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Emergent Learning, Connections, Design for Learning

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Editorial - Special Issue: Emergent Learning, Connections, Design for Learning


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In a digital world dominated by social media, networks, and instant communication, the creation of viable, effective, and sustainable learning environments remains a challenge for designers, administrators, teachers, and learners.

The purpose of this special issue was to examine this challenge through a lens of connections, emergence, chaos, complexity, fractals, and quantum theory, which are terms that originated and have been widely studied in the natural sciences, and which are now appearing as important interdisciplinary ways to understand both natural and social sciences, including education. The question therefore arises, are the traditions of what it means to teach and learn being challenged by these concepts, or are we simply experiencing the natural evolution of education through a process of emergence, connections, and the design experience?

As editors of this issue, we proposed the following frameworks to provide a prompt for the submitted papers.

- **Emergence** encourages random encounters, paying attention to your neighbours, and "more" being different. Through such encounters and interactions we can look for patterns in the signs which can be extrapolated to an entire system, the intelligence of which comes from the bottom up, and where low-level rules can create high levels of sophistication.

- The **connections** being made between people through social networks has emphasised "connectivism," an emergent theory of learning where the interactions that are generated by these connections, whether informal or formal, have the potential to result in new, emergent knowledge.

- For **designers**, taking account of emergence and connections can challenge the tradi-

> tional models which have been used to create 'instructional order.' Emergence theory offers insights into complex adaptive systems that can self-organize, a quite different way of conceptualising the teaching/learning space.

Given this interaction between connections and emergence, and the significant impact this interaction will have on how we teach and learn, it is important therefore to analyse what it means to design for emergent, connected learning experiences.

The more we (as practising online teachers and researchers) reflect on the encounters students experience when enrolled in online courses, the more we see the need for different ways of conceptualising the online learning space. From our experience at universities in both Australia and the United States, we are seeing online courses that ask students to do little more than read, regurgitate, and respond, the very antithesis of the collaborative, open, and flexible environment proposed for the online learning experience.

In response to that, we have argued (Irlbeck, Kays, Jones, & Sims, 2008) that reconceptualising the online learning space as one that is proactive and enabling students to test the boundaries of knowledge is the preferred aim of online learning rather than keeping students inside those boundaries. When we look at the work of Jonassen (2010), who argues for the integration of problem-solving into the educational experience, we can begin to see further connections, that problem-solving can be the trigger for the possibility of emergent knowledge. We can see also solutions that are not premeditated and that potentially might change to a broader understanding of the context in which that problem was initially established.

Knowledge is dynamic and boundless, and the online learning environment provides the perfect set of tools and connections to redefine current understandings and perceptions. To reflect on these concepts we have selected six research articles and two reflective pieces that shed light on new ways of thinking about teaching and learning, especially those that address the more informal and emergent ways of educational thinking.

The first paper to note is presented by David Murphy in the Research Notes section; his reflections of a PhD journey are insightful and provide a background for the thinking that has informed the focus for this special issue. The ideas and issues raised by David lead us to question whether we should continue to subscribe to the traditions of "instructional design" or whether we need to adopt more *chaotic*, organic, and ecological models for design, perhaps tapping more into the essence of human learning rather than the mechanics of design. The second reflective paper by Carlo Ricci provides a valuable set of examples of emergent learning both in terms of informal learning external to the formal school setting and the integration of mobile "apps" into unstructured learning experiences. Using three examples of young children using different "apps", Ricci argues they provide a means to emergent learning which Williams, Karousou, and Mackness (2011, p. 41) have described as "learning which arises out of the interaction between a number of people and resources, in which the learners organise and determine both the process and to some extent the learning destinations, both of which are unpredictable."

Through these reflections we have a context for the current research which is presented to shed light on different ways we might think about teaching, about learning, and about the environments in which educational interactions occur.

The first research paper by Gail Casey considers the application of social networking in the high school environment and the potential for enhancing education through connected learning. The extent to which the class group becomes the empowering force, rather than the teacher, is one of the most interesting findings from Gail's study, questioning the traditional role of teaching and curriculum. Most telling is Gail's conclusion that we need to look beyond the constraining nature of formal education and consider a more holistic, organic, and ecological perspective:

> When writing his book *Fractal Horizon* Pickover (1996) described watching the surf break and considered the billions of water particles responding separately to the conflicts between gravity, wind, inertia and cohesion. One could make links to this surf breaking if one could imagine each student as a water droplet. Each droplet is measuring its own local forces from moment to moment and calculating its own path through the chaos. The result is a thing of beauty.

Beginning to appreciate the complexity of human systems and interactions is a start to realizing the potential our student groups can bring to the creation of emergent knowledge.

Pekka Ihanainen and John Moravec provide a different perspective of teaching and learning, examining the notion of facets of time within contemporary pedagogy, "creating a diverse ecology of time constructs within learning systems." Examining the interplay and overlap between microblogging (a *pointillist* activity) and discussion forums (a *cyclical* activity), the authors present contentious conclusions such as,

> when pointillist learning is examined from a pedagogical point of view, it opens itself as an anti- or a de-pedagogy. This means that pointillist learning cannot be taught - it just happens! And, because it happens so frequently, it is one of the most natural forms of learning for humans.

Arguing that "the chaordic nature of learning (overlapping cyclical, pointillist, and temponormative learning) in en-pedagogical systems cannot be managed," the authors ask how "we can best leverage these multidimensional opportunities of pedagogical time to facilitate multidimensional learning and meaningful new knowledge production." The narrative reminds us that the empowerment of learners and learning enabled through social networks and time-dependent communications is challenging the accepted and traditional notions of teaching and learning.

The third paper, presented by Marta Kawka, Kevin Larkin, and Patrick Danaher, addresses a critical question with respect to the affordances of social networks and the resultant informal and emergent learning: "whether institutional frameworks can accommodate the opposing notion of 'cooperative systems' – systems that facilitate the creation of user-generated content?" Embracing the broader themes articulated for this issue, the authors compare practices of interactive art, where "the focus is on the articulation of meaning through the work; meanings are not static and predefined but co-created in the process of interaction" and reinforce the potential for co-creation of knowledge, emergent knowledge, within the educational context. Using a two-dimensional matrix (interaction and knowledge-source) the authors examine a design continuum that enables student-regulated interactions and the emergence of unpredictable outcomes. While we contend there is debate as to whether emergent systems can be designed, we do acknowledge that we remain in an education society that is traditional. Even so, the conclusions that "those involved in the design and delivery of learning must become increasingly sensitive to learning which emerges from their students rather than imposing learning outcomes upon them" encapsulates again the threshold of change we are witnessing in the educational sector.

Focusing on a more theoretical perspective, Katherine Janzen, Beth Perry, and Margaret Edwards propose that

> If it is accepted that there are multiple ways of knowing (Netzer & Mangano, 2010) then it follows that there are multiple ways of learning. If there are multiple ways of learning, then multiple ways of explaining how individuals learn must be requisite.

Arguing for the implementation of a *quantum perspective of learning*, the authors remind us that "human beings share connections with themselves, other individuals, the environment and the universe (Hare, 2006). Quantum holism suggests that this interconnectedness extends infinitely in all things, in all places, and at all times." It is this mindset, a common thread in the papers presented, that highlights a shift from learning being restrained by educational models to learning as an holistic, almost spiritual, outcome. By introducing a quantum layer over the current discourse of teaching and learning, the authors demonstrate how new ways of thinking about our field are critical and that we need to think of the design of the associated environment quite differently; for example, "Online learning needs to be multidimensionally constructed and occur in various planes/dimensions in order to access holistic development." As the authors demonstrate, enabling teaching and learning practice to develop and improve is not just about research within current understandings, but being bold enough to examine pedagogy through quite different lenses.

Rita Kop, Hélène Fournier, and John Mak provide a very concise summary of our current place in teaching and learning research: "The structure of the learning environment, the place and presence of learners and educators within institutional boundaries, the nature of knowing and learning are all challenged by the fast pace of technological change." They

raise the key question, implied through each of the papers presented in this special issue, of whether it is appropriate to put the responsibility for the learning process onto the learners themselves. In doing so, the role of formal educational institutions is also called into question: Are they able to meet the challenge from and compete with the ever-growing and ever-connected web of knowledge? Presenting a comprehensive study of two massive open online courses or MOOCs (one with 1,641 participants and the second with 700+ participants) the authors highlight both the benefits that accrue from intentional education networks (such as visualisations of connections and resources) and deficiencies (such as limited facilitator involvement and management). The authors conclude that "meaningful learning occurs if social and teaching presence forms the basis of design, facilitation, and direction of cognitive processes for the realization of personally meaningful and educationally worthwhile learning outcomes," reiterating the need for independent and motivated participants (who each play both teaching and learning roles) and that while such large networks have strong learning potential, the reality of its achievement depends on both the motivation and experience of the participants and the acceptance of a knowledge network as a legitimate learning space.

The final paper provides a second perspective on the massive open online course (MOOC) and the importance of addressing the complexity of our environment not through preparation for the future, but participation in the creation of possible futures (Davis & Sumara, 2008). Through their analysis, Inge de Waard and her co-authors demonstrate ways in which the MOOC can be self-organising, connected, and open and emphasise the linking of mobile and social elements: "This is the first time in history that learning content can be accessed via mobile devices and social media. This expands knowledge acquisition beyond the traditional classrooms and libraries, hence redefining those spaces and adding to knowledge spaces overall." The authors provide evidence as to the dynamics of the MOOC, the importance of sharing, and that "dialogue has always been at the center of knowledge exchange." As with the other papers in this issue, the consensus is unequivocal: We are now in an age where we can interact and engage anywhere and anytime, and participants in learning are more readily able to know what knowledge they need, and where to find it, to achieve learning outcomes.

Through these insights we contend that the days of traditional teaching or instructing are limited, that we are on the cusp of different ways of learning such that new knowledge will emerge as a result of both formal/structured and informal/unstructured interactions, and that this knowledge will integrate seamlessly into relevant global networks. Within this context it is simply no longer sustainable to think of designing courses for instructors to deliver; rather, we must design, as best we can, for learning that will be a product of interactions between participants, learning that will come from within and without the formal classroom and learning that will focus on proactive change rather than reactive recollection.

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Designing for Learning: Online Social Networks as a Classroom Environment


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Abstract

This paper deploys notions of emergence, connections, and designs for learning to conceptualize high school students' interactions when using online social media as a learning environment. It makes links to chaos and complexity theories and to fractal patterns as it reports on a part of the first author's action research study, conducted while she was a teacher working in an Australian public high school and completing her PhD. The study investigates the use of a Ning online social network as a learning environment shared by seven classes, and it examines students' reactions and online activity while using a range of social media and Web 2.0 tools.

The authors use Graham Nuthall's (2007) "lens on learning" to explore the social processes and culture of this shared online classroom. The paper uses his extensive body of research and analyses of classroom learning processes to conceptualize and analyze data throughout the action research cycle. It discusses the pedagogical implications that arise from the use of social media and, in so doing, challenges traditional models of teaching and learning.

