us is that activities develop authentically from the question and the evidence. Activities are responsive to the learning need and can be created or discovered as individuals or community members engage.

Six Frames for Entangling Learning

In her intriguing work that discusses information literacy explored through studies of the ways people use and interact with information and technology to learn, Christine Bruce (2008, pp. 22-37) proposes six frames for exploring information need, content, and assessment. These frames suggest avenues for developing meaningful questions. We have adapted Bruce's questions that shape each frame's approach to curriculum so that they relate to practice, which is the curriculum in Entangled Learning.

1. Content Frame: What should I know to be knowledgeable in my practice?
2. Competency Frame: What should I be able to do within my practice?
3. Learning to Learn Frame: What does it mean to think like an informed learner in my practice?
4. Personal Relevance Frame: How does it benefit me to know more about my practice?
5. Social Impact Frame: How does my practice impact society?
6. Relational Frame: How does being active in my practice transform ways of seeing or experiencing ?

Designing learning can begin with asking probing questions about one's practice from one or more of these frames. Members of a community of practice may be exploring different questions simultaneously, and their interactions further enrich their entangled collaborations. Learners can only become self-directed if they have a destination in mind. Discovering a question from one or more of these frames identifies the destination. That the question is compelling - something the learner is invested in - creates motivation to pursue the question and engage in learning (Deci, 1995). Motivation driven by authentic inquiry is a significant departure of Entangled Learning from traditional educational models.

How each individual or community pursues answers to the questions or engages in activities that lead to mastery of identified learning outcomes will vary according to the *ba* of the community. Young learners will have a very different design and will be capable of different levels of activities than a community of seasoned, practicing professionals. The shape of *ba*, hence the particulars of the design, vary also with availability of resources, technical expertise, levels of trust and openness to vulnerability, and any number of other cognitive and noncognitive ingredients. What is important is that each community develops an understanding of the *ba* - the shared space for emerging relationships and foundation for knowledge creation - within which they are designing their learning.

As much as we appreciate how these models may be used for designing learning, we do not prescribe their methodologies as a rigid approach for designing all learning within Entangled Learning. Design must be open to wonders of discovery and to being energized by spontaneity. Design changes as reflection and integration develop deep learning. Design also varies by community and practice. In the next section, "How to Entangle Learning," we suggest practical approaches to designing learning.

Program Design

Designing the landscape of a program would look different from the college majors and other programs of study as they are currently structured. Instead of a list of courses to choose from and pass, an EL-designed program looks more like a list of practices and competencies in which to develop expertise. This is a subtle shift at the goal level but a massive change in what it means for the learner, who assembles and tailors their own plan for addressing the program goals. The program goals, themselves, are designed with broad input from representative stakeholders (learners, instructors, business, community, alumni, etc.) and representative practices. The learner's design process looks different from the self-designed majors many colleges and universities currently have, because being centered on *practices* instead of *courses* opens new fields of options for learners and reimagines what counts as learning.

But just as learners do not collect credits for courses in an entangled program design, they also do not assemble a sampler of experiences. Experiential learning consists of reflecting on one's observations or participation in aspects of a practice and then integrating knowledge gained from the experience. What we are discussing in this paper is sustained engagement in

strategically-chosen practices, processed through the social network of a community of likewise engaged practitioners, with reflection being part of a process of iterative cycles of skills for driving learning deeply. Entangled Learning is not an experience of sampling. It is commitment to building a rich, dynamic landscape of practices that the learner maps out for exploration and development on the pathway they design for long-term learning goals. Seen in this perspective, learning in a designed program is not the entire landscape -- it is merely part of the landscape.

Landscape Design

Our discussion in this section so far has been of designing learning within the context of a practice. This is a focused and immediate approach to design: what do I need to know and be able to do so that I can develop expertise in my practice? This is important but is only one level of design. Entangled Learning exists, ultimately, to empower people to be self-directed along the trajectory of their learning across practices over a long term.

Once an individual identifies a passion, a deep-seated need to contribute, an opportunity to address challenges, or any other compelling purpose, they begin to design their learning and map the landscape. This aspect of Entangled Learning has potential to be both the most difficult to attempt and the most rewarding to pursue. The helpful metaphor of a body of knowledge as a landscape of practice is articulated by Etienne and Beverly Wenger-Trayner in their chapter “Learning in a landscape of practice: A framework (2015b)”: “If a body of knowledge is a landscape of practice, then our personal experience of learning can be thought of as a journey through this landscape (p. 19).” They continue the metaphor, saying, “As a trajectory through a social landscape, learning is not merely the acquisition of knowledge. It is the becoming of a person who inhabits the landscape with an identity whose dynamic construction reflects our trajectory through that landscape (p. 19).” It is relatively easy to look back on one’s journey through life and identify the practices that give shape and meaning to the landscape of that person’s lived knowledge. It is quite another matter to consider that you have agency - that there are opportunities available if you can develop vision for your learning and that you can grasp those opportunities if you have the mindset that it is possible.

Theory usually follows practice -- cartographers draw a map after they have been in the landscape. Designing a landscape of learning requires a completely different orientation: learning is no longer something that happens to you - learning is shaped by the choices you make. Self-directed learning is intentional, strategic, and opportunistic. Imagination, creativity, and intrinsic motivation are required, along with growing self-knowledge of personal strengths and challenges. Unlike the cartographer, though, designing your landscape does not involve drawing each practice on the map. Designing a landscape in Entangled Learning begins with the end point - what is my vision for what I want to learn, do, or become - and a starting point - what do I know and value, and what skills do I have. Designing the rest of the landscape is additive and responsive - identifying necessary practices as you proceed and discovering some when you least expected them to appear.

To find your end point, explore meaning. What matters to you? What injustices do you want to repair? What are your values? What interests you? What challenges do you want to solve? What do you have that the world needs? How do you want to make the world a better place? Your answers to these questions will illumine the pathway you will design.

Next, explore what expertise you will need in order to accomplish what you set out to do and compare with your current skills and aptitudes. A variety of resources are available to you. If you are thinking in career terms, occupational handbooks have information about skills needed and the work of various careers, but this is only a place to start. A trusted mentor can be invaluable in helping to frame the questions that need to be asked and in guiding you towards resources or practices that will blaze sections of your path. Make a list of the skills and knowledge that are necessary. Work from the end point backwards to identify incremental knowledge that you need to gain. Use the six frames described above to suggest questions that can inform your landscape design.

Finally, get on with it. Set foot on the path and enter the landscape. Reach for the opportunities and delve into the practices you have identified. Gather about you a community of people who can share and enrich your path for a while, as well as people who cross your path and challenge you in important ways. Engage deeply in your learning skills, individually and as a community, so that you are constantly documenting, regulating, thinking about, integrating, and deepening your collaborations.

In this regard, designing your landscape is intentional, for you have defined an ending point, a starting point, and practices along the way. But it is also serendipitous. People may cross your path who spur intense learning or who cause you to reconsider your end point. Assess those surprises against your values and what is meaningful. Designing your landscape means that you may change your end point and identify different practices to engage in. Being a member of a trusted and supportive community of practice is so important for this reason - so that you can test your new sense of direction. Communities are political, and people have vested interests that inform the counsel they give. Being self-directed means that the decisions are yours. It is your learning. Everyone's landscape looks differently. There is no "right way" to proceed -- there is only the way you choose based upon the knowledge available to you.

How to Entangle Learning

The overarching purpose of Entangled Learning is to give individuals knowledge, skills, and resources to direct their own deep learning in meaningful practices. Entangled Learning may be thought of as an ecosystem. In a biological ecosystem, organisms are integrated in a particular space, and their life processes impinge upon and influence each other. The community of practice (CoP) constitutes an analogous learning space for individuals who are integrated through their ongoing participation in a practice to build and use knowledge. Each individual, by virtue of their participation in multiple practices and learning communities, moves through a varied and unique learning landscape of multiple ecosystems over time.

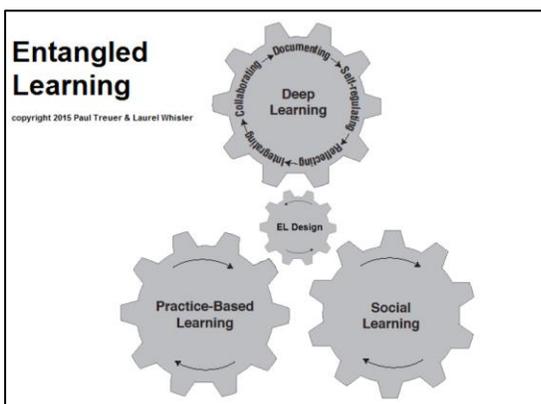
It has been noted elsewhere in this paper that Entangled Learning can be applied to any learning environment. It is most common for initial experiences with Entangled Learning to be small implementations that are part of traditional learning environments, such as peer-to-peer learning groups associated with college courses. Through a gradual expansion of collaborative learning skills, it may be applied to academic courses and programs and colleges. Skills developed through formal education can then be used in professional, organizational, and social learning environments.

The question, “How do I entangle my learning?,” is best answered by a description of what it is that will be entangled. Is it a course, a professional craft, a social or political activity? The nature of the application will determine how and with whom the learning will be entangled. Regardless of the nature of the application, however, there are several overarching characteristics that are worth emphasizing.

First, Entangled Learning is a holistic approach to learning. Whereas it can be implemented in narrowly defined practices, it is essential that each component -- practice-based learning, social learning, and deep learning -- is taken into consideration when designing one’s participation in Entangled Learning activities.

Secondly, Entangled Learning mirrors the natural landscape of learning with which most individuals are already familiar. Most early learning, such as language and culture, is done through interaction with tacit knowledge through learning exchanges, many of which are

between peers. Your decision to entangle learning is one that adds rigor to this natural type of learning.



Rigor in Entangled Learning is put in motion by intentionally designing learning spaces that are most conducive to your learning - physical and mental. Physical learning space includes not only the environment of the actual location, but also the qualities and characteristics of the people in your CoP. Mental learning space includes the habits you develop associated with the skills for deep learning, your

mindset and motivation toward learning, and the social and psychological milieu that develops within relationships among the community. In this sense, individuals build their own *ba*.

This section frames suggestions for entangling learning in the three spheres of the Entangled Learning model that are driven by design -- practice-based learning, social learning, and deep-learning.

Entangled Learning Design



You are the designer! This means you contribute to the design of your own Entangled Learning. This sounds a bit scary -- designing one's own learning. You may think, "How can I do that? That's what my teacher is supposed to do." In reality, the biggest hurdle to overcome is one of mindset. Accepting that you take an active part in your own learning is the door that, once opened, frees you to contribute ideas to how your learning takes place.

Importantly, within the Entangled Learning model you are not alone! You are always part of a team that learns together within the context and support of each other. Entangled Learning designs are group endeavors because they reflect what you and your community of practice partners deem to be optimal and effective ways of learning.

Initial design decisions necessitate answers to a first set of questions. The key factor to keep in the front of your mind is that you contribute your thoughts and wishes to the group as you and your peers answer the following design questions:

2. What is it you want to learn?
3. Why is this learning important?
4. How will you know your learning goals have been met?
5. Who is participating in this learning endeavor with you?
6. When and where will you and your community of practice meet?
7. How is your community of practice going to develop your learning? What learning activities will you pursue?

With each instance of an entangled approach to learning is an intentional design component. Self-constituted communities of learners agree together on the design of their learning program. Other programs may be designed as entangled communities within a more formal environment, such as a course. This design does not negate, nor does it mitigate, the importance of participants being empowered to direct their own learning. The design creates the structure within which participants operate, freely deciding what they want to learn and how they want to learn it, in collaboration with peers.

Program design is like an overarching set of rules players agree to follow when sitting down to play a board game. Like a board game, implementation of program designs vary from program to program, yet the design needs to be standardized so that all players know the rules of the game from the start. Also like a board game, program design must be documented to provide direction and objectivity and repeatability as learning continues.

There are four components to Entangled Learning program design -- purpose, expectations, activities, and evaluation -- that each group needs to consider at the beginning of their learning collaboration. Whereas participants in the CoP ideally should answer these questions for themselves, program designers will, in some cases, offer guidance to the collaborative learning groups.

Purpose describes the domain. It answers the questions -- what is the practice? why is it important? how does it contribute to the well-being of our community? Furthermore, it clarifies why the practice is entangled. In the General Biology course, for example, it is entangled in order that students are fully engaged in their studies in ways in which they learn *how to learn* Biology. Their practice is learning. Their goals may range from passing the course to gaining insight into how to learn and recall complex metabolic pathways.

Expectations are the ground rules. They clarify what is expected of participants, coaches, and the program designer in terms of process and content. Overall learning objectives define the goals which learners pursue as they design their own learning. Not only do they clarify broad expectations, but they also explain why particular rules are in place. In the General Biology course the expectations detail how Entangled Learning is embedded in the course. These expectations are built into the course syllabus. It also includes how students document their learning.

Activities geared to deepening learning vary between programs considerably. There is no right or wrong to the degree of entanglement other than to avoid micro-managing the learning process. The challenge is to entangle learning so that it is aligned with the purpose. Training is a crucial activity that varies in depth and breadth depending on the learning context and participants. Skills to consider including in training are the following:

- defining the purpose for entangling learning,
- describing the practice,
- equipping for self-directed learning,
- modeling the use of specific tools or processes,
- developing interpersonal skills, and
- previewing approaches to problem-solving when learning challenges or difficulties in social learning appear.

Activities are the range of items in the toolkit available for learners to choose to implement as they decide among themselves how they want to approach meeting the expectations and engaging the skills and behaviors identified in the deep learning design. Examples of EL activities include paired problem solving, group presentations, peer-to-peer tutoring, group

review, shared lecture notes, group reviews, shared resource materials, and skype study sessions. The list is endless. Activities can include drawing upon external resources, such as inviting other individuals or groups to share their expertise. Students in the Evangelische Schule Berlin Zentrum (ESZB) high school in Berlin, for example, developed activities in which they spent multiple years preparing themselves for highly competitive college entrance exams (Laboux, 2014, pp. 93-97).

Evaluations. Because Entangled Learning is peer-to-peer collaborative learning, its purpose is not merely socializing, though it leverages social connections to enhance learning. The focus is on learning. Therefore, meaningful evaluations are aligned with program purpose and community values are essential for keeping the scope of the practice in focus while measuring the effectiveness of the learning, from the perspective of all roles involved: learner, community, coach, and program designer. Evaluation by learners revolves around “what do I know and how well do I know it?” as well as “how important is it to my emerging values and learning frameworks?”

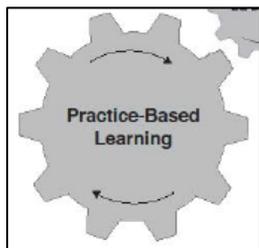
The Entangled Learning concept of evaluation is a distinguishing feature. Because the group designs its own learning goals, guidelines, and activities based on its members’ experiences and values, monitoring progress is integral to the functioning of each community of practice. This is called self-evaluation. It is akin to the way the body continuously monitors and maintains its temperature or the self-regulating process in a biological ecosystem in which feedback is continuously monitored in order to progress.

Evaluation is accomplished in Entangled Learning communities through the cycle of deep learning. Documenting the learning of the group and the individuals within the group is the core process that uses authentic evidence to monitor and guide learning. Collecting evidence creates the means for individuals and communities to monitor the validity of their claims of learning - that preferred activities for learning have been effective and that their learning choices are optimal. There are no two ways about it, deep learning is the goal as well as the means towards the realization of self-directed learning in the Entangled Learning model.

Documentation of learning, as you will see in this section, is uniquely designed and carried out by all members of each community of practice. Documentation is integral to effective Entangled Learning!

Each community of practice goes through multiple cycles of establishing goals, expectations, activities, and evaluation. This is how learning design takes place on an on-going basis in Entangled Learning -- many iterative cycles of learning create spirals of design. *Design is cyclic.*

Designing Learning Practices



Practice is the act of doing something over time. In the realm of Entangled Learning, practice is participation in an activity over time in which there is a *strong* desire on your part to develop new knowledge and skills. It is intentional activity that contributes to the well-being of community. When physicians establish their offices, for example, they are said to open their practices, which includes caring for patients, managing the office work, and developing professional networks with other physicians. It is important the physician keeps up to date on the latest medical advances. This is an example of a practice that benefits from close alignment with a community of practice between medical colleagues.

There are questions that can guide you to identify practices that are well-suited to be associated with communities of practice, keeping in mind that the purpose of engaging in a community of practice is your learning:

- Is your practice one you are passionate about and enjoy participating in?
- Does this practice require a large commitment on your part (time, money)?
- Is the practice one in which you are highly creative? Does it involve performance?
- Is it a practice in which your curiosity is high and you want to learn more?
- Is it a practice that is supported with an existing community of practice?
- Is it a practice that is important to you and your circle of family and friends?
- Is it a practice that contributes to the well-being of your community, including your community's shared spaces and natural environment?

The converse of building a community of practice to support your practice is also true. When you are actively engaged in learning, it is important to identify or create associated practice(s). Traditional education is especially weak in this regard because intense learning often is not associated with relevant practices. This issue is being remedied by colleges that offer civic engagement opportunities, internships, and other forms of applied learning.

The task of identifying practices in areas in which a person wants to learn more is an important one. It is especially important that one finds meaningful practice in which to engage. For a practice to be meaningful, new learning and skills are applied to practical, hands-on situations or it creates benefit to others.

Academic support centers provide an example of how this works within an academic setting. High achieving students can be selected, and trained to provide peer-to-peer tutoring for their fellow students. These tutors are then engaged in a practice that is often found to be rewarding, engaging, and meaningful. The practice is coaching their peers how to learn a topic that students find challenging. Tutors in many academic support programs are primary beneficiaries of this practice. Regardless of who benefits most, however, tutors discover ways of applying

their own knowledge and understanding of how to learn the material. This is an example of a practice that serves nicely to enhance learning.

Once the value of practice as a means of enhancing learning is realized, it is possible to find and/or cultivate new practices. An endless array of practices is possible. However, in order for practices to be suited for Entangled Learning, practices should be chosen where learning is an important reason for engaging in that practice.

This raises the fascinating topic of landscapes. True to Entangled Learning, you contribute to the design of your landscape (of practices), not only to each particular practice in isolation. How you design your landscape is extremely important because it shapes all aspects of your learning in the context of your family, your community, your profession, and your environment.

Whereas the design of communities of practice clearly is a communal endeavor, the art of designing your own landscape looks, on the surface, as a solitary endeavor. Your landscape is yours and yours alone. It is unique to you! Although you may design it in whatever way you want, the process of designing your landscape benefits from input by others. Ask family, friends, colleagues, academic advisors, even EL coaches, to participate in your quest for significant practices in which to invest your energy. Your design will benefit from the input and advice of other perspectives. You are not and should not be alone in your landscape design.

Use the following exercise to understand your landscape. We recommended that you draw pictures of these broad landscapes to gain a visual, high level, perspective.