Keywords: Social networking; online learning; student learning; emergence; chaos and complexity

Introduction

Modern school systems place increasingly sophisticated pedagogical demands on teachers, including the need to be able to make decisions about how, when, and with whom they should select and use new technologies in their teaching. Many of these new demands also, at times, conflict with the traditions of what it means to teach and learn. When used effectively, new technologies have the potential to allow students to "speak" to a world far beyond their local community. In doing so, they empower students to write and publish for

a global audience, encouraging them to be more than just the audience (Wells, 2007). Research exploring the impact that new information and communication technologies (ICTs) are having on teaching and the ways students learn, particularly the role of one-to-one laptops in the classroom, continues to be a priority for many educational policymakers. And due to young people's attraction to them, social networks are emerging as an important tool in today's schools. Senior high school students are interacting in such networks with or without their teachers' consent (and, at times, without their knowledge) through study groups organized using Facebook (http://www.facebook.com/). In Years 7 to 10 of the Australian school system, a small number of teachers are exploring the use of private social networks, such as Nings (http://www.ning.com/), while some primary (elementary) school teachers explore environments set up specifically for education, such as SuperClubsPLUS (http://www.scplus.com/d/index.php). Connections, emergence, chaos, complexity, and fractals are theories that the authors will discuss at length throughout this paper as they share the sometimes unexpected outcomes of this classroom action research study. These theories have helped the authors appreciate learning as a dynamic and shared experience that extends beyond the boundaries of the classroom, where the unpredictable is considered a treasured learning experience. They allowed the teacher to relax her hold on the teacher "power" in the classroom and gave her the confidence to design new learning experiences that challenged what it meant to teach and learn.

Many researchers have asked questions about today's youth, who are growing up in a digital world, and about the Web as a transformative medium (Brown, 2002; Prensky, 2010; Reamsbottom & Toth, 2008; Sultan, 2010; Weinberger, 2008; Wheeler, 2001; Williams, 2008; Yuen & Yuen, 2008). Consequently, exploration of and discussion about the connections between young people, social networks, and education is needed. There is also a pressing need for students to be literate in the new digital practices that are required to actively participate in the global economy. Such views are commonly expressed by Dillon (2006), Johnson and Kress (2003), Edmonds (2006), Luke and Elkins (2002), and Merchant (2007). A major concern many educators have is the fact that students often communicate among themselves in ways that school systems do not formally recognize but that the workplace is moving to embrace. An example of this can be seen at the web page of Geelong City Council (http://www.geelongaustralia.com.au/Default.aspx), which uses both Facebook and Twitter to advertise and promote local events. Worldwide acceptance of social networking in the workplace is paving the way for education to take advantage of this type of connected learning.

The Internet, social media, and Web 2.0 are becoming important components of students' education as schools increasingly provide a laptop or other portable device to each student, but just how these new ICTs should be used is still a topic of debate. School administrators, generally, are wary of social media in the classroom. Students using online social media in school settings or elsewhere have access to content every hour of every day, but teachers are unable to constantly monitor them; hence, an element of understanding and trust is required. Social media platforms enable students to develop content and interact with one another and allow them to build a sense of community. Furthermore engaging with social

media becomes addictive for certain young people as they constantly monitor their own developed online presence for new activity or comment. Mason (2008, p. 70), however, describes some positive qualities of social media use in the classroom: They require students to participate, think, contribute, and become active in their learning. Using a social network such as a Ning in the classroom allows the teacher not only to incorporate multimedia and multimodal texts but also to share these quickly and easily, providing a collaborative learning environment where students can communicate at any time. This new reality has the potential to significantly impact how we design learning experiences if we take advantage of opportunities for connectivity. By incorporating social media into the lives of students in the classroom, teachers also incorporate the new literacies that are becoming part of students' out-of-school lives (Alvarez, 2001; Fletcher, 2007; Glover & Oliver, 2008; Hahn, 2008).

Graham Nuthall's approach to learning underpins the analysis of the research reported in this article. By his own account, Nuthall was drawn to social constructivist theory, although he was relatively pessimistic about the feasibility of social constructivist approaches to teaching, except in rather narrowly specified situations (Brophy, 2006). Nuthall (2007, p. 14) believed that teaching is about sensitivity, adaptation, and adjusting to the "here-and-now" circumstances of particular students. He believed that it is about making immediate and intuitive decisions as a lesson or activity progresses: Topics that interest some students do not interest others, and solutions that work one day may not the next. Nuthall makes it clear that students learn a great deal from their peers. In fact, their motivations, interests, attention, and involvement may all be strongly affected by relationships with their peers. By looking at the interactions between students in this study, patterns become visible and can be extrapolated. Simple conversations between students have resulted in important classroom decisions being made. New and emergent knowledge is the end point of both the informal and the formal learning that occurred.

In traditional schooling, teaching tends to imply that the content is a finished and complete packet of information to be "transferred" from teacher to learner, and this notion is directly or tacitly conveyed to students (Doll, 2005a, p. 175). In this simplistic transfer approach, Doll argues that the complex "poetry" of learning goes ignored or unrecognized. This article attempts to provide examples of such poetry with its discussions on the interactions and learning experiences of the students. It reports on the way they presented their ideas, reacted to their peer's ideas, and how the complex patterns of communication arose against the backdrop of their own experiences. These patterns made links between connections and emergence and had a significant impact on the design and implementation of the teaching and learning process throughout the study.

Research Design

This action research investigates the use of online social media as a learning environment for adolescents between 13 and 16 years old throughout semester 2, 2010. The first author (Casey) is both teacher and doctoral researcher (hereafter referred to as the research-

er), and the second author (Evans) is the doctoral supervisor. The project involved all of Casey's classes at a Year 7 to 12 coeducational public high school with a student population of approximately 900. The school is located in Geelong, a city with a population of approximately 200,000 located about 80 kilometers from the Victorian state capital of Melbourne in Australia. Students are predominantly from a mid-range of socioeconomic backgrounds. The school runs a vertical curriculum using A, B, C, and D as subject levels (A being the lowest) in Years 8 to 10, where students of different year levels are often in the same class. All vertical classes operate for five periods per week, each being approximately 50 minutes. The researcher taught seven classes with an average-size class of 25 students comprising

- four Year 7 Information Technology classes (2 periods per week for each class);
- one level B Mathematics class (5 periods per week);
- one level B Information Technology class (5 periods per week); and
- one level C Multimedia class (5 periods per week).

The study searched for new approaches to learning. It took place during the school's initial stages of their one-to-one laptop program when all Year 7 students were required to lease a small laptop from the school. Throughout the research, online tools and environments were used in all of the researcher's classes to deliver the classroom curriculum. One main Ning social network was used as a base camp to communicate, publish, and link to other online environments. The teacher covered the curriculum topics required within each relevant subject area. But with all her classes she had the freedom to decide how the content was delivered. The researcher incorporated a range of online tools and environments into the content delivery, presentation, communication, and publication of class and student work.

All the students used pseudonyms when working online and were able to change these, their online profiles, and avatars at any time; hence, they were not openly identifiable to one another. Typically more than one class worked on the same online project at the same time, and usually the four Year 7 classes worked on the same project at the same time.

The researcher focused on three areas.

1. Teacher: What new demands does this type of classroom practice bring to the teacher?
2. Student: What scaffolding is needed to help students cope with the complexities of such an environment?
3. Learning: What potential does this type of online social medium have for learning?

This article will focus on the second area, that of the student. Figure 1 shows the main concepts of this focus area.

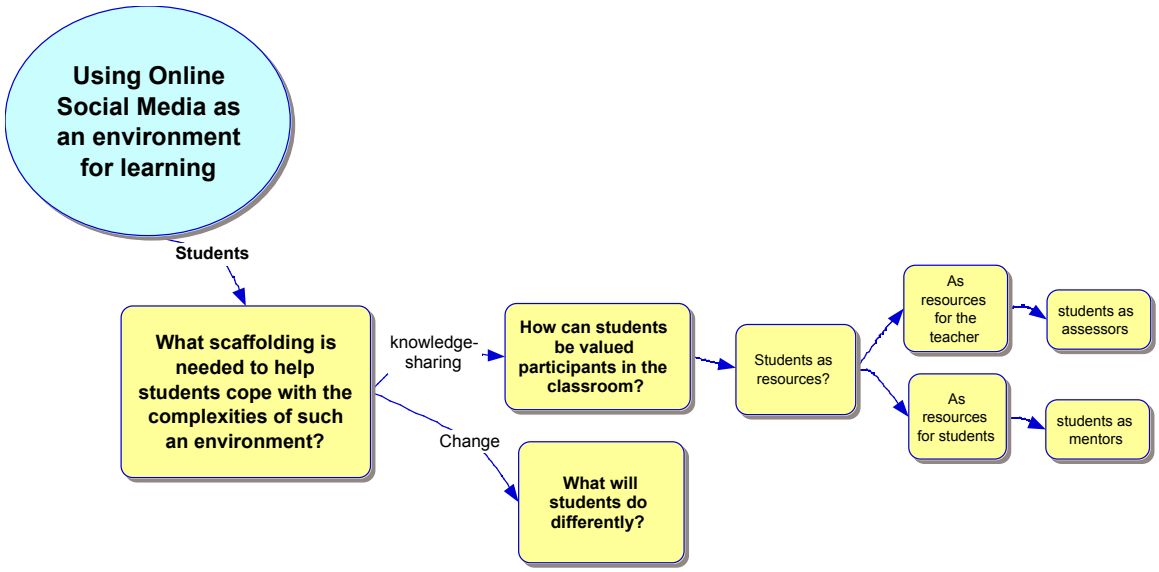


Figure 1. The focus of the research—students valued as resources for both their peers and their teacher.

This study used Armstrong and Moore's framework (2004, p. 13) of the action research cycle that explicitly encourages inclusive processes through the research design, practice and process, and outcomes. This framework does not suggest a sequence of segmented activities. Rather, it encourages a continuous, overlapping process of reflection, consultation, planning, and change. The researcher found this action research framework flexible enough to use throughout the data collection, which was important due to the many classroom projects and multiple classes involved: There could be as many as six classes, totalling approximately 150 students, at different year levels and stages working on the same project, including cross-class interaction. Thus, any stage of the action research cycle could become extended and might overlap with others. However, the processes of observing, identifying issues, raising questions, developing ideas, monitoring, evaluating, and changing what and how things were done were constant and became part of teaching life. These processes provided the researcher with ideas and inspiration on how to set about changing places, practices, and minds, as encouraged by Armstrong and Moore (2004, p. 14). The framework supported the flexibility that was needed in the curriculum delivery and allowed the researcher to think through other models of delivery, which assisted in helping her move away from the "instructional order" of the traditional classroom.

In order to develop authentic teaching and learning experiences which addressed the focus areas, the researcher chose to work full-time at the research site, ensuring that the pressures of full-time teaching could be related authentically in the research design. Hence, the researcher had a full allocation of teaching and other obligations, which included yard duty and scheduled meetings, although she took a leave of absence for approximately one week twice each term, or as required, to support the documentation and analysis of the research cycle.

Data collected included

- teacher planning documents, which incorporated teacher-directed activities, thoughts for future development of projects, resources, and general ideas for integrating Web 2.0 into projects and helping students become more independent learners;
- the teacher's field notes, taken while in the classroom and reflections made soon after each class was concluded;
- end-of-week teacher reflections, along with big picture planning and reflections at the end of each five-week period;
- student work, which included screen clips from online Ning activity and scans of hand-written student self-evaluations and reflections; and
- summary notes from teacher critical friend discussions.

This study used social networking as an environment for teaching and learning in a way that, at times, challenged what it means to teach and learn. The analysis of the data thus needed to be sensitive to emergent ideas. This analysis was based on identifying what was useful for educators or not, rather than on what was "right" or "wrong." Szempli and Stupnicka (2003, p. 1) explain that when we observe the evolution of various phenomena in the macroscopic world that surrounds us, we often use the terms *chaos* or *chaotic*, meaning that the changes in time are without pattern or control and hence are unpredictable and uncontrollable. Just as long-term weather forecasting is used as an example when conceptualizing chaotic behavior, due to the great array of influencing factors (such as temperature, barometric pressure, wind direction, and precipitation), one could argue that working with adolescents in the classroom produces a similarly large array of influencing factors that lead to "storms" or "calms" of a different kind. Chaos and complexity are perspectives in new science and postmodern inquiry that may implicate significant changes in how we understand and approach curriculum (Fleener, 2005).The data from this study provide insight into how a teacher might conceptualize chaos and complexity in the classroom and thus foster the development of activities that support emergent and connected learning.

A discussion of selected findings and their analyses follows. It uses qualitative data and explores students' online interactions with one another and the classroom teacher while drawing on related theory for analytical discussion.

Designing Learning Experiences

More than 150 students from the researcher's classes were registered on the Ning during this semester-long study. Members formed 77 groups by the end of the semester on this one network. The Ning offered students a great range of opportunities to form their own groups and discussion forums and become involved in those made by others. Students were able to be explorers, designers, and publishers, and this encouraged them to support their peers, self-reflect, and provide both peer-assessment and self-assessment. The Ning provided stu-

dents with a "life-like" curriculum (Beane 2006, p. 10) and continued to move away from the "instructional order" of the traditional classroom as the semester progressed. Students supported one another when solving problems and were able to draw upon the relevant, integrated knowledge and skills that many had honed outside the classroom. They were developing what Beane (2006, p. 10) calls self and social meaning. The way students communicated on the Ning allowed them a great deal of flexibility to read and write comments and to ask questions and seek clarification. They also enjoyed the freedom to develop new profiles, change their avatars, make friend requests, and send "gifts."

Students became active users of the Ning, and a complex, self-organizing interactive environment appeared to evolve. Teaching and learning was occurring, it seemed, as much informally as formally. Figure 2 shows a screen clip from the main page of the Ning online learning environment used throughout this research. (Note that group membership numbers shown do not indicate the number of students accessing a particular group but rather are the number who chose to formally join and hence are able to leave comments and upload to that group. The actual number of students viewing and using information from different groups is often a significantly larger number than the membership number indicates.)

Figure 2. Screen clip of the Ning social networking site with 159 members from the teacher's classes.

A large volume of qualitative data was collected throughout the classroom projects. At times there were 75 students in one group publishing their work, so as many as 75 discussion forums could occur in that group. Students found it helpful when their peers posted work because it allowed them to more clearly see, and hence understand, the project expectations. Initially, the traditional concepts of cheating were a topic of conversation, but students eventually perceived that the project design ensured that cheating was not an issue, and they valued learning from one another, which even led to high levels of sophisticated work. As the semester progressed, students were given more opportunities to make decisions and have more responsibility for things such as assessment and feedback to others. Normally, students come into the classroom and expect the teacher to be responsible for assessment; therefore, it took time for some students to accept these new practices, but eventually they did. It was interesting to see that many students were very accepting of the approach and appreciated the extra flexibility. As students provided constructive feedback to one another about important concepts such as assessment, this opened the door to generating new knowledge. In the traditional classroom, it is often the teacher who is the sole viewer and critic of student work. Students started to value the opinions of their peers and, at times, were very critical of peer work that contained little thought or effort or was simply cut-and-pasted from the Internet.

For each of the seven face-to-face classes, the most vocal students rarely participated in online situations. However, three of the quietest students who never appeared to do anything wrong in the classroom were suspended from the Ning or had to be spoken to about their inappropriate behavior, which produced a surprising result. Over the last 10 years in the public school system, it has become rare in the researcher's experience for students to seek assistance outside the classroom without being specifically instructed to do so. However, the students who were banned from the Ning often did want clarification on why they were suspended and directions on what to do to resolve the issue promptly. Students also sent a number of emails to the teacher requesting support to resolve issues. The connections students made through the Ning social network emphasized *connectivism*, where interactions that were generated by these connections, whether informal or formal, allowed students to behave in different ways and learn from one another rather than just from the teacher. As a result, opportunities to present new and emergent knowledge continued to develop which helped to enhance the teaching and learning process.

The researcher's interpretation of learning and teaching was informed by Nuthall's (2007, p. 36) criteria for effective teaching. His four premises follow, and under each one the researcher discusses how it relates to her research.

- First premise: Students learn what they do, and what they are learning is what you see them doing: writing notes, coping with the boredom without complaining, and later, memorizing headings and details they only partially understand. What they do in the classroom, day after day, is what they become experts at.

Response: After two weeks of using the Ning, most students became competent in the collaborative methods of learning as provided by the social network. There were usually one or

two students in each class who found the Ning difficult to use and navigate, and these individuals required more support. But by the end of the semester, most students were experts in their new learning environment.

- Second premise: Social relationships determine learning. It's very important to remember that much of what students do in the classroom is determined by their social relationships. Even in the teacher's own territory, the classroom, the student's primary audience is his or her peers. More communication goes on within the peer culture than within the school and classroom culture.

Response: More than 44 student-directed groups were produced in the Ning, where a range of informal learning could be found; some of this is evident in Figure 3.

- Third premise: Effective activities are built around big questions. If we want to design effective learning activities, we must carefully monitor what students are gaining as they engage in focused learning. We have to spend a considerable amount of time and resources monitoring what they are understanding and learning as well as designing and carrying out these activities. Taking the time and providing the resources needed to design effective learning activities means covering much less of the formal curriculum. To justify doing this, we must make sure that the outcomes of these learning activities are significant not only in the official curriculum but also in the lives and interests of the students.

Response: While the researcher valued all aspects of this premise, extra time was not available for activities due to school timetable constraints, but she integrated an approach where students could choose from a range of themes or devise their own.

- Fourth premise: effective activities are managed by the students themselves. The ideal learning activity, in line with the previous three premises, has the following characteristics:

    - It focuses on the solution of a major question or problem that is significant in both the discipline and the lives and culture of the students;
    - It engages the students continuously in intellectual work that is appropriate in the discipline;
    - It provides teachers with opportunities, as the class engages in solving the smaller problems, to monitor individual students' evolving understanding of the content and procedures.

Response: A number of projects the teacher gave to students involved teaching their peers or younger students.

There is more to teaching than simply engaging students in activities, and a good teacher, whether following a traditional model or otherwise, has certain qualities and attributes.

Atkinson and Claxton (2000, p. 1) argue it is self-evident that much of what teachers (and others) do in the heat of the moment is not premeditated, but intuitive. A situation arises, the teacher responds, and only later (if at all) will she pause to figure out what was going on and why she responded in that manner. Atkinson and Claxton go on to discuss the relationship between the rational and the intuitive, between the explicit and the tacit, and between articulated comprehension and gut feeling. Their discussion of what professionals do and how they learn to do it helped the researcher understand why she often went into the classroom and changed aspects of what lessons she had planned for a given day. She now understands the importance of the role of intuition in professional practice, particularly the significant part it played in her position as a teacher designing projects for learning within this online environment. She kept the words of Draut (2000, p. 267) in mind; he claims that teachers remain accountable for the learners' long-term progress, motivation, and well-being, the focus of many evaluations of practice. This does not change whether an instructor uses a traditional model for teaching and learning or not. In many professions, expert judgment, one variety of intuition, is often wholly or largely intuitive, and a teacher coming to a decision draws upon a vast database of largely inarticulate impressions (as well as documented materials) and may be forced to neglect rich nonverbal, nonmeasurable information if forced to justify every judgment explicitly (Claxton, 2000, p. 37). Yes, the researcher is challenging what it means to teach and learn in this study, but it should remain clear that as the content, delivery, and even assessment methods change in the exploration of connections, emergence, and design for learning, the teacher remains accountable.

Emergence: Social Media as a Classroom Environment

The analysis of students' online participation and interactions showed that there was a variety of levels for each. Some students took much longer than others to become familiar and comfortable with the Ning environment; these students often preferred "lurking" rather than actively participating. Others openly used the environment to promote their own ideas and interests, increase their own popularity, or present themselves as knowledgeable. Some students also used the Ning to air their frustrations and feelings. The following three examples indicate some emerging patterns of interaction found in the data.

Example 1.

Throughout the data collection, students were free to make their own groups or to join and communicate with any group on the Ning (except, rarely, when students chose to make a private group). By the end of data collection for this stage, more than 40 out of 77 of these Ning groups were student-directed (that is, they had nothing to do with class projects or teacher instructions). Some of these are shown in Figure 3 below and include "Fortress B," "King of All Groups," "Not enough chairs in a class room," "TF141," "Melbourne Victory," "PC gaming," "Ducks are awesome," "iTunes," "Apple," "Xbox 360's are better then PS3's" and "mr.bean awsomee." Many students, both male and female, enjoyed the connectedness provided by these student-directed groups. This connectedness is described well by Pickover (1996, p. 4). In his book *Fractal Horizon*, he described watching the surf break and considering the billions of water particles responding separately to the conflicts between

gravity, wind, inertia, and cohesion. One could make an analogy to this surf breaking if one imagines each student as a water droplet. Each droplet is measuring its own local forces from moment to moment and calculating its own path through the chaos. The result is a thing of beauty. Students formed groups, with each individual having the opportunity to add, join, contribute, or lurk. The decision to do any of these things changed depending on how a student felt at any given time and how they wanted to respond to their peers. The result was a massive bank of student-documented interests and thinking. Many times the researcher pondered, without success, how one could use this "thing of beauty" in the formal arena of learning, rather than watching it dissipate, just as the surf.