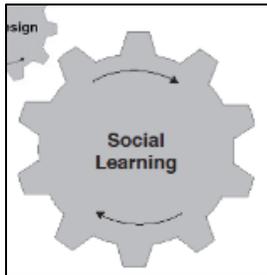
Surveying. Interview family members, such as family elders, asking them to identify learning practices in which they have been engaged during their lifetimes. Prompt them to name the practices, describing some of their most important learnings in each practice. A lifetime map of family members or mentors can reveal the terrain of learning landscapes that may be familiar territory for potential exploration. Once you've drawn a map of their landscape, draw one of your past and current learning practices, sharing this map with a trusted family member or friend. The emphasis of this exercise is on identifying a high level view of the most powerful learning practices in which you have been engaged.

Dreaming. Since you are in the clouds, figuratively, from which to see the expanse, do some dreaming. This is where an Entangled Learning mentor or personal coach will come in handy. Ask to meet with a mentor or coach to guide you to identify your potential landscape. With the mentor asking questions, identify three to five practices in which you would like to develop knowledge in community with others who share common practices. Name the practices and draw them in the landscape in proportion to their importance. Color code your practices to correspond to practices that are personal, academic, social, cultural, or professional.

Reality. Draw your current landscape of practice(s) in which you are, or would like to be, engaged. If there are multiple practices, show relationships between similar practices and the

distance between vastly different practices. This makes for a varied and diverse landscape. Be sure to date this map in order that you may return to it at a later date.

Social Learning: Participating in Communities of Practice



Communities of practice consist of individuals, who are engaged in the same practice, joining together for conversation and shared exploration of their practice. For example, professional associations, such as the American Medical Association, are essentially large communities of practice that engage virtually through mailing lists, professional journals, and social media, as well as corporately at meetings, workshops, and conferences. A musical ensemble is also considered a community of practice, not only as they join their musical abilities together, but also in the shared conversations around their practice before and after rehearsals.

People can be members of multiple communities of practice simultaneously, and their learning is enhanced as they cross boundaries between practices. Take, for example, an ear, nose, throat doctor who is a choral singer. His understanding of anatomy informs his approach to vocal production, and he shares within each community the perspectives from the other.

In Entangled Learning the atomic unit, the core building block, for learning is the Community of Practice (CoP). Within the context of an educational institution, it replaces the course in this regard, as being the foundational place where learning takes place. CoPs exist outside of formal organizations as well, such as community gardening initiatives or neighbors studying the impact of a proposed development on public infrastructure.

This is not to say, however, that courses don't exist in highly entangled learning environments. Courses can exist in such a way that CoPs are associated with a course. But, the CoP is foundational to providing social means for enhancing that learning, and at the same time, providing a means for continuing and furthering that learning beyond the lifespan of the course or the duration of one's college enrollment.

I think that EL makes people more efficient learners because you will learn more quickly and better with others than you will on your own, and then once you learn how to do EL you can learn more and more and more and more. I'm a huge fan of discovery learning and I think that EL embodies those ideas very well... we have to inquire and dig for things in EL instead of just being spoon-fed them. Why is it better? Because you remember things more when you figure them out for yourself. - Sarah Dickenson, 2015

Furthermore, CoPs are collections of individuals who are agreed they will collaborate with one another in a democratic, open, and trusting manner to develop their learning about their common practice. There is implicit agreement that the community of practice uses shared

governance -- that is, the group itself determines what it does -- and that members are active participants. Community members have equal standing and equal power, including any instructors who become members with their students. Bringing different, sometimes conflicting ideas into the conversation, is the sign of a healthy community of practice. Developing strong interpersonal skills of listening, communicating, questioning, and resolving conflicts permits members to continue working together well.

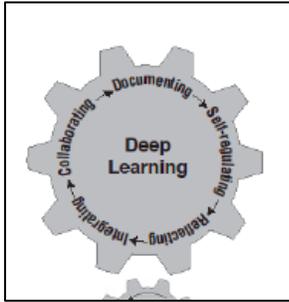
Entangled Learning is associated with a framework for CoP in which members work optimally to further their learning. Within this framework, communities of practice, often consist of 5 - 15 members. Its learning capacity is not limited, however, except by constraints that restrict participation of all members. Each CoP meets regularly, usually at least once weekly and at a set time. Roles within the group switch at each meeting so that the roles of facilitator, recorder, and timekeeper rotate throughout the group (other roles may be identified by the group).

Each meeting consists of a routine in which participants start out the meeting by quickly introducing themselves and selecting group leaders for the meeting. The facilitator, who may only ask questions, develops an agenda by asking for suggested discussion topics. Once these are identified and posted, participants are asked to provide rationale for why these are important. The group is asked to identify, and prioritize topics. Several rounds of discussion may be needed to agree on what is important. The facilitator leads a discussion by asking questions about the topic, while the recorder documents the discussion in a folder on the group's shared drive, or the group chooses collaborative learning activities which they also save on the drive.

When time permits, the group may be led to discuss other topics, following cues from the timekeeper. At the end of the community of practice meeting the facilitator asks the group to assess and evaluate their learning, in particular to reflect on how the discussion and other activities provide insight into how to learn this topic. If there are further topics in which the group is interested in exploring, the facilitator may ask the group to suggest ways to continue their learning together outside of their set meeting time. Once all topics have been discussed, the group may end their session with plans for their next meeting or activities outside of their meetings. The final discussion is summarized by the notetaker in the drive.

Variations in the structure of each meeting will occur naturally as groups go through multiple cycles of meetings, goal setting, and evaluation. When the multiple cycles take on a rhythm that produces desired results, the CoP is said to be humming.

Deep Learning Design



Designs for deep learning are perhaps the most nuanced compared to practice-based or social learning. Subtlety in the deep learning design is embedded in the fact that it takes considerable effort and discipline to document learning while it is taking place in the group. It also requires self-discipline to document one's own learning while it is taking place outside of the group. That being said, there are tools and frameworks (cycle of deep learning) that can make this work much easier than it would otherwise be.

There are two reasons deep learning is an essential component of Entangled Learning. The first is that rigor will be too easily avoided if there isn't a feedback loop that informs learning activities. The second reason is that by documenting learning within the CoP, tacit knowledge will be made explicit. This step, moving from tacit to explicit, is essential in the process of developing deep learning. It is a step college professors do with apparent ease as they move between subject area expertise and communicating that information to students. In order for students to develop deep, rather than surface, knowledge, they must participate in this important step of knowledge-building.

The recipe for deep learning is relatively straightforward and is cyclic. It starts with documenting for several reasons. Learning goals must be articulated and subsequent stages also need to be documented. Therefore, deep learning starts, and ends, with *documenting*. Learning is associated with behavioral changes; thus, evidence of self-regulation is intrinsic evidence that meaningful learning is taking place. For that learning to become knowledge, it must be reflected upon critically. Then, for the learning to be deepened and validated, it must be integrated into real life situations. This is where knowledge is applied to practices. Finally, the social context, the community of practice, serves to provide the means for discovering and sharing that knowledge, thereby taking a simple task of creating knowledge and generating new questions that have an audience of actors who will move through the cycle again and again. Through sharing, new questions will invariably arise. In this way the cycle is a spiral that is fed by its associated CoP social interactions and meaningful practice.

There are multiple ways to participate in the cycle of deep learning. The following are only a few suggestions; there are endless ways to do so. Best practice CoPs will generate many, many more. Training manuals with suggested ideas and scaffolded prompts are being developed to support CoP participants in the process of deepening their learning.

Profiles. CoP participants are encouraged to share collaborative portfolios with one another that include relevant contact information, biographical features, skills, knowledge, experiences, and evidence of learning relative to their common practice and inquiry.

Shared Documentation. Common folders, organized around the CoP's meeting logistics and learning goals can be set up so all members have access to shared materials. Meeting notes,

can be maintained in real time so that the notetaker is recording notes as they are being taken. Likewise, other evidence of learning such as written documentation, stored video recordings of meetings and talks, spreadsheets, joint reports, and other shared documentation may be maintained in shared files.

Dashboard. A list of key, self-identified targets associated with critical measures serves as a comparison point when periodic snapshots are taken that show how the group is progressing. The dashboard can be posted in such a way that immediate feedback is guaranteed on how well the group is meeting its goals. The dashboard list of targets may also be defined by program designers.

Learning Portfolio. The CoP can maintain a group learning portfolio that demonstrates, with authentic evidence, how it is making progress in each of the domains of the cycle of deep learning. In this way the record of learning is maintained, and possibly shared, with the group as well as key partners, such as instructors, mentors, tutors, friends, partner CoPs ... whoever the group decides are learning partners.

Journaling. CoP participants may agree to respond to well-scaffolded prompts that generate on-going reflections about their learning. These entries can serve to help individuals and groups understand and resolve learning challenges. These journal entries may be audio and video recordings.

Rubric of evidence of deep learning. Appendix D of this paper contains a rubric of evidence of deep learning. CoPs may self-evaluate using this rubric or ask an outside evaluator, such as a coach, to score their group portfolio to determine where they are in the level of self-sufficiency in terms of independence with each of the areas of deep learning.

Case Studies. Case studies that document how the CoP worked together to meet its goals can be invaluable as a tool to understand what went well, as well as what didn't go so well. It provides an excellent means for showcasing best practices and structuring critical reflection. In settings where there are many CoPs, shared case studies may be used to improve the performance of all groups. A fictitious case study based on our example Biology instructor and her course illustrates this tool in Appendix C.

Critical Measures. Each CoP will identify its own areas in which to measure success because the context of each CoP determines what measures of success are meaningful. Nonetheless, meaningful measures need to be monitored and recorded by each group, and shared only when they deem it necessary to do so.

In summary, many ideas are emerging on how to entangle learning. Only some of which are shared in this section. Detailed resources, some specific to domains of practice, may be found in the Manual accompanying this paper. But ultimately, there is no limit to ways to deepen learning beyond the imagination of participants in each Community of Practice.

Roles within Entangled Learning

Multiple roles exist within entangled learning ecosystems. In this section we describe four principal roles and associated responsibilities with each. These roles do not exist in isolation, since it is not uncommon for individuals to take on multiple roles. However, foundational to Entangled Learning is *participation*. All individuals associated with Entangled Learning are strongly encouraged to become actively involved, at one time or another, as a participant in one or more Entangled Learning collaboratives. Usually, but not always, this involvement precedes taking on other roles. So, what does it mean to be a participant?

Participants

Entangled Learning participants are individuals who are actively engaged in one or more practices and their associated communities of practice. In terms of engagement in a practice, this means the individual is working (or playing) on projects and activities either alone or in a group in which new learning is valued highly. A person learning to play the fiddle is such an example; they are actively playing the fiddle, and they want to get better. Additionally, that individual is participating in a group that meets regularly to help one another improve their fiddle playing. In fact, the group is passing down a knowledge base of established songs and lyrics as well as discovering new songs and ways of playing. It is their community of practice.

The responsibility of participants is (1) to actively participate in the associated community of practice to share, learn, and discover new knowledge and skills, (2) to apply the new learning to their practice, and (3) to document their new learning.

Multiple roles exist within each CoP. Roles within each person's practice, as well as their CoP, will vary considerably. There is no set expectation for engagement across all practices or CoPs other than an expectation that all individuals will be actively engaged. Each CoP establishes its own expectation of what active engagement means in terms of how individuals will participate in the functioning of the group, how those roles will change, and how learning will be documented. The fiddle group, for example, may participate in the tradition which has established that the more experienced musician leads the group by playing, and that on occasion other individuals in the group bring in new tunes and lyrics, taking on the role of leading the group. The group may decide to document their learning by recording and sharing new songs on *YouTube*. Each participant may then build and share their own website chronicling their learning and new-found skills.

Diversity is an asset to participation. Asking questions is active engagement just as much as providing answers. In this sense, learning and discovery are more robust in diverse groups where members freely ask and answer questions than in homogenous groups. The key to participation is give and take within the group.

Participation, by necessity, involves conflict. One individual may get frustrated that another isn't working hard enough, or that another person is unable to grasp a difficult topic, or that one person is avoiding certain roles such as facilitator or notetaker. Participants are expected to

agree to identify their own preferred processes for resolving conflict. Significant learning emerges from successful resolution of conflict. One of the agreed upon ways of resolving conflict may include consulting with a coach. The role of coach is described in the following section.

Ultimately, the participants, in aggregate, decide how to run their community. Each individual is expected to share in the decision-making, thereby contributing to the functioning of the group. If a group is not meeting the needs of a participant after making efforts to influence decisions of the group, the participant is encouraged to form a new group or join an existing group consisting of individuals who can work together successfully to meet shared learning goals.

The ideal is that each individual develops confidence in their ability to facilitate and participate in communities of practice. This confidence should be based in collaboration skills that are enhanced over time and are capable of producing the leadership necessary to support learning in new and challenging domains.

Coaches

The role of coaches in Entangled Learning is to help the CoPs flourish by providing the minimum amount of assistance necessary for them to be self-directed in their practice. Coaches have the greatest capacity to adversely affect Entangled Learning by consciously or inadvertently promoting dependence. Coaches who think they are helping by saying or doing too much for the community members actually impede learning, for the learners could begin asking “is this what the coach wants us to do?” instead of being autonomous. This is one of the counterintuitive truths about learning: the more one person does to make the learning task easier, the less learning happens, and the more dependency is established. Believe it! Do not be tempted to do too much for a community, thinking that you are doing them a favor. Instructors should be cautious about coaching lest they revert into their teaching role.

The coach’s primary tool is asking questions. Coaches draw upon their experience and the benefit of a broader context to formulate questions that draw the community members into thinking differently about a challenge. Questions reinforce self-reflecting and integrating. They create space for dialogue and do not impose an answer. After all, learning is pursuing questions rather than collecting answers.

Patience and resolve are important tools as well, and they work hand-in-hand. Being patient while the community works through their challenges, and resolving to stay out of their way so that they can be self-directed, may be the most difficult challenges for the coach. Self-directed learners are free to make mistakes, including making poor choices. Learning from mistakes is an important exercise denied to community members if the coach imposes too many suggestions or directives. Thus coaches make no decisions for the communities; likewise, they are not accountable for the community’s results.

Just as modeling learning is important, coaches model information-seeking and working within a community. Coaches should be prepared to assist in all four areas of Entangled Learning but

also to know when to refer to the instructor, when to call upon another coach's expertise, and how to access information or tools to support learning.

A coaching session begins with the coach asking the community members to clarify the challenge they face. Additional questions that probe reasons for the challenge, underlying assumptions, and perceived sticking-points create opportunity for the community members to talk through their challenge and potentially discover resolution for themselves. Discussion should always direct the community back to the relevant goals as a context for decision-making: learning objectives and design; accountability to the community and to the practice; the community's values statement and ground rules, as well as the framework for social learning described here; and engagement with the skills for designing deep learning.

Once the community makes a decision, the coach's responsibility ends. The community moves on and experiences the consequences of their decision; the coach moves on to the next community that seeks consultation. Coaches may follow up with the community to learn how the challenge was resolved, but the coach expresses no judgment about the community's decisions. Coaches should not consider communities to be "theirs." Indeed, if any relationship exists the coach "belongs" to the communities. The coach has no power over the communities of practice; they hold the power to seek the coaching and use the assistance to move ahead as they choose.

The only instance when the coach takes a more active role is in facilitating movement among communities if successful group interaction has repeatedly failed. Sometimes a community's dynamics may be beyond repair. The coach helps members find welcome in other communities so that they can re-engage in their practice.

Program Designer

The program designer is akin to EL CEO. It sounds like an important role, and it is. It is a role that requires institutional knowledge and an ability to "entangle" their course or program.

The program designer envisions the big picture of how learning will be entangled within an organization. Because of their organizational knowledge and role within that organization, they are able to design an implementation of Entangled Learning that meets the needs of students enrolled in a course, a series of courses, or an area of study, such as a college major or minor.

It is the responsibility of the program designer to build integration with course instruction, design how entangled groups will be trained, formed, and supported, as well as how the groups will be assessed. The program designer will be responsible for agreeing to the content in the Entangled Learning Manual and will provide oversight for coaches and trainers in this domain. The program designer decides how training will happen, and how it will be delivered. The program designer is responsible for ensuring that Entangled Learning contributes to the institutional goals, and this individual communicates to institutional leaders how effectively the program is delivering on this promises.

Trainer

The trainer is a specialized role that is, in most cases, specific to a given community of practice domain. For example, there may be one or more trainers for an entangled General Biology course in which there is a program designer, many participants in multiple communities of practice, and several coaches.

Trainers are responsible for writing the domain-specific training manual based on the general manual provided by the Entangled Learning Collaborative, for presenting the information to the individuals involved in the domain, for assessing how well each person is prepared to handle their role, and for recognizing the individuals for successfully completing training.

Trainers may also structure on-going training through facilitated communities of practice in which designers and coaches from multiple domains share best practices with one another.

Assembling the Cast

Putting these components together within the context of the example of the university Biology class illustrates the roles in Entangled Learning. Many of the students are enrolled in this course because they want to enter a professional health field and become a physician, dentist, pharmacist, or related health care professional. This goal motivates them to learn. Discovering how to learn biology is their *practice* as a community of learners in the course as a whole.

When the students review their syllabus with the instructor on the first day of class, they discover that she has designed the course around five intriguing questions. The instructor tells the students that within their learning groups, they will have the latitude to explore the questions about biological processes within any context that interests them. For instance, if a group wants to explore aerobic respiration from a health perspective, they may choose physical exercise as their context and design experiments to learn the process. The instructor draws their attention to the unit goals and explains that each group's learning design should be structured so that they can provide evidence that they have accomplished each learning goal and have met the assessment criteria that are specified. The syllabus provides grading criteria, rubrics, and assessment prompts to shape the students' self-evaluation and to align their learning with departmental standards.

During the first lab period, the trainer and coaches introduce themselves to the students. The trainer facilitates their self-selection into learning communities, reviews the purpose and expectations of being entangled learners, and then explains the way their learning meetings are structured. He draws the students' attention to the manual that he and the instructor tailored to meet the specific needs of this course. The trainer works with the students through a few core learning activities that will facilitate their mastery of material. The groups engage in role play to learn the function of each role they will assume, and near the end of the training, each student sets up their own file space within the group's shared folder. The training session closes with each student writing a reflection about their personal aspirations for learning, why they chose to

be with the group they selected, what they look forward to most and least about the course, and what questions or uncertainties they have about being entangled learners. These responses form the basis for an end-of-semester reflection activity.

To implement their entangled learning process, each of the 25 communities of practice begins meeting according to their own schedule and develops their own routine around learning how to learn biology. They develop their own charter that states their shared agreements about how they will interact with each other and what their mutual expectations are for collaborating. They name their CoP to build a sense of belonging and record their contact information. They may even engage playfully in their collaboration -- The *Green Team* decide that to build community identity they will always wear green shirts to their study sessions. They develop a Google document for members to sign up to provide organic snacks, and they agree to cook a meal together after attending Earth Day events later in the semester.