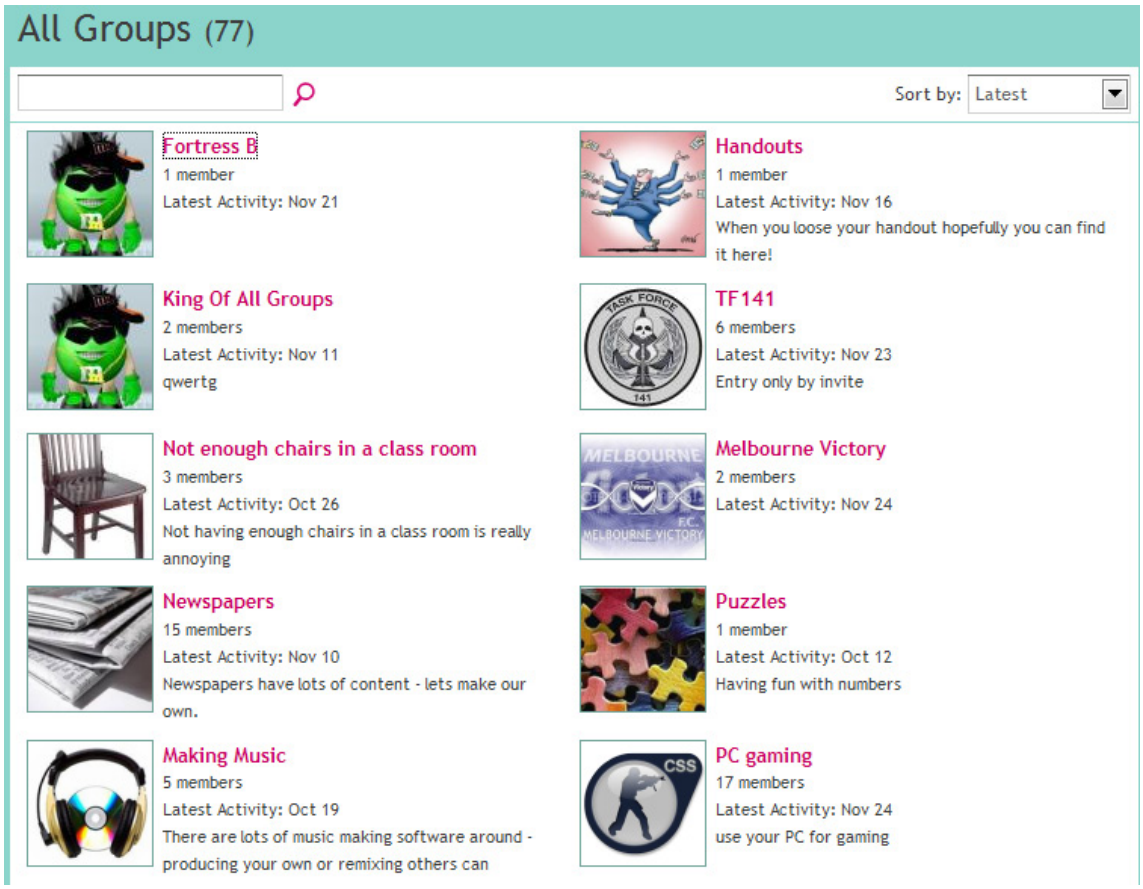


Figure 3. Screen clip showing a range of both student- and teacher-directed Ning groups.

Example 2.

It was vital for the researcher to monitor student Ning activity because the social network had to conform to the school's expectations and requirements. One morning, during the second week of using the Ning in the classroom, a feeling of confusion came over the researcher as a host of new Ning groups continued to appear. The researcher panicked and tried to change the administration settings for the network to require students to gain approval before they could start a group and be active online. She found this was not possible because she did not know how to change the setting, and due to other teaching commitments, she had no time to find out. Since very few Ning groups had appeared during the

first week, the researcher had not predicted this eruption of groups in the second. Looking back on this occurrence, one could picture the wave as it formed, rose, broke, and crashed with an enormous splattering of particles in every possible direction. Then it calmed, and without any intervention, order returned once again. Thankfully, the teacher's instinctive response of trying to take charge and enforce order was not necessary as the chaotic Ning activity did calm down by itself. From that time on, the waves that continued to form had varying heights and points of impact, adding depth and excitement to the learning process. It was during these times that the water droplets connected and became the active drivers of their environment.

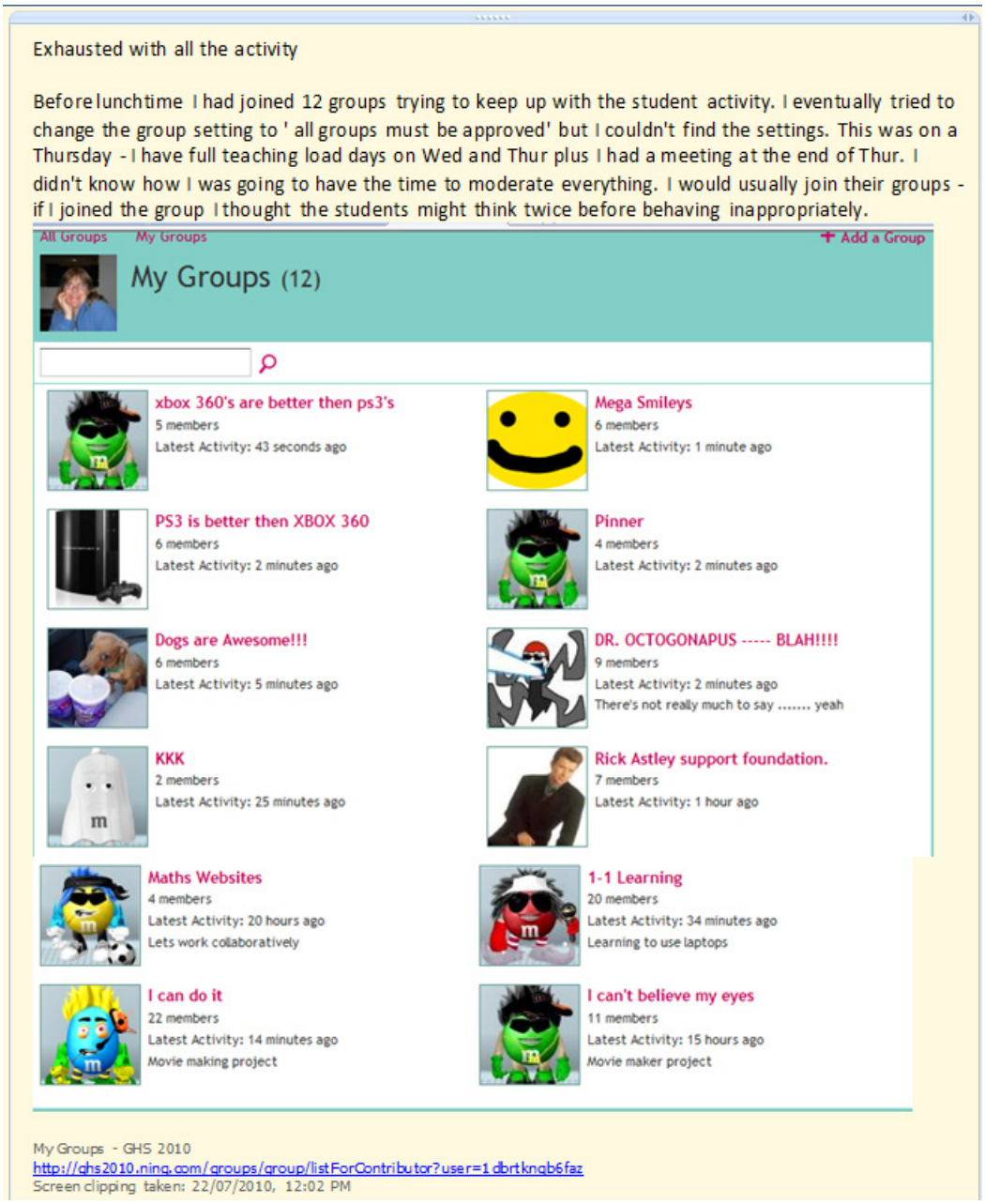


Figure 4. Sample of the researcher's comment showing that, at times, the pressure of moderating the Ning became stressful due to the unpredictability of student activity.

The analysis of students' online interactions, combined with researcher reflections on both informal and formal learning, showed signs of developing disorder, which was significant. Using Hayles (1990) paradigm of orderly disorder, one can draw connections with some of this student-directed activity. This paradigm of disorder offers the possibility of escaping from what Hayles (1990, p. 265) describes as structures of order that are increasingly perceived as coercive. As a result, complex layering arises, where traces of old paradigms are embedded within new. On one hand we may celebrate the disorder, seeing turbulent flow not as an obstacle but as a great, swirling river of information that rescues us from sterile repetition. On the other hand it also shows that when one focuses on the underlying recursive symmetries, the deep structures that serve as foundations for chaos can be revealed and analytical solutions can sometimes be achieved (Hayles, 1990, p. 291).

Example 3.

As part of any Ning, each person automatically has access to his or her own My Page. Students could choose a theme for their page, and others could leave comments and request friendship. Figure 5 shows a student using his My Page heading to express his feelings about the loss of his pet.

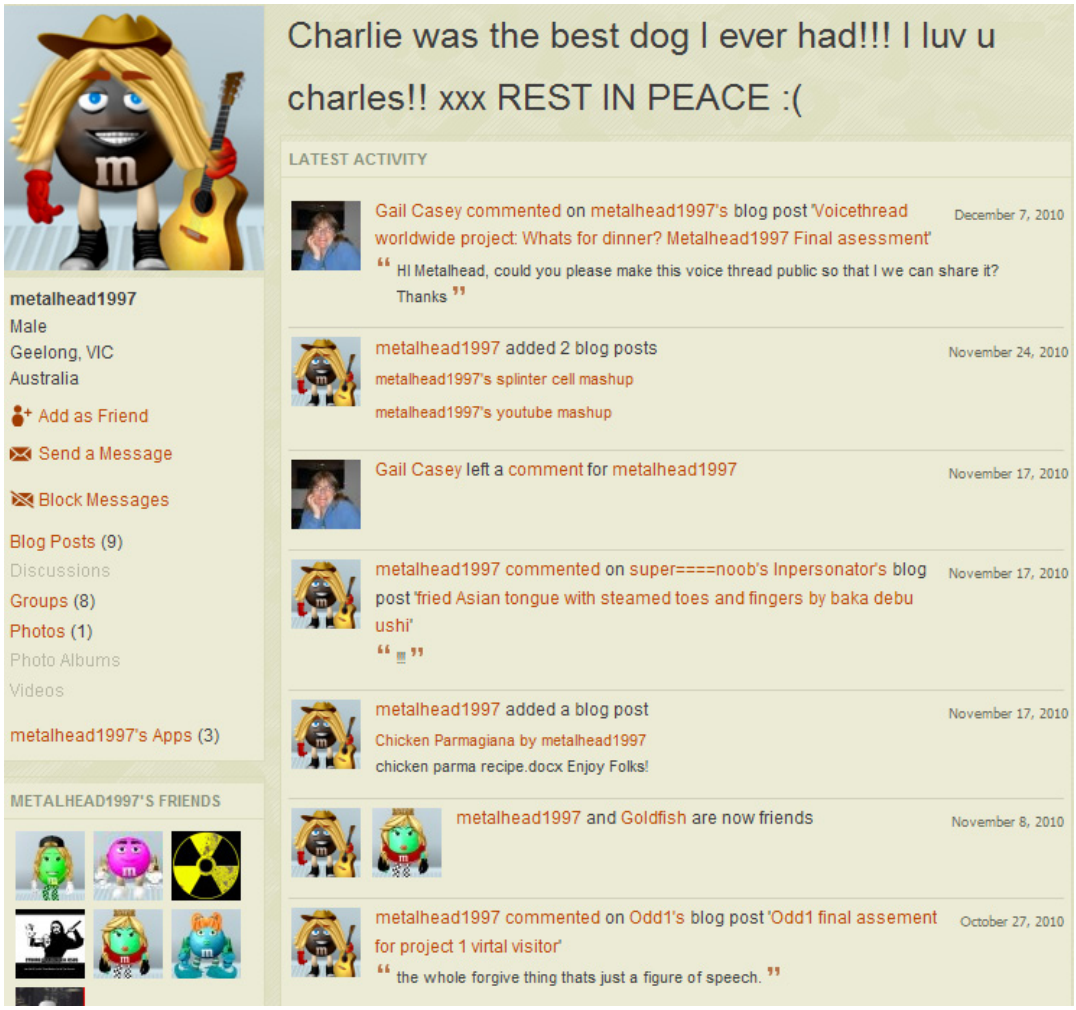


Figure 5. Screen clip of a student's My Page where he organized his theme, profile, and avatar, and published work and blogs.