The *Green Team* has met twice, and each meeting was both more comfortable but more frustrating than the previous meeting. They agreed to develop and share their collaborative portfolios, and they have traded roles within the group, but they feel overall like their group just isn't coming together. They discussed their challenges during the last meeting's check-out and realized that while they know that they have the freedom to be self-directed in their learning, none of them is comfortable with what this means. They realized that they have been trying to guess what the instructor wants them to do. They remember that the trainer said this would be a challenge, and by the end of the check-out they realized it is time to seek help from the coach so that they can become more comfortable and productive.

One of the coaches agreed to meet during the *Green Team's* next meeting. She introduced herself and led the group in a teambuilding activity that was geared towards problem-solving. The coach carefully observed their group dynamics, and during the debrief of the activity, she asked questions to facilitate identification of their strengths and skills. Next, the coach addressed the group's challenges in becoming comfortable as self-directed learners. Again, she asked questions to spark a group discussion to connect their learning interest and personal long-term goals with the course framework. She helped the group interpret the course's framework and gave them ways to consider designing their first learning activity, but she emphasized that the choice was theirs.

When the coach reflected on her coaching interaction, she wrote in her journal that she was so proud of the good discussion that she was nearly tempted to tell the *Green Team* members how well they did with designing their learning activity to align with the course goal and the assessment criteria. She continued writing, explaining that she had remembered that her own training urged her to delay giving the group positive reinforcement until she had modeled for them how to check the validity of their design by asking questions that relate the design to the assessment. Only once they had completed those self-regulating and critically-reflecting questions did she tell them how well they were doing and that they are now on their way to becoming more skilled in directing their own learning.

It is five weeks into the semester, and the *Green Team* members are already feeling more comfortable and enthusiastic about their learning in Biology. The group members are gathering in the learning commons for a study session. They greet each other and check in about how they are doing, how their week has been, and what's on their minds. They sample the snacks someone brought. The facilitator from last week's study session suggests that they rotate roles and makes sure someone is designated to document their work and report back to the professor, someone is responsible for monitoring that they stay on task, another monitors the emotional quality (stress, tension, humor, helping), someone monitors that everyone understands, and someone else is designated to serve as facilitator and timekeeper.

The group members are preparing for an upcoming exam. The students have their laptops on and are logged into the Google Drive where they have been collecting outlines of the chapters, lecture notes, notes from their previous study sessions, and other resources they have created together. Each person identifies content that they think will be covered on the exam. They also individually identify material they think they need to review. Group members who feel confident in an area offer to explain it to someone else, and the group immediately pairs up for a few minutes of review.

As they reconvene, the facilitator suggests they look in their manuals to the section on exam review, and the group selects a couple of review activities that they think will help them with the material: creating a matrix to classify course content by characteristic and creating a concept map to synthesize the material. One of the group members pulls out their markers and begins to set up a matrix on the whiteboard. The group discusses what categories are important for classification, and they resolve their differing perspectives on what should be included, what the categories mean, and why they are important. Everyone contributes to the matrix. When they think they have completed it, the group compares their work with their course materials to think about what they may have missed, checks that the information is correct, and revises accordingly. When they are satisfied, the documenter takes a photo and uploads it to the group's Google Drive folder. They move on to the concept map....

After they are satisfied with their concept map and with the quality of their review for the exam, the students chat briefly about other courses they are taking. They discover that they are all enrolled in calculus and general chemistry as well. As they chat, it becomes clear that some of the group are having difficulty keeping track of which characteristics relate to varieties of chemical bonding. Since working on the matrix was such a helpful new learning activity, the group decides to take a few minutes and develop one for their chemistry question as well.

At the end of the session, the facilitator leads a check out to ask what was the most helpful aspect of their study time, what each person learned, and what questions they still have. They take a few moments to record their reflections in their individual Google drive and make links to the materials they saved in their group folder in Drive. Understanding the energy dynamics of the carbon cycle was challenging, so they decide to record that as a question for the professor in their group learning portfolio.

They move on to discuss their group dynamic, pointing out helpful things such as when one person encouraged someone who was really frustrated, that they did a better job of staying on task and working efficiently, and that someone's really bad puns kept the mood light even though they were working really hard. They set the location, time, and duration for their next session and exchange good wishes for the exam as they depart.

Vision for Entangled Learning in 2025

Kara, a 17 year-old junior in high school, browses through college catalogs, scanning them carefully, looking for a perfect fit ... looking for that special college. Her search is like looking for that special person. “Do they really exist,” one wonders? Suddenly she spots Trueblood College, a small liberal arts college in Indiana. She reads the description with keen interest. “Mom,” she shrieks, “I found it!”

The college is characterized in its 2024 catalog as “entangled.” The catalog describes the entire campus community as “a flipped college in which from start to finish students and faculty are engaged, as equals, in the pursuit of knowledge through collaborative learning teams.” It goes on to explain that one of the core values of the college is the belief that students are capable of directing their own learning. Trueblood College provides a supportive environment where learning independence is valued and fostered.

Ever since being introduced to Entangled Learning in her freshman year of high school, Kara actively took part in communities of practice for her academic studies and co-curricular interests. She estimates that by her junior year she had taken part in twelve different communities of practice. The formal Entangled Learning training she participated in during her sophomore year qualified her to be a certified Entangled Learning participant. She hopes as a senior to complete her training to be a certified coach.

As she is looking for colleges, she targets institutions where wide ranging practices are available within and outside the college community. She knows she wants to study veterinary medicine, and it is important to her to volunteer with a group of veterinarians who work with horses. She also wants to find a Biology major that is entangled in such a way that she can participate in a group of students who would develop a lasting community of practice throughout their studies. Kara has a passion to research leg injuries in horses; she has ideas about breeding to use genetic traits to improve physiology, but she also wants to create a new method for splinting that she thinks is promising. Reading the catalog she can't believe the long list of practices that are available to students, and she looks forward to forming her own community of practice that includes bioengineering, genetics, physiology, marketing, and art students as collaborators.

When she did a search of ‘entangled colleges,’ a list of 28 U.S. colleges showed up. She was amazed that this was the case because she thought her high school was one of the first to be entangled. It was the first to be entangled in her home state, Missouri. But, upon further research she found a list of hundreds of entangled high schools, and even many junior high schools. She even found employers looking for entangled graduates.

Kara read an article in *Forbes* that interviewed the CEO of a cutting edge green energy firm. The CEO discusses that they recruit from the 28 entangled colleges because those graduates have workplace skills that are so unusual to find in other college graduates. The CEO said to

the interviewer, “We find that these employees who were entangled undergraduates are some of the most influential people in our organization. They have an exceptional ability to look at a challenge and analyze what departments need to be included on their team to examine the problem from all perspectives. They have this penetrating vision of possibilities that creatively and efficiently solve challenges. People in my company look forward to joining a team with an entangled graduate. They know they will be working with a team member who has high expectations of themselves and their teams, but they draw upon everyone’s strengths to magnify the working capability of the group. At the same time, collaborating in these teams is highly rewarding because the team dynamics permit everyone to contribute their best effort. These entangled team members know how to ask the right questions that get everyone thinking critically, but creatively, about the challenges. They have great mental agility, moving from one challenge to another quickly and flexibly. Keeping really good records is another strong suite -- I can think of several in particular who went through their portfolios of past work to find new uses for products or processes that they had not imagined when they were working in the research and development department. These employees are still relatively new in our workforce, but they are so astute in self-knowledge and ability to both learn from their experience and apply ideas in new ways. The value they add to my company’s operations is impossible to overestimate!”

Kara’s visit to Trueblood College reveals how thoroughly everyone is entangled. Her interview with the Admissions Collaborative includes a Biology professor and a second-year student in addition to the admissions facilitator. She learned that participating in service-learning collaboratives is a way students participate in campus governance as well as earn grants-in-aid to offset tuition. During the interview, Kara was invited to discuss what practices she wanted to participate in and develop around her interests in leg injuries and physiology.

The Collaborative arranged for her to meet with a community of practice organized around veterinary studies. Several of the students had been in the community since they entered college and were enrolled together in General Biology I and II. The community also includes a few students from Chemistry, Bioengineering, and Mathematics/Statistics. Two local veterinarians, a Biology professor, and some recent alumni are also members of the community of practice. Kara was excited to learn that in their weekly meetings, the community members discuss challenges and research developments in the field. Some of the students developed a research project in conjunction with the alumni members to test a new protocol the practicing veterinarians proposed.

Subgroups of the community get together two other nights to study. They have developed their own learning practices around Biology and Chemistry, and the more seasoned members mentor the newer members in what they have found to be most effective. The community’s learning portfolio contains resources to deepen the learning of the newer members, and their practice is that everyone who benefits from using the portfolio is responsible to contribute new material. In helping the newer members learn how to learn, the third- and fourth-year students maintain their familiarity with the foundational course material and increase their collaborative network.

Kara's visit coincided with the biweekly meetings of the Governance Collaboratives. Her Admissions Collaborative host explained that all students, faculty, and staff members serve on at least one Governance Collaborative so that everyone understands how decisions are made and how the decisions, such as occasional calls for divestment or shifting interest in majors and practices, have a ripple effect throughout the College. One intriguing community of practice associated with the Facilities Collaborative is developing a plan to retrofit the residence halls to capture and purify grey water as a means to address water conservation. This community will be working over the summer for the students to learn, through apprenticeships with the campus plumbing staff, local plumbers, and plumbers in drought-stricken states, how to re-plumb the buildings and install filtration systems as a proof-of-concept for wider implementation.