Murphy's (1995, p. 28) discussion on chaos theory and education is concerned with unpredictability and indeterminism in human behavior and the implications for educational research. He states that the principles of self-renewal and self-organization are essential foundations of chaos theory, adhering to the idea of order through fluctuation. Figure 5 is one of these fluctuations: It was far from a common type of communication, and many students did not know how to respond. As a result, there was little, if any, response.

Analysis of the research data shows that the Ning was not a linear learning environment. At times it was a very dynamic system, which leads the researcher to consider Smitherman's (2005, p. 158) metaphorical interpretation of patterns in the classroom. Her perspective stems from chaos theory and lends itself to analyzing relationships that are emergent and sensitive to the system of the classroom. Sensitive dependence on initial conditions is an important component needed to generate chaotic behaviors, and small variations in conditions may lead to great differences in nonlinear dynamic systems (Smitherman, 2005, p. 160). The way students interact in the classroom is very complex; one wrong move by a student may exclude him or her from friendship groups. The researcher noted that

circumstances were similar in the online Ning activities, so here lies a critically sensitive dependence. Smitherman's (2005) links between curriculum and chaos theories provide excellent material for thought:

> Linking pedagogical goals with the unpredictable behavior of students generates a curriculum that is emergent, generative, and open. Rather than averting the "noise," a teacher can imagine "chaos" as patterns that emerge as teachable moments, embracing the notion that not everything that occurs in the classroom can be predicted. (p. 162)

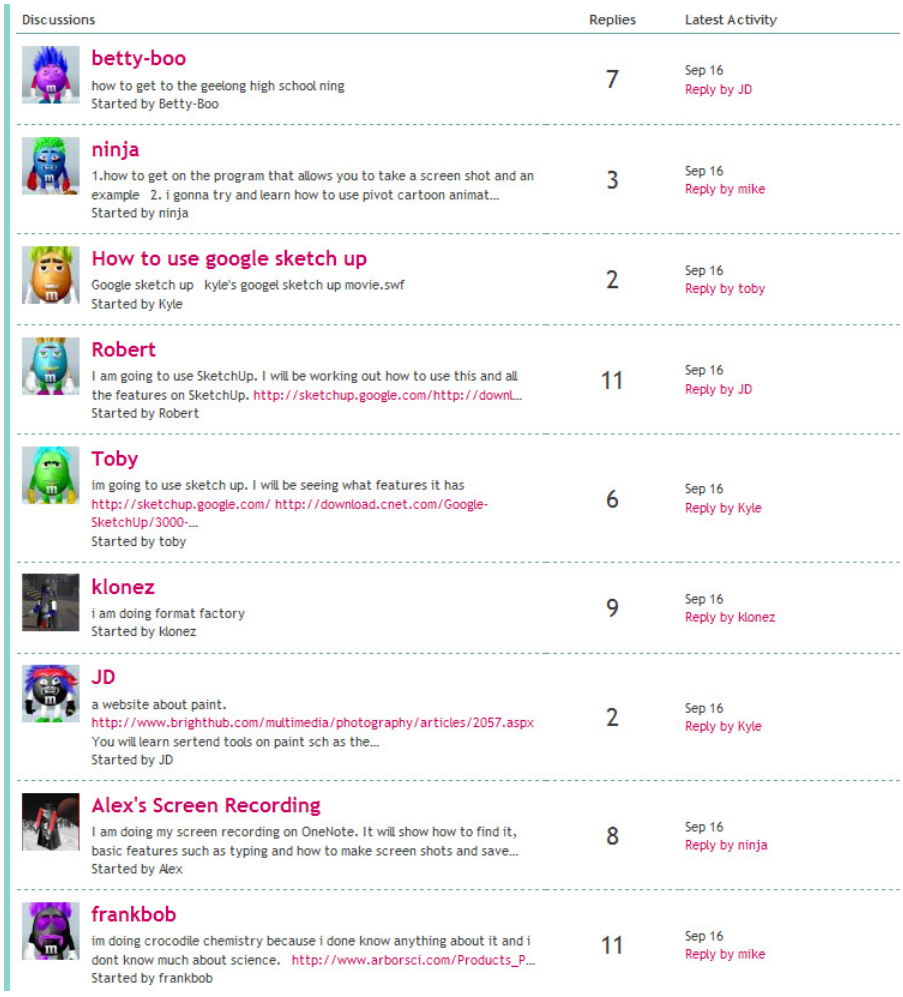
Reflecting on the disorder that occurred, the researcher could see the possibilities of using disorder as a teachable moment. Understanding the implications of disorder in relation to curriculum and learning allowed her to reassess what was needed before taking control of future issues/activities. Remaining flexible and occasionally resisting teacher instinct (or perhaps the learned behavior) to take control continued to be a challenge for the researcher.

Analysis: Formal and Informal Learning

When reviewing the online data one can see the diversity of roles and activities in which the students engaged. In addition to the teacher-directed projects and the student-driven responses to these projects, much of this was evident when students were interacting with their peers at a personal level, talking about sports, games, music, and their other interests. In analyzing this type of interaction, Bertram (2002, p. 1) reminds us of when we were their age, but one key difference is the mediation of activities through electronic technologies. Students are regularly engaged with these technologies, and for many they are part of their methods of communication with friends. It was clear when looking at the broad range of student-directed groups that those who were members enjoyed and appreciated the semester-long opportunity to communicate and express themselves freely online, within school rules, as part of their classroom environment. For some students, these connections made through the Ning online social network helped them become confident and, at times, valued, yet able to remain anonymous if they so desired. The connections emphasized connectivism as an emergent theory of learning, where the interactions generated by these connections, whether informal or formal, had the potential to result in emergent knowledge.

In a classroom, a teacher may have established objectives and pedagogical goals, but in the act of instruction, he or she responds to the random interactions of the students (Smitherman, 2005, p. 160). This was also clearly evident in the Ning environment. The researcher would set out an activity and students responded in different ways, at times asking questions and eventually publishing their work. On the Ning, students had a much larger audience for their work than usual. The following screen clip shows the number of peer replies to students when working on a teacher-directed activity. In this activity, students were asked to produce a multimedia product of their choice that other students would find helpful and

informative. Peers were then asked to give constructive feedback to one another with the aim of improving their final product. Online discussions and interactions were an important feature in providing students with constructive feedback for improvement prior to peer- and self-assessment. This process of interaction was used only for major projects initially, but it gained momentum and students started to incorporate it without being asked; it appeared that students valued one another's feedback, and many enjoyed providing it. Peer feedback also improved gradually and became an important resource for both the students and the researcher. The following three screen clips show different aspects of this process: the first illustrates the number of interactions/replies different students gained when seeking feedback; the final comment on the second screen clip shows some appreciation for students who shared information; the third shows a range of individual peer assessments with feedback.



Discussions	Replies	Latest Activity
betty-boo how to get to the geelong high school ning Started by Betty-Boo	7	Sep 16 Reply by JD
ninja 1.how to get on the program that allows you to take a screen shot and an example 2. i gonna try and learn how to use pivot cartoon animat... Started by ninja	3	Sep 16 Reply by mike
How to use google sketch up Google sketch up kyle's googel sketch up movie.swf Started by Kyle	2	Sep 16 Reply by toby
Robert I am going to use SketchUp. I will be working out how to use this and all the features on SketchUp. http://sketchup.google.com/http://downl... Started by Robert	11	Sep 16 Reply by JD
Toby im going to use sketch up. I will be seeing what features it has http://sketchup.google.com/ http://download.cnet.com/Google-SketchUp/3000-... Started by toby	6	Sep 16 Reply by Kyle
klonez i am doing format factory Started by klonez	9	Sep 16 Reply by klonez
JD a website about paint. http://www.brighthub.com/multimedia/photography/articles/2057.aspx You will learn sertend tools on paint sch as the... Started by JD	2	Sep 16 Reply by Kyle
Alex's Screen Recording I am doing my screen recording on OneNote. It will show how to find it, basic features such as typing and how to make screen shots and save... Started by Alex	8	Sep 16 Reply by ninja
frankbob im doing crocodile chemistry because i done know anything about it and i dont know much about science. http://www.arborsci.com/Products_P... Started by frankbob	11	Sep 16 Reply by mike

Figure 6. Screen clip showing the number of replies some students received after giving constructive feedback and support to one another.

Students' critiquing abilities continued to improve while working in the Ning, which was very encouraging. The researcher asked students to be constructive, to say something positive before giving critical feedback, and, where possible, to finish with a positive comment.

This helped the students to build an understanding and acceptance of the opinions of others.

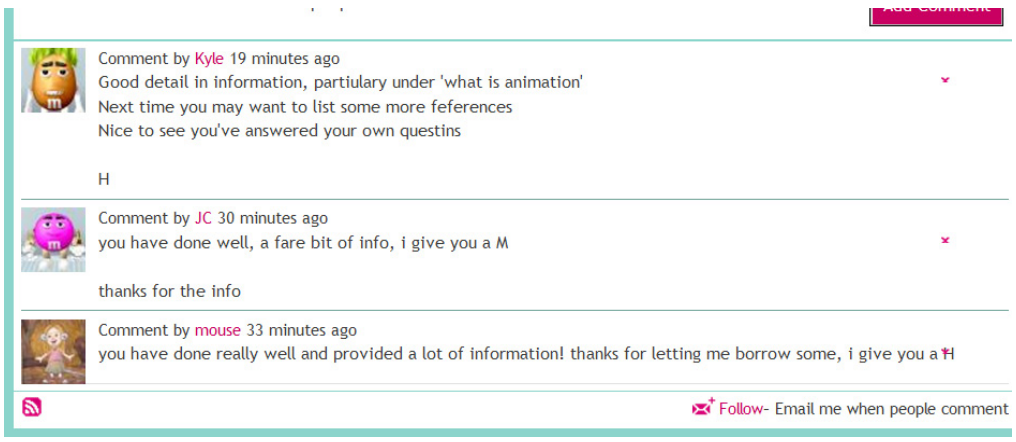


Figure 7. Screen clip showing student feedback and assessment, as well as appreciation from the user "mouse," who thanks another student for sharing information.