This vision, ten years into the future, is conservative. It assumes existing pressures to reform education continue to drive change at the same level as 2015. It assumes fiscal constraints on education systems continue at roughly the same pace being experienced today. It assumes needs for professional development in the workforce parallel what they are today. In summary, the vision above represents a sensible model given current demands on an education system that is acutely in need of reform. Should societal pressures, such as economic or environmental stressors, increase, the need for reform such as that described in this paper will be significantly greater. Should this be the case, the type of education available at Trueblood College will be more widespread across the United States and elsewhere on the globe than what is described in this vision for 2025.

Conclusion

In this time of rapid change and increasingly complex challenges, Entangled Learning is a promising new model that offers a solution for the need to increase learning as fiscal resources diminish.

While our purpose has been to introduce this new model, we are quick to acknowledge that components have been developed elsewhere. It is the integration of these parts into a whole system of learning that makes Entangled Learning unique and effective. By bringing all four components -- design, practice, social, and deep learning -- into close enough proximity to drive one another, a self-perpetuating system is put into play that is capable of driving learning within and outside of formal educational settings.

The solution offered by Entangled Learning applies to learning in communities of practice formed outside of institutional structures as well as within schools and universities. College courses are already being entangled. Entangling college majors is already being considered, even though the concept is less than a year old. It isn't much of a stretch to envision how entire college campuses can be entangled.

Curiosity and an inquisitive nature are the only prerequisite skills necessary in Entangled Learning. People of any age can participate. Learners in their twenties and younger are especially comfortable and competent with peer-to-peer learning; their energy and enthusiasm balances and enhances life experience and perspective older learners bring to learning. Mastering collaborative learning skills will be accomplished through participation in multiple communities of practice.

The major mindshift necessary to embrace Entangled Learning is changing one's conceptual viewpoint from the traditional learning model to a starkly contrasting paradigm. In the traditional model, learners are managed and directed by educational systems that are intentional, systematic, and uniform. In the new paradigm described in this paper, individuals control and manage their own learning. Gone is the massive top-down architectural accretion of programs, majors, curriculum maps, predetermined schedules, and requirements. In their place are learning opportunities driven by compelling questions that spring from individuals' engagement in meaningful practice. The traditional model asks much from the institution and little from the learner, besides compliance and successful completion. Entangled Learning asks much from the learner and requires less from the institution; it delivers considerably more to the learner, in the way of facility to further one's own deep learning independent of formal institutional affiliation.

This paper suggests ways in which this mindshift may take place. Needless to say, chaotic disruptions, both economic and pedagogical, have the power to transform our learning paradigms overnight. Understanding Entangled Learning will inform educators how to facilitate this transformation so that learners are well-prepared to optimize those learning opportunities

within each person's grasp. A case study is presented in appendix C describing how this transformation may be realized within the setting of an academic course.

Ultimately, learners who develop facility with Entangled Learning will, over their lifetimes, create unique personal landscapes of multiple practices in which learning is deep, highly personalized, and well-documented. These learning landscapes are as varied and magnificent as the natural and community environments which sustain us; they have the power to shape responses to complex global challenges for the common good.

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Appendix A -- Glossary

Ba

Of Japanese origin, *Ba* translates into the English word “*place*.” Proposed by the Japanese philosopher Kitaro Nishida in the 20th century, *Ba* is considered to be a shared space (literally and figuratively) for emerging relationships in which tacit knowledge inherent in each person becomes a platform for knowledge creation to take place. Nonaka and Konno (1998) propose a model (called *SECI*) for cycles of generating organizational knowledge that converts tacit knowledge into information that is used in a transactional sense as knowledge is made explicit and returning to tacit knowledge that informs the work of the group. While the idea of knowledge creation that involves this cycle from tacit to explicit is intriguing and informs Entangled Learning, we caution that knowledge creation is for the benefit of the learners, not for an organization.

Case study

Focused upon the learning and interactions of a specific community of practice, the case study is an exercise in description, reflection, analysis, and integration that is a tool for learning and assessment. The suggested format includes a description of the Entangled Learning environment, roles of participants and case study author, description and analysis of the activities of the community of practice, and evaluation and recommendations. Description, analysis, and evaluation are of the community members and of the case study author. Guidelines for writing a case study are available in *Untangling entanglement*, the manual for Entangled Learning. A fictional but illustrative case study is found in Appendix C.

Coach

This role in Entangled Learning helps community of practice members when they encounter difficulty with their learning or with group dynamics. The coach asks questions to model for the community the thought processes necessary for solving their challenge. Coaches also assist with understanding each component of the Entangled Learning model, facilitating conflict mediation, and developing and using a variety of collaborative tools and activities, including various portfolios. For more information on the importance for and limitations imposed on of coaches in self-managed teams, see Laloux (2014), pages 69-71.

Collaborating

Individuals participate in community of practice as a means to ask questions and discover new knowledge relative to their common practice. Collaborating is more than interacting together in a group setting. Sharing skills, contributing knowledge and information, solving problems, discussing and imagining new possibilities and then working to bring them to reality are processes of collaboration. Collaborating implies giving of oneself to enhance the community and its learning.

Collaborative ePortfolio

This type of ePortfolio is used to introduce community members to each other and is a tool for each person to share what knowledge, skills, and attributes they can contribute to the collaboration. Contact information is useful to include, as is information about personal interests and personality traits. Individuals decide what they share and how much to include. Just as a resume changes depending on the position the job applicant seeks, collaborative portfolios should change as necessary to reflect each domain of learning.

Community of Practice (CoP)

A collection of individuals who are agreed they will collaborate with one another in a democratic, open, and trusting manner to discover new knowledge and skills together in an area of mutual interest. Although membership in a community of practice can and should fluctuate, the community maintains relative stability until it disbands. The relationships that are formed within the community create a supportive network for learning and developing personal and group identity. Wenger (1998) has written an extended description of community of practice as social learning theory.

Deep Learning

Learners engage in deep learning as they work beyond the minimum requirements and engage in critical reflection and integration on their learning (Entwhistle, 1997). Deep learning engages individuals in rigorous practices of knowledge creation. A literacy of skills necessary for deep learning is described in Jenson and Treuer (2014). Appendix D is our adaptation of their rubric for assessing deep learning skills in an entangled environment.

Design

Individuals decide for themselves what they want to learn and how they will learn it within the context and support of their community of practice. Many models and processes for design are readily available with a web search. Wiggins and McTighe (2005) describe design process applied to learning, but note that in their model, an instructor is designing learning experiences for students. In Entangled Learning, experiences are designed by the learners themselves.

Documenting

Individuals assemble and share with community members evidence of knowledge and skills germane to their learning goals and practice. Countless forms of documentation are possible. Writing in a journal is a way to document self-reflection. Keeping meeting notes provides documentation of decisions, assignments, responsibilities, and future learning to explore.

Ecosystem

As it does in biological and environmental contexts, ecosystem in Entangled Learning relates to the components of a learning environment and their interactions as they work together to support or hinder learning. Gütl & Chang (2008) discuss elaborate on the metaphor of ecosystem as applied to learning, particularly in online environments.

Entangled Learning (EL)

Entangled Learning is a model of self-designed learning in which people work collaboratively to learn in an area of interest in ways that they find work best. The name is drawn from the concept of quantum entanglement in physics (“Quantum entanglement,” n.d.) and relates to networks of learners who influence each other as they learn together.

Electronic Portfolio (ePortfolio)

“Electronic portfolio is a tool for documenting and managing one’s own learning over a lifetime in ways that foster deep and continuous learning.” This definition is from an article on the topic of defining ePortfolio (Jenson and Treuer, 2014). There are many types of electronic portfolios, each of which is characterized by a web-based, multi-media, presentation and explanation of authentic evidence of learning.

Evidence

Evidence is an artifact that provides an objective reference point to which someone can compare an assertion and judge its validity. Learners collect their own evidence to use in documenting and validating their learning. Evidence is included in an ePortfolio as material to fuel the process of reflecting and integrating learning, supporting assertions of habitual self-regulating, and establishing skills in collaborating.

Integrating

Individuals synthesize their knowledge and skills through applications to real-life and theoretical situations within their practice and in other practices. Integrating includes incorporating new knowledge into one’s current knowledge base as well as applying current knowledge to new situations. Integrating applies to knowledge, skills, behaviors, and other cognitive and affective ways of learning.

Landscape

As Wenger-Trayner and Wenger Trayner (2014) discuss the metaphor, a landscape is a body of knowledge that defines practices which constitute an occupation or field of endeavour. Individuals’ interaction with the landscape shapes their learning. Practices create boundaries on the landscape; crossing the boundaries creates opportunities for learning. In other words, a person can look back on their pathway to learning and identify practices that shape the accumulated learning and knowledge inherent in the person. Conversely, a person can look forward and identify practices to develop so that they can build a pathway to achieving learning goals.

Learning ePortfolio

This type of portfolio is used to document an individual or a group’s learning. It is intended to be dynamic, changing as more learning is accomplished. Artifacts can be included to provide supporting evidence, and reflections can be included to make meaning, provide context, analyze, or validate the learning. A learning portfolio can be created for learning in one practice or for an individual’s landscape of practices (Wenger-Trayner & Wenger-Trayner, 2014). A learning ePortfolio is not intended to be used primarily for summative assessment or to present

a public persona; its power is in providing an environment and serving as a tool for ongoing reflection and self-assessment that deepen learning and prompt reflection on learning design (Jenson & Treuer, 2014).

Metacognition

Literally, metacognition is being aware of and thinking about thinking. One way of thinking about thinking is to review the results of past efforts, considering what the goal was, whether the process was effective for meeting the goal, and what aspects of the process should remain or be amended in order to meet future similar goals. Metacognition relates in our model to self-regulating and reflecting.