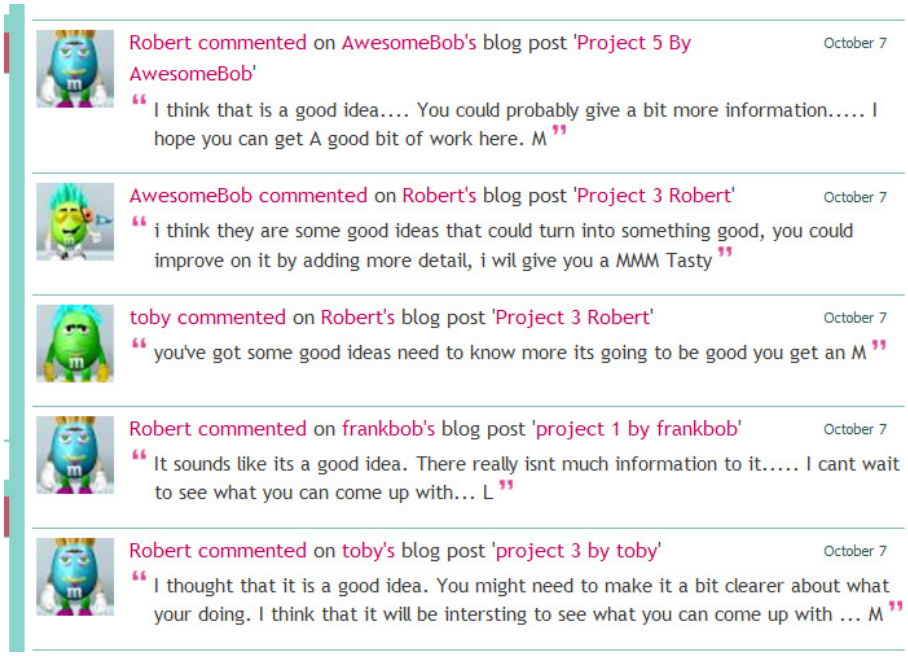


Figure 8. Examples of individual peer feedback and assessment.

When designing projects, the researcher needed to take into account the dynamics and connections the students would have in their Ning social network. Many projects allowed students to use multimedia, and they generally enjoyed and appreciated this type of interactive medium, along with interactive Web 2.0 tools. These tools encouraged students to be creative while publishing their work for the Ning's wide audience, often giving them a reason to produce higher quality work.

Students' peer feedback and assessment involved some complex interactions. The re-

searcher continued to remind them that the process of giving feedback to others required sensitivity and the need to be constructive while being understanding and positive. When looking closely at peer feedback, one can connect it to complexity theory:

> Complexity theory is an emerging field in which scientists seek patterns and relationships within systems. Rather than looking to cause and effect relations, complexity theorists seek to explicate how systems function to rely upon feedback loops (reiteration, recursion, reciprocity) so as to (re)frame themselves and thus continue to develop, progress, and emerge. (Smitherman, 2005, p. 163)

Certainly, peer feedback involved loops and recursion, and it continued to develop and progress. Smitherman (2005, p. 158) also relates classroom behavior to fractal patterns. She describes how certain patterns of behavior seem to be fixed, with some that are periodic and others that are chaotic. According to Smitherman, these fractal-like patterns display dynamic relations that occur in a class among teachers, students, subject material, and the classroom environment. Most of the Ning groups, both teacher- and student-directed, produced this fractal-like pattern of dynamic relations. One interesting example of this is shown in the following screen clip where a student formed a group in a fit of frustration. She was not listening in class, and when other students were ready to start work on a project she did not know what to do, so she asked the researcher. The researcher replied in a negative manner, knowing the student had not listened to the initial instructions. The student responded by forming a Ning group called "WHY." She deleted the group soon after it started to gain the interest of other students.

Figure 9. Student-directed group formed in frustration in the classroom.

When signed into the Ning, students often worked in different ways than they did when in the traditional classroom. One example of this was when students worked on projects that involved a number of different classes. The researcher established these projects to promote cross-curriculum work, and students usually found them interesting. These project work online groups gave no reference to specific classes, so most students did not know which group was related to a particular class. It was interesting to watch Year 7 students confidently connect with those in Year 10 as equals, taking on a profile of their choice.

The MashUp and Data Visualisation screen clips in Figure 10 show two shared groups that were used by the researcher to encourage students to explore interesting concepts and work across classes.

The MashUp group included links to a range of Web 2.0 applications. The most popular one was likely Taggalaxy (http://taggalaxy.de/), where students could look at a wide range of photos from Flickr (http://www.flickr.com/).

The Data Visualisation group was set up initially for maths, but many students from other classes looked at and discussed its contents. Students enjoyed viewing this group because it involved visual information relating to real-world events.

Figure 10. Screen clip of two teacher-directed groups. These were used for multiple classes of different ages and subjects.

Enabling students to work online allowed them to access the classroom anytime they wished. At parent–teacher interviews, parents were appreciative of the availability of online help resources and support for their children. They also acknowledged that the availability of classroom work details was useful. Having them always visible online saved the researcher time because she did not need to repeat explanations as frequently. Even so, the researcher believes that making good use of new technologies increases demands on teachers, as argued by Bertram (2002, p. 17). Through the course of this action research study, the researcher found that there was an increase in the time needed to monitor and participate in the social network. It took extra time and effort to observe the "Latest Activity" on the Ning during and after class and after school. It also took extra time to ensure that class projects, interesting Web sites, and resources were published online and available for students to access as needed. However, the researcher found that she successfully reduced her time spent on correction by implementing peer- and self-assessment with students and by using her classroom observations. This led to an effective triangulation of assessment data. The researcher felt that by making a more refined design of learning experiences for this Ning environment, she may well reach the richer and more meaningful interactions that Smitherman (2005) describes:

> Chaos and complexity theories easily lend metaphorical analogies for education. There are connections within each student, but these are difficult and sometimes virtually impossible to ascertain. Instead of isolating students into one specific situation, "what is important, epistemologically and pedagogically, is a comparison of the patterns an individual develops operating in a number of different situations—this is an ecological, holistic, systematic interrelated view. Within this view lie patterns otherwise unseen" (Doll, 1993, 92). These patterns allow students not to suspend part of who they

> are in order to participate but rather encourage the development of oneself, and thus produce even richer and more meaningful interactions. (p. 177)

Conclusion

Connecting the Dots ...

As the authors continue to analyse and review this research we think of the connect-the-dot puzzles enjoyed by children. In the minds of parents there was only one correct answer, but in a child's mind there were endless playful pictures that could be formed. We look forward to finding new and novel ways to examine the data from this study through the different perspectives of theorists. As educators interested in innovative approaches to teaching, the idea of designing learning activities that take account of emergence and connections is encouraging. This is especially the case when teaching young people who are experienced social beings, both online and face-to-face. Connections to fractal patterns and chaos theory are very real in the online classroom, where interaction can be used as a vehicle for learning, and students' awareness of their own communications encourages them to be active participants in the learning process. This research supports Smitherman's theory (2005, p. 168) that learning occurs in nonlinear patterns: emergent, divergent, and convergent.

Imagine the impact on classroom teaching, tutoring, and educational research if it were recognized that linearity has often been falsely assumed in teaching and learning (Kahn, 2005, p. 181). It was clear in this study that participants were able to take control of many aspects of learning, including supporting and assessing their peers. Their online connections served a purpose, diversifying their networks and uncovering new possibilities for learning. In many ways, these students' interactions supported the communities of practice model used in professional learning for teachers, as discussed by Mackey and Evans (2011). One can imagine both teachers and students learning together online, with the students acting as facilitators. It was clear in this study and that of Mackey and Evans that participants took control of their online learning experiences; perhaps the problem is that, too often, educators do not offer to hand over this control. That is why the words of Doll, who encourages the future of active and emergent learning, are crucial:

> A dynamic, emergent curriculum, transformative in its processes, sees both the learner and the curriculum (child and curriculum, in Dewey's phrasing) having their own voice. The point-counterpoint of this duet/dialogue, with practice and over time, produces transformative results. . . . In this way, child and curriculum, learner and teacher, self and text, person and culture, dance together to form a complex pattern—ever changing, ever stable, ever alive. (Doll, 2005b, p. 55)

Such a redesign of learning requires both teachers and students to be learners, working together in nonlinear ways. Teachers cannot take this approach in fear of chaos and disorder; they must find innovative ways to construct disorder and flow with chaos and build resilience to the traditional training that instinctively drives them to take control. Doll (1993, p. 16) asserts that we must all begin where we are. This gives educators their entrée into postmodern curriculum practice, where they individually develop their own pedagogic practicalities for curriculum. For the authors, with different, but related, interests in chaos and complexity theories, there are creative possibilities. With this in mind, one must also consider the words of Klaus (2010):

> It is an established fact that the vast majority of systems or processes in the real world are so complicated that there is no hope and even no sense in trying to analyze them in full detail. The method of analysis for social sciences and in the humanities involves observation and thought along with creating notions and their operational interactions. The very process of modelling even a small part of reality is naturally accompanied by a loss of information, in the sense that some aspects are deliberately eliminated from further considerations. (p. 18)

So the question that should now be asked while reviewing this research data comes from Doll: "has the teacher, intentionally or otherwise, caused enough chaos to motivate her students to reorganise? Too much chaos will lead to disruption, while too little chaos will produce no reorganization" (Doll, 1987, p. 16).

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Pointillist, Cyclical, and Overlapping: Multidimensional Facets of Time in Online Learning


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Abstract

A linear, sequential time conception based on in-person meetings and pedagogical activities is not enough for those who practice and hope to enhance contemporary education, particularly where online interactions are concerned. In this article, we propose a new model for understanding time in pedagogical contexts. Conceptual parts of the model will be employed as a "cultural technology" to help us relate to evolving phenomena, both physical and virtual. We label these constructs as *pointillist*, *cyclical*, and *overlapping* times.

Pointillist time and learning takes place in "dots" of actions that consist of small, discrete moments (e.g., tweeting). Producing, receiving, and sharing ideas in this context are separate points in each actor's timeline. Cyclical time and learning emerges from intensive periods, which are highly visible in online forums. This construct reveals itself through interactions that often exist in multiple online environments. Overlapping time and learning involves various configurations of linear, pointillist, and cyclical layers, which are mainly evident through the simultaneous uses of social communication technologies.

Pointillist, cyclical, and overlapping time constructs enable new orientations for conceptualizing time in pedagogy. In this article we also introduce *de-*, *re-*, and *en-* modes of these pedagogies that connect with approaches to meet the needs of learners for individualization, personalization, and cyborgization.

Keywords: Open learning; online learning; pedagogy

Introduction

In dialogues mediated by information and communication technologies (ICTs), time often deviates from the distinct, clear structures normally perceived in the "real world." Individuals may participate many times and in different ways. Messages, comments, questions, et cetera can arise in asynchronous communicative activities at any time, occurring after hours, days, and weeks, or, on occasion, immediately. Of course, these communications take place during a certain time scale, but it is neither accurate nor absolute. The messages may be viewed by different users repeatedly, and through this cycle, new meanings and content may come into light. Viewed from a temporal perspective, past events regain new life when examined (and reacted to) in different contexts. Often, online events exist in isolation, becoming real only within the flow of the network. This facilitates the creation of new virtual conceptualizations of time as it relates to social interactions.

We present two virtual extensions to the traditional, linear conceptualization of time that emerge within ICT-enabled learning systems: (1) *pointillist* (dot-like) time, revealing itself through discontinuous, separate acts that participants can return to; and (2) *cyclical* time, illustrated by clusters of events in which intensive interactions occur for a period of time, and then cyclically reemerge as bursts of activity in the same or different forums after a certain amount of time has passed. These modes are not necessarily exclusive of each other, but often overlap, creating a diverse ecology of time constructs within learning systems.