Practice

A culture that integrates a community's knowledge base of actions, methods, values, and perspectives. It is developed over time through social interaction and mutual engagement in a particular pursuit. (Wenger 1998) Practice is not only what the group does but also includes how they do it, what their history is, why it is important to them, what values they express or hold in relation to the activity, and ways of describing or discussing the activity. It essentially is a culture that the community grows around their common engagement in a pursuit.

Practice-based learning

Learning a particular pursuit while engaged in that pursuit. Practice-based learning includes becoming competent in the field of knowledge as well as learning how to learn in that field. It involves being on the inside of a practice and learning from the insider's perspective. It means engaging in the activity and culture of of the pursuit rather than observing, discussing, or sampling at the edges.

Program designer

One of the roles possible in Entangled Learning, program designers typically work in environments that are more structured, such as a course, a university major or program, or in another similar setting. Program designers may be faculty members who integrate Entangled Learning into their courses. The role of the program designer is to establish the purpose, expectations, potential range of activities and resources, and evaluation criteria for learning. The program designer creates the environment for learning and then gets out of the way by avoiding the temptation to determine how the students will proceed with their learning. Program designers who have been working in a traditional environment will find it extremely challenging to refrain from specifying too much structure or being too directive. Students accustomed to the traditional teaching environment will likewise be extremely challenged to take an active role in directing and designing their learning. This is good -- this is transformative learning that will pay dividends later.

Reflecting

Individuals contextualize and validate the meaning and significance of their learning consistent with their personal and community goals and values. Reflecting means thinking about learning experiences and seeking meaning from them; there is a metacognitive component. A critical

component is incorporated by comparing one's learning with established standards or thinking about the reflection to consider its validity as well as to evaluate the learning.

Self-directed learning

Individuals and communities decide for themselves what they will learn, with whom, in what space, how they will learn it, and how they will evaluate their learning. The ability to be self-directed relates directly to ability to self-regulate one's behavior and actions according to the design the learner creates.

Self-regulating

Individuals are aware of and exercise control over their behaviors associated with desired learning outcomes. Behaviors are practiced. Self-regulating is an important skill to develop so that learners are successfully able to be self-directed and to persist in the learning environment. Metacognition is a component of self-regulation.

Social learning

A cognitive process of creating knowledge that occurs through interaction with other people. It includes developing meaning and identity, both for the individual and the group. Community of practice is a social learning theory (Wenger, 1998).

Trainer

The trainer is an important role, for self-directed learning requires structured training and support to be effective. Giving learners the manual and wishing them luck is a recipe for failure. Training need not be overwhelming, for the model is relatively simple and direct; it does, however, need to address enough of the theoretical basis of the model to illuminate why the components are included and why they are important. Training should be tailored to each learning environment and should include the purpose for entangling learning, expectations of the learners, what the learners can expect of others in the environment, what learning activities are and how to engage in a few that are especially important, and how to evaluate learning for themselves and within the broader context of the learning environment. The trainer also articulates what support is available, what roles the supporting cast play, and what to expect from that support.

Appendix B -- Differentiating Entangled Learning

	Academic Support Program	Academic Course or Program	Entangled Learning
Community	Peer leader or facilitator external to the group is selected and charged with developing community for the target population. Surface level community may be established within sessions. Regular participants form core membership and develop community among themselves. Participation in sessions is highly variable with no expectation of accountability.	Incidental to learning, though may be considered beneficial. Micro-community may form among students. May be facilitated through activities related to the program or social events.	Formed organically among equal practitioners. Everyone is part of the in-group. Developing and maintaining community is integral to learning. Community members persist over relatively lengthy period of time, participate consistently, and hold each other accountable.
Practice	For the peer leader: learning how to facilitate other people's' effective learning. For the participants, learning through activities that have been prepared in advance or through asking questions.	Fulfilling the requirements specified by faculty and collecting numbers of specified credits.	Learning how to learn in a target area
Existential environment	Connected to a course or sections, typically in higher education, with face-to-face or online instruction.	Constituent of a larger academic organizational unit - department, school, college, or university.	Not necessary to be within a formal educational setting. Any age can participate.
Expertise	Selected according to subject matter and interpersonal expertise.	Supplied by the faculty.	Developed among members through engagement in the practice. Some members may have more expertise in certain aspects of practice, but expertise does not alter equal standing of all members.
Schedule	Set by program administration or peer leader, with or without input from target population. Participants choose frequency of attendance.	Established by the faculty. Documented in the syllabus, departmental handbooks, or university catalog.	Set by community. Members participate regularly. Documented in learning portfolio.
Agenda	Set by peer leader or facilitator and may be negotiated with participants. If for individual assistance, the person seeking help sets the agenda.	Set by the faculty and documented in the syllabus, departmental handbook, university catalog, or web site.	Set by community. Documented in learning portfolio.
Group process	Fostered primarily by leader or facilitator. Not integral part of learning experience.	May be important component of certain courses. Unnecessary and perhaps unwelcome at program level.	Core to developing community, establishing values and practices, and integral to learning. Facilitated among members. Roles may be assigned for monitoring.
Learning resources (worksheets, incomplete outlines, etc.)	Developed in advance by peer leader or facilitator or borrowed from another source.	Textbook, workbook, online resources determined by instructor or course coordinator.	Developed or identified by and for the community as component of learning.
Documentation of participation	Initiated by peer leader or facilitator. Supports program assessment.	Attendance recorded by instructor or ignored. Registrar documents credits earned. Supports evidence of time on task or completion of course for assessment and external regulatory oversight (accreditation).	Documented by members, individually or by the community. Supports self-regulation and autonomous functioning.

	Academic Support Program	Academic Course or Program	Entangled Learning
Documentation of learning	If it is conducted within a session, it is initiated by peer leader or facilitator. Indirect measures applied through program assessment.	Student may keep record of homework sheets, exams, etc. Instructor documents grades earned. Possibly self-reported via student evaluations of teaching. Programmatic assessment, typically summative and quantitative.	Conducted by members, individually or by the community. Supports reflection, integration, and collaboration. Influences subsequent learning design.
Program administration	Determined by learning center staff.	Conducted by faculty, coordinator, and administration.	Conducted by members.
Training	Specialized training provided to peer leader after successful course completion: group processes, mentor training, learning theory, collaborative activities, and administrative processes. Certification as mentor available.	Instructors learn as they teach and participate in faculty development seminars or professional conferences. Some learn through mentorship, including as TAs.	Initial training available through a manual and orientation by program designer. Members learn together as they engage in their practice. They seek additional training or coaching according to their learning needs. Certification process.

Appendix C -- Case Study

This fictitious program evaluation illustrates how a case study can be used to reflect upon an Entangled Learning experience. A detailed guide for writing a reflective case study is provided in the Manual. Note that the author reflects upon her experience and participation as well as those of her students.

Case Study for Implementing Entangled Learning in General Biology

Background

Members of the communities of practice were enrolled in my General Biology course. They were predominately first-semester freshmen in Biology and related pre-professional majors. The communities of practice met as study groups attached to the course so that they could learn how to learn Biology and persist in the track for pre-professional majors, rather than dropping to the affiliated major level that is less rigorous. Approximately 75% of the enrolled students participated in the communities of practice. 90% of those students reported on the end-of-course survey that they were satisfied or highly satisfied with their experience, citing increased motivation, peer collaboration, subject material competence, and learning skill acquisition as the highest reasons for satisfaction. Review of reflections in collaborative learning portfolios indicates that most of the communities were successful in establishing productive social interactions within their groups. They developed group identity and planned their registration for the next course in the sequence so that their communities of practice could remain intact.

This is my fourth year of teaching General Biology at this college, but it is my first experience with Entangled Learning. I and the coaches followed the progress of the communities of practice through their individual and collaborative learning portfolios. During each lecture I devoted a few minutes for questions the groups wanted to ask, recognizing their notable work, or offering suggestions for increasing the effectiveness of their group dynamics and learning.

Characteristics of the Communities of Practice

The initial size of the communities of practice was six individuals. I took some care to initially constitute each group with a mixture of genders and scores on a content-based pre-test. As the groups began meeting, some members joined different groups because of group dynamics, desire to be with friends, or scheduling difficulties. Three groups disbanded because of the deadbeat clause, and seven of those members joined other groups. Groups were strongly encouraged to meet once weekly for an hour. Half of the groups met once weekly for two hours. One-third of the groups met twice weekly for 90 minutes. The remaining 17 percent met more often, for longer periods of time, or failed to meet the minimum expectations.

During group meetings, the participants follow an established meeting guideline that includes assigning roles, setting an agenda, engaging in discussion and collaborative activities, reflecting

on learning and the social dynamics, and documenting learning in individual and collaborative portfolios. Most of the study groups created outlines of material, developed graphical study guides such as concept maps and matrices, assigned each other material to learn more thoroughly and present to each other (peer lessons), and design predictive quiz or exam questions to answer. Group members generally rotated a variety of roles for the first six weeks but then settled on permanent assigned roles based on individual strengths and interests. Most groups began to identify individuals with particular learning strengths or metacognitive skills and relied on them for leadership and skill development within the group.

Challenges for Establishing Entanglement

Students initially felt that meeting weekly for an hour was an excessive added commitment beyond the five hours they already were required for class and lab. Being new to the expectations of learning in college, many of the students initially were skeptical that the study habits developed in high school would be inadequate to meet the increased rigor. The Academic Support Center provided persuasive data illustrating the learning efficiency inherent through structured collaborative learning as well as information related to transition experiences of first-semester college freshmen. When the students began meeting in their study groups, they initially were unsure of how to proceed. Once they grew accustomed to the freedom available to them to direct their own learning, they discovered that it was both enjoyable and beneficial, provided they followed through with the suggestions and guidelines communicated during the training. Most of the groups sought assistance from the coaches at least twice. Common requests for assistance were for understanding roles or managing conflict within their group, clarification of collaborative learning activities, or understanding course content. Of the skills in the design cycle, critically reflecting and documenting were the two for which the students expressed the most initial resistance. As the semester proceeded, and as I and the coaches encouraged the students to engage thoughtfully in these, the students discovered that these two components became more important than the other skills for deepening their learning, asking richer and more nuanced questions, and engaging more thoroughly with the course material.

The greatest challenge I faced with implementing Entangled Learning was to become comfortable and secure with giving the students the freedom to direct their own learning. Although I believed in the possibilities inherent in Entangled Learning from the beginning, actually letting go of the details of their learning activities was a difficult mindshift to make. When designing the overall framework for the entangled course, I tended to want to be too directive in assigning homework and learning activities. I also realized that as soon as the students left my classroom, I had to rely on their ePortfolios to gather information about their learning. It took a few weeks to learn how to communicate with them about improving the quality of their reflections so that they became more beneficial as learning opportunities for the students and windows onto their learning for me and the coaches.

Plan for Entangling the Community

Each of the communities of practice established a charter that described the values and practices they agreed to follow. Common values included themes of respect, listening, patience, and sharing resources. Groups varied on practices related to their meetings. Most gathered on weekday evenings in campus learning commons areas or group study rooms. Each community developed their own approaches to organizing their collaborative learning portfolio. Most used shared file space in Google Drive and organized by chapter in the textbook, but developed various subfolders. It was a simple matter for them to create a Google Site to selectively share their documents.

As I considered designing an effective structure around their learning, I built more activities in the beginning of the semester to model effective learning practices. I was very pleased that as the semester proceeded, the study communities were able to thrive with less structure. Most of the communities developed the habit of outlining the chapter on their own, comparing their outlines, and compiling for their collaborative portfolio a comprehensive outline. Most groups also developed a running list of potential quiz or exam questions at the end of each study session. These are two practices I included in the training experience and heavily promoted during lectures. At the beginning of the semester I projected to the class a number of outlines and questions that were excellent and discussed approaches to improving some of the more average attempts.

Analysis

The peer coaches were essential to the success of entangling this class. Being peers, some of them were even Biology or Genetics majors, the students found the coaches to be less intimidating and more accessible than I. The coaches were available Sunday through Thursday evenings with drop-in times as well as via Google Hangouts. It took the coaches a few weeks to grow accustomed to their practice of asking questions to prompt the group members' thinking about how to approach each challenge. Everyone's tendency was to expect the coaches to actually solve the challenges themselves. Training the coaches to expect this, equipping them with strategies in Socratic questioning, and developing in them more understanding of mindset and metacognition will be important for next fall's implementation.

Scaffolding the students' independent learning with more prescribed activities early may have backfired by providing too much assistance. Scaffolding heavily while simultaneously promoting the self-directed nature of their learning was a mixed message. Rather than modeling, as I had hoped, I am concerned that the scaffolding actually made the students dependent. It would have been better to begin from the first day of class with the students completely self-directed and to spend slightly more class time modeling a few more activities so that the support and the choice are both present.

It was instructive to experience the way my program design unfolded through the semester. As I wrote the design into my syllabus, I was uncertain whether to list some components as

expectations or as activities. In the end, I determined that expectations would be anything that would be graded work. I listed as activities those experiences I hoped would engage the students. I will revise the purpose section next semester to place more emphasis on the reasons why I expect the students to work in social groups. During the semester I have read more widely in literature about the importance of non-cognitive skills and the value placed on employees' approach to work, interpersonal skills, and social skills. Students' reflections in the groups that performed well in the social learning aspect indicate that they were intentional about developing that part of their practice. Students in groups that paid less attention to or discounted the importance of social learning tended to exhibit less nuanced and shallower consideration of their learning. Additional assessment will reveal whether there is any correlation with mastery of course content.

An aspect I am still wrestling with is quantity, timing, and mode of providing feedback for formative assessment. Because their drive contents are visible to me, many of the students expect, and I feel a responsibility, to read and comment on their reflections and learning artifacts weekly. This quickly became impossible with a class of 150 students. The peer coaches assisted, and while many of their comments were helpful, I still feel responsibility as the instructor and as someone with more extensive education, to comment. In this regard, I am struggling with integrating my role as instructor with the learning paradigm in the article by Barr and Tagg that the Academic Support Center shared with me at the beginning of our collaboration on this course. Because their learning is supposed to be self-directed, I felt self-conscious about commenting on their reflections -- doing so felt voyeuristic-- and commenting with each journal entry seemed as if I was being overly-active, pouncing enthusiastically on each week's comments. Eventually I fell into a pattern of reading multiple week's entries and sending an e-mail message with comments. I question whether the students actually read what comments I inserted into their reflections, and commenting within their text seemed to be an unwelcome intrusion marring the entries.

Evaluation and Recommendations

As I look ahead to next semester's General Biology II, I need to give attention to integrating students who were enrolled in Dr. Daniels' section this semester. I notice that enrollment trends are that the students who did not engage with their Entangled Learning group have enrolled in his section. His students this semester who regularly attended his review sessions have now enrolled in my section. Most of the communities of practice have decided to remain intact next semester. I asked representatives of the communities their recommendation on how to integrate newcomers to our practice; they agreed that one or two newcomers should be randomly assigned to each community so that the group members themselves can mentor them into their practices. I will still require them to complete the formal training and will hold a mandatory orientation session outside of class during the first lab period.

To capture my learning as a practitioner of entangled learning, I plan to annotate my copy of the design for learning and post it in a collaborative ePortfolio I am developing to share with other faculty members who will be using the Entangled Learning model next semester. I will also

include this case study and some pertinent journal entries I made. Because I required my students to write a weekly reflective essay about their learning and the group's learning, I decided I should do likewise. Engaging in this practice quickly convinced me of its value, for I found my thinking time about the course became more productive. Committing to writing in the journal spurred me to think more deeply about the course, and documenting my thoughts kept my mind free to work on more complex challenges, while still enabling me to review and reflect on what I wrote. I wish that our campus had adopted this stance of ePortfolio as reflective practice. It makes so much more sense and is such a deeper, more effective learning experience than ePortfolio as program assessment. It's no wonder the students are cynical about keeping a portfolio!

Future research directions will be compare pre-/post-tests of motivation or engagement with pre-/post-tests of course material to determine any correlation between motivation and engagement with quality of learning. Qualitative analysis of the students' reflection journals will provide context for positing hypotheses about causation and the efficacy of Entangled Learning.

I also plan to develop a longitudinal study to track students' continued practice of meeting in their study groups. Research areas include whether they continue to use the same practices in their collaborative learning or if they develop more sophisticated or complex practices, whether they create successful new communities around different practices, whether their current groups remain intact throughout their undergraduate career, and whether persistence in their community of practice correlates with course performance, overall GPA, and persistence in the major.

Provided that these studies indicate that this implementation of Entangled Learning has merit, I will develop a larger longitudinal study of students 2, 5, and 10 years out to explore their collaborative practices in their graduate school and professional careers.

Appendix D: Deep Learning Literacy

Literacies	Level 1: Lacking Proficiency	Level 2: Partially Proficient	Level 3: Proficient	Level 4: Exemplary
Documenting Learning Assembling and sharing evidence of knowledge and skills relevant to learning goals and practice.	Collecting artifacts with prompting, but without demonstrating their relevance to learning.	Collecting relevant artifacts to demonstrate learning outcomes as a result of prompting.	Collecting relevant artifacts to demonstrate learning outcomes without prompting.	Habitually collecting relevant artifacts that demonstrate learning without external prompting.
Self-Regulating Being aware of and exercising that control over behaviors associated with desired learning outcomes.	Being unaware of individual behaviors that affect learning; putting responsibility for learning on others.	Being aware of learning behaviors and strategies but depending on others to enable and/or require those behaviors.	Consistently controlling behaviors and strategies to meet learning goals in a structured learning environment.	Consistently and independently controlling behaviors and strategies to meet learning goals in any learning context.
Reflecting Contextualizing and validating the meaning and significance of learning consistent with personal and community goals and values.	Naming and/or describing learning activities as prompted but lacking awareness of relevance to learning design or their significance to community goals and values.	Identifying processes and experiences associated with learning but being unable to relate them to outcomes or values when prompted.	Contextualizing the meaning and significance of learning experiences consistent with established goals and values as prompted.	Contextualizing the meaning and significance of learning experiences consistent with evolving goals and values without prompting.
Integrating Synthesizing knowledge and skills through applications to real-life and theoretical situations within the practice and in other practices.	Being unable to recognize the significance to or application of a learning experience to any other setting.	Recognizing the significance to or application of a learning experience to other learning situations when prompted.	Synthesizing and transferring learning in a learning situation to other situations when prompted.	Synthesizing and transferring learning of any kind to any number of other situations in any number of environments.
Collaborating Participating in community of practice to ask questions and discover new knowledge relative to common practice.	Following the lead of others to design and demonstrate learning but unable to connect that learning to the goals of the community.	Participating in a community of practice to develop, document, and assess knowledge and skills in response to prompts.	Contributing to a community of practice to develop, document, and assess desired knowledge and skills.	Stewarding a community of practice that collaborates to meet the learning goals of its participants.

Adapted from Jenson, J. & Treuer, P. (2014). Defining the e-portfolio: What it is and why it matters. *Change*, 46(2), 50-57.