In this paper, we argue that linear time normally does not exist in online learning environments, but is instead supplemented or replaced by pointillist and cyclic temporal modes (Ihanainen, 2006). For facilitators of learning in online environments, it is important to recognize, understand, leverage, and construct new opportunities within any configuration of these conceptualizations. We expand on this heuristic framework and identify ways to maximize pedagogical performance based on these multidimensional understandings of time in online education.

Multidimensional Conceptualizations of Time in Learning

Temponormative Learning

When most people hear the word *pedagogy*, they are likely to think of it within what we label a *temponormative* framework. For those of us born before the 1990s, this is the framework we are most familiar with. It is a pedagogy that embraces linear time, Cartesian (linear) thinking, and continues to be the most prevalent framework within modern educational contexts. A linear conceptualization of time ensures that the learning process has a beginning and an end, with predictable (and measurable) waypoints between. The causal linearity of the temponormative frame allows the developmental procession of teaching and learning that is often best suited for transmitting explicit knowledge to learners. This mechanical process, for example, allows a group of learners to read a book progressively, chapter by chapter, and recite information and facts that may be measured and evaluat-

ed summarily. Temponormative knowledge is typically encoded in predefined curricula, transmitted through "banking" pedagogies (see Freire, 2000), and transmits just-in-case information and knowledge (e.g., memorization of the world's capitals) that might be useful outside of the learning event's timeline.

The ongoing development of online learning environments that allow non-linear communications (both synchronous and asynchronous), however, suggest that the continuing reign of the temponormative framework will become outmoded by the twenty-second century. The three post-temponormative alternatives we identify in this paper utilize ICTs to expand the temporal ecology of learning options beyond traditional, linear progression.

Pointillist Learning

When one sends a *tweet*[1] about what one feels or does, to tell others about an idea, or to let them know about an interesting Internet item (blog post, video, podcast etc.), an experiential time point for the readers of the tweet is produced. Online readers and followers can retweet that expression to others, producing a new time point. When one person follows the tweets of others, he or she jumps into their time points for a while. This kind of microblogging is pointillist both in a temporal sense and as an activity. Compatible with Bauman's (2007) "pointillist" concept, the term may also be employed generally to depict the life of a modern and fragmented world. In this extension, we see pointillist time as a one-time reality among simultaneous others.

Elements for pointillist learning are masses of fragments and pieces as used, for example, within Twitter messaging. They transmit separately beginnings, middle-points, and endings of events in an order that may seem perceptibly vague. Among others things, they comprise experiences, opinions, perceptions, comments, and what-if scenarios.

Pointillist learning takes place in the middle of the timeline. Pointillist behavior and learning implies an ability to tolerate the insecure, uninterrupted, unanticipated and obvious absurdity of the "moment," but at the same time it indicates a capacity to differentiate the essential from the unessential and to perceive the whole from fragments, almost as a fractal construction of personal experiences and understandings.

The spontaneous nature of pointillist learning has always been a natural part of everyday human activity.[2] While physical–social–virtual activity has become the one unique reality shared among most people within Western society, forces of globalization are gradually forming an expanded mindset (global awareness), which increases possibilities of a greater role for pointillist learning.

Cyclical Learning

In online forums, where participation (usually discussion) occurs within threads as a dialogical activity, learners experience both densification and diffusion of learning intensity. These kinds of forums are, for example, discussion areas inside closed platforms, open social media chatting and interaction hubs, commenting tools in blogs, et cetera. Based on our experiences in such forums, we have customarily been very passionate and eager to discuss, comment, ask about, and develop specific thematic units. However, after a period of time this intensity decreases and even ceases. Later on, the topic or an evolved form of it reappears on that same forum or a different one.

This activity can be called a cyclical performance. The idea of cyclical learning relates to "orient" approaches for repeating cycles of seasons (for example, see Briers, 2010), but here we examine cycles in a smaller and disordered online scale. Phases of intensive activity and calm alternate with each other, and together they construct a pulsating interaction within the environment. Because the pulse activity is usually connected with specific themes and content, it almost always is directed toward something. This does not mean that the activity is determined by explicit objectives, but instead by goal-seeking encounters (i.e., as "strange attractors" in the language of systems thinking) and processes with forum discussants.

Cyclical activity and learning is connected with the ability to observe intensive periods of online interaction and join them. New competencies emerge in the perception of pulses from emerging processes of thoughts, emotions, and understandings (among others). It is also very important in cyclical learning and activity to be aware of and understand the role of intervals. When participants take part in these cycles of processes, they develop individual perceptions of the artifact explored. Participants therefore develop a new competency, gaining the ability to perceive and acquire new knowledge within intensive peaks of learning.

Overlapping Learning

The three frameworks we have described do not necessarily exist exclusive of one another, but can coexist and overlap in simple or complex relationships (see Cynefin framework, 2011). Overlapping may occur as (1) fragments within fragmentary entities, or (2) waves within pulsating content processes. With regards to the former, for example, overlapping incorporates the ability to move from pointillist activities to cyclical learning and vice versa. The latter includes an ability to construct new insights, conceptualizations, and contextual applications for knowledge within pulsating waves of cyclical, pointillistic, and/or tempo-normative learning sets. Overlapping learning can take place through the overlapping uses of technologies. For example, in online education, microblogging (a pointillist activity) may be layered with intense activity within discussion forums (a cyclical activity).

Educators find that the management of learning in this layered framework requires a keen ability to cope with uncertainty and ambiguity in outcomes, which may be driven by the complex interactions between components of the system (such as "mashups" of online tools). For example, a forum discussion could serve as a launching point for sharing ideas

in microblog posts, which immediately draw new insights and reactions from actors outside of the learning group in the form of blog comments, Twitter responses, and so on. This new knowledge may be fed back into the forum discussion and/or additional microblog posts, igniting pulsating waves of new knowledge generation within the learning group, beyond the learning group, and in the spaces between. In such a scenario, learning happens in instances and waves, independent of a definable pedagogical time.

Table 1

Characteristics of Temponormative, Pointillist, Cyclical, and Overlapping Learning

	Temponormative	Pointillist	Cyclical	Overlapping
Pedagogy	Traditional	De-	Re-	En-
Systems analogy	Cartesian, linear	Moments	Pulsating	Chaordic
Knowledge produced	Explicit	Personal (explicit and tacit)	Personal and social	Personal and social
Learning happens through…	Direction	Serendipity	Evolution of dialogue	Intersection of direction, serendipity, and evolution
Predefined learning outcomes	Yes	No	Sometimes	No
Teleogenic?	No	No	Yes	Yes
Examples	Lectures, readings	Microblogging	Online forums	Mashups, MOOCs

Note. In online contexts for learning and education, activities and behaviors are embedded within the four identified time modes: temponormative, pointillist, cyclical, and overlapping. For teaching and learning, it is important to recognize them and how they interplay in educational settings and practices.

Implications: De-, Re-, and En-Pedagogy

The pointillist, cyclical, and overlapping extensions operating beyond temponormative conceptualizations of pedagogical time allow us to revisit and recontextualize our traditional views of pedagogy. We label these de, re-, and en-pedagogies.

A pointillist activity requires the learner to have spatial and temporal independence in the different contexts of (virtual) responses and events. This capacity also creates sensitivity to hectic communication processes and fragmented content items. Within these situations of cognitive uncertainty and obscurity, the question of emotional certainty and trust emerges for the learner.

Pointillist learning is, on one hand, learning in separatenesses (separate interactions and content items), and, on the other hand, it is emergent, forming a gestalt of separatenesses based on the learner's personal interests. Pointillist learning is also tacit, but can acutely and situationally become explicit, only to change again into a tacit form. The pointillist emergent gestalt has both an unexpected and intuitive character: It takes place on its own.

Pointillist learning pays attention to culture and activity, and Twitter emerges as a powerful example of this. The attention space or horizon maintains the individual's attunement to learning, producing her own reciprocal or separate awarenesses. Learning is facilitated by this state of attunement and the attention-producing activity.

When pointillist learning is examined from a pedagogical point of view, it presents itself as an anti- or *de-pedagogy*. This means that pointillist learning cannot be taught—it just happens! And because it happens so frequently, it is one of the most natural forms of learning for humans (Cobo & Moravec, 2011). Based on this argument, we label pointillist pedagogy (if there is such a thing) as de-pedagogy, in which continuous—both interrupting and restarting—pointillist presence is essential. It does not emerge from any planned or consciously intended activity, which may also include pointillist learning. Pointillist pedagogy is the pedagogy of serendipity.

The greatest challenge de-pedagogy presents to educators is that we must trust that valuable and significant learning is actually taking place. For pedagogical activity, de-pedagogy means that as facilitators of learning, we have to give up our role as teachers and start working as colearners and peers within our own pointillist environments.

De-pedagogy can also be viewed from a perspective of individualization (Dorninger, 2008; Ray, 2005) that is different from personalization. Individualization in the context of de-pedagogy means that single investments, such as tweets, messages, blog entries, articles, or other (multimedia) content, are appreciated and learners are encouraged to produce and use them individually (Bruns, 2008; "produse" in Produsage, n.d.). In this sense, de-pedagogy is an expression of pedagogical individualization.

The serendipitous nature of pointillist de-pedagogy becomes especially visible in the context of Twitter as the service limits communications to 140 characters or less. Users who

have embedded themselves in the communication style of the 140-character limit feel the empowerment and impact of de-pedagogy, although the experience cannot be explained explicitly with rational and causal terms. Of course, de-pedagogy is also present in real-life interactions, but its power is more apparent when real life realms are actively connected with the virtual in real time.

Pointillist de-pedagogy may also trigger *re-pedagogy*. Often times, people wish to continue their explorations and re-understandings of pointillist events and contextualize the knowledge to better suit their own needs and interests. This activity often takes place in online discussion forums, which make ongoing communication and collaboration possible.

In cyclical activity, the same themes and topics arise in discussion and other activities semi-regularly on either the same online forum or on different ones, where the topic is recontextualized. In other words, the topic may be examined in new or different environments. The cyclically repeating activity creates a reinforcement of its concepts and includes concepts that are closely connected with it. In cyclical activities, learners develop the capability to apply knowledge, competencies, and skills in new interactive contexts.

The recontextualization of learning through conceptual reinforcements and innovative applications of knowledge in new and different interactions means that individuals, groups, and networks are able to build up the knowledge and capabilities produced in previous cycles. New learning takes place in these cyclical renewals.

We therefore describe cyclical pedagogy as re-pedagogy. It builds and supports frameworks in which previously learned knowledge and competencies may be reconstructed to be used in new situations and contexts. The cyclical pedagogy is re-pedagogy, in which something is done again, but in a different way (recontextualized). The substance of re-pedagogy is not new, but it is not old or the same either; it is a mode of learning that provides for the evolution of knowledge.

Re-pedagogy is synonymous with educational personalization.[3] The core activity in personalization is multilateral interaction and negotiation, in which shared experiences, knowledge, and orientations are made explicit for participants. This pedagogical personalization is always a joint and equal process, not an external "marketing" endeavor to produce desired behaviors for the benefit of a single party.[4]

Pointillist and cyclical activities as experienced in life and learning overlap each other. We describe them as coexisting within layer-like membranes of time and behaviors. The overlapping activity has the capability to attend to and orient participants flexibly in complex events and contexts. It has the capacity for simultaneous temponormative, pointillist, and cyclical modes and outcomes.

Overlapping learning is knowledge-building of everything/anything, everywhere/anywhere, and at all times/anytime. In other words, overlapping learning is boundless in its scope and capabilities. When examined from a pedagogical point of view, it can be seen as

pedagogy of encoding. We understand and recognize the pointillist de-pedagogy and cyclical re-pedagogy mainly in virtual realms. The overlapping phenomena we have described in this article can only be experienced in authentic virtual realities. It is possible to collect the phenomena via mashups and other tools into understandable entities for purposive applications (for example, to familiarize oneself with explicit knowledge about a certain element, development, or research project). They may be purposefully encoded with ICTs. We therefore label overlapping education *en-pedagogy*.

In online education, en-pedagogy transforms technology into virtual teachers' activities through the use of mashups (which we define as combining web tools in creative ways). What was formerly perceived as chaos or noise is instead presented and made available for understanding in new and resourceful ways.

Parallel with de-pedagogy/individualization and re-pedagogy/personalization, we regard en-pedagogy as *pedagogy of cyborgization*. This does not mean the creation of human-technology hybrids, but rather recognizes the "normal," already ubiquitous use of mobile ICTs by humans. Cyborgization is an educational activity incorporating overlapping linear, pointillist, and cyclical content and behavior for the learners' everyday learning and studying through ICTs. Access to mobile technologies becomes so fluid that they represent extensions of the human body (hence we use the term cyborgization).

Table 2

Summary of Implications of Pointillist, Cyclical, and Overlapping Learning for Pedagogy

	De-pedagogy	Re-pedagogy	En-pedagogy
Learning status	Exists in itself	Exists in meeting	Exists in encodings
Educational orientation	Trust in individual productivity	Organized interaction in forums	Organized through "mashups"
Educational specification/emphasis	Individualization	Personalization	Cyborgization

Typical classroom learning has instilled in most educators a strong tradition of temponormative orientation. In de-, re-, and en-pedagogical contexts, educators should view classes as malleable places and gatherings of people that resemble studios and workshops more than classrooms.

Pathways for Maximizing Pedagogical Performance: Examples

The pointillist and serendipitous de-pedagogy is impossible to describe with concrete examples, unless we speak about individual experiences. As Sugata Mitra illustrates in his talk, *The Child-Driven Education* (TED, 2010), this question emerges through the shared

tales of tacit learning experiences. The "holes in the wall" (computers) in his research correlate (in the beginning) to pointillist learning moments for children, and later these moments can evolve into self-organized conversations and learning activities. The re- and en-pedagogies instead may be illustrated by certain activities and cases.

The idea of re-pedagogy is illustrated through an example John Francis (in TED, 2008) shared in his TED talk.[5] Mr. Francis remained silent (did not speak) for 17 years. During his silence, he still found opportunities for teaching. When he taught without words, he used a unique sign and body language. Students then recoded his messages themselves and interpreted their own individual meanings. Through this experience, Mr. Francis reports that his students sometimes understood the content better than he himself had intended to teach. Re-pedagogy is the perfect description for Mr. Frances' case. In the real-life situation—which often is a cyclical process—there are various content items within communications, multimedia, traditional documents, and so on. The participants in the situation then reproduce the content in a unique way that meets their own needs and purposes.

The pedagogical activity in re-pedagogy is the evolving reproduction of the knowledge itself and can also be labeled *situated* or *personalized knowledge and competencies*. For re-pedagogy, teachers must trust in people within the situational moment. Their task is to try to arrange environments and places for learners to interact and collaborate. Re-pedagogy is a pedagogy that facilitates or curates ideas and experiences (Siemens, 2007).

Re-pedagogy is visible in activities that happen in simulational learning and replaces the just-in- case learning of the temponormative paradigm (that is, rote memorization) with "what if?" virtual, pointillist, and de-pedagogical opportunities. This approach allows serendipitous learning that can provide solutions to past and present problems. In either pointillist or cyclical forms, simulational learning also permits preactive, foresight-generative thinking that allows students to consider and act upon solutions to problems that do not yet exist. It is plausible to consider the genre of online simulations as an example of re-pedagogy.

Chaordic learning is an en-pedagogy, attending to the chaordic systems of overlapping cyclical, pointillist, and temponormative learning.[6] Chaordic environments balance chaos (elements that cannot be controlled) and order (such as temponormative pedagogies) within a system (Amidon, 2003), and "mold chaos and order for their design serendipities" (Harkins & Moravec, 2011, p. 132). Examples of chaordic learning include videoconferencing with remote experts (pointillist) to overlap a series of lectures (temponormative) or mashups of learning environments with ambient computing. The learning facilitator, however, needs to focus on the interaction between the various elements because they can lead to learning outcomes that may deviate from what he or she formerly planned. A chaordic approach can maximize the horizontality of relationships between facilitators and learners and engage all actors in the construction of new knowledge. As Moravec (2006) postulates, intelligent applications of information and communication technologies may be best leveraged to facilitate such chaordic learning. As artificial intelligence technologies improve, we can expect the ecology of chaordic learning options to expand and diversify. We believe

massive open online courses (MOOCs), originally organized by Steven Downes and George Siemens (Downes, 2008; Mackness, 2010), are examples of en-pedagogy.

Apart from exploring new pathways for maximizing pedagogical performance, educators need to rethink assessment and evaluation in non-temponormative education. De-pedagogies produce outcomes that may be unexpected and not quantitatively measurable through legacy regimes. Likewise, the cyclical nature of re-pedagogies builds personal knowledge and competencies that cannot be measured directly. Finally, the chaordic nature of learning in en-pedagogical systems cannot be controlled. Rather, as Allee (2003) suggests, chaordic systems need to be attended to, not managed. The challenge for educators is therefore to broaden the scope of expected outcomes in an environment that may seem ambiguous or uncertain. Educators need to ensure that these systems have strong teleogenic (goal-seeking) attributes.

Summary

As stated above, we argue that temponormative time normally does not exist in online learning environments, but is instead supplemented or replaced by pointillist and cyclic temporal modes. Together these form an overlapping mode of time. We provided an expansion of this heuristic framework with pathways for maximizing pedagogical performance based on these multidimensional understandings of time in online education. Recognition of this framework with expanded temporal characteristics, however, calls on us to develop new, purposive approaches that embrace and maximize the best configurations of de-, re-, and en-pedagogies. So in lieu of a conclusion, we leave educators—particularly online educators—with a challenge: Afforded the post-temponormative enabling of online environments, how can we best leverage these opportunities of pedagogical time to facilitate multidimensional learning and meaningful new knowledge production?

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Endnotes

1 A tweet is a post on the Twitter network (see http://www.twitter.com), which limits its messages to 140 characters or less.

2 For a detailed discussion of the relationship between formal, non-formal, informal, and serendipitous learning, see Cobo and Moravec, 2011.

3 For a discussion of educational personalization, see Leadbeater, 2004, 2005.

4 In the private, for-profit sector, "personalization" often refers to activities that collect information about customer behavior and desires, and then produce "personalized" goods to sell to those same people. For our approach in learning, context personalization is given a different meaning to enable the joint meeting and interaction of participants to create something new.

5 TED is a technology, entertainment, and design conference series. The talks are available to download for free at (http://www.ted.com).

6 The term chaordia was coined by Dee Hock, and was originally applied in the area of management theory during his tenure as CEO of VISA International. For more information, see Hock & VISA International (1999).

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Emergent Learning and Interactive Media Artworks: Parameters of Interaction for Novice Groups



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Abstract

Emergent learning describes learning that occurs when participants interact and distribute knowledge, where learning is self-directed, and where the learning destination of the participants is largely unpredictable (Williams, Karousou, & Mackness, 2011). These notions of learning arise from the topologies of social networks and can be applied to the learning that occurs in educational institutions. However, the question remains whether institutional frameworks can accommodate the opposing notion of "cooperative systems" (Shirky, 2005), systems that facilitate the creation of user-generated content, particularly as first-year education cohorts are novice groups in the sense of not yet having developed university-level knowledge.

This paper theorizes an emergent learning assessment item (Flickr photo-narratives) within a first-year media arts undergraduate education course. It challenges the conventional models of student–lecturer interaction by outlining a methodology of teaching for emergence that will facilitate student-directed and open-ended learning. The paper applies a matrix with four parameters (teacher-directed content/student-directed content; non-interactive learning task/interactive learning framework). This matrix is used as a conceptual space within which to investigate how a learning task might be constructed to afford the best opportunities for emergent learning. It explores the strategies that interactive artists utilize for participant engagement (particularly the relationship between the artist and the audience in the creation of interactive artworks) and suggests how these strategies might be applied to emergent generative outcomes with first-year education students.

We build upon Williams et al.'s framework of emergent learning, where "content will not be delivered to learners but co-constructed with them" (De Freitas & Conole, as cited in Williams et al., 2011, p. 40), and the notion that in constructing emergent learning environments "considerable effort is required to ensure an effective balance between openness and constraint" (Williams et al., 2011, p. 39). We assert that for a learning event within a Web 2.0 environment to be considered emergent, not only does there need to be an effective balance between teacher-directed content and student-directed content for knowledge to be open, creative, and distributed by learners (Williams et al., 2011), but there also need to be multiple opportunities for interaction and communication between students within the system and that these "drive the emergence of structures that are more complex than the mere parts of that system" (Sommerer & Mignonneau, 2002, p. 161).

Keywords: Educational institutions; emergent learning; interactive art; media arts; knowledge; novice learners; Web 2.0

Introduction

Williams et al. (2011) investigated how the introduction of Web 2.0 technologies in tertiary education has generated the challenge of creating learning environments that are less teacher-led and instead relate to content creation by learners. Institutions face the dilemma of learning occurring outside the classroom context. This may be particularly symptomatic in the training of preservice education students who are often enculturated into existing models of teaching and learning. Emergent learning, as an alternative pedagogy, suggests that there are silent experts within a student cohort, and that it is worth exploring what benefits these individuals can bring to the community. Williams et al. (2011) suggest that alternative models of education can be explored which use the connective potential of Web 2.0 technologies:

> . . . learning which arises out of the interaction between a number of people and resources, in which the learners organise and determine both the process and to some extent the learning destinations, both of which are unpredictable. The interaction is in many senses self-organised, but it nevertheless requires some constraint and structure. It may include virtual or physical networks, or both. (p. 41)

Williams et al. (2011, p. 39), in suggesting an emergent learning framework, maintain that in constructing emergent learning environments "considerable effort is required to ensure an effective balance between openness and constraint." They articulate the difference between prescriptive learning and emergent learning. In prescriptive learning, knowledge is predetermined for the learners. In emergent learning, the knowledge is open and is largely created and distributed by learners themselves. We are proposing an educational approach which can self-organize; the learning activity is not bounded by specified outputs but rather

is organic, growing with the input provided by the learners. Depending on the specific characteristics of the student cohort (for example, first-year students vs. fourth-year students), the organic space for growth can be to some degree "shaped" by the educational context provided by the lecturer.

The notion of emergent learning environments is also recognized by social network proponents. Shirky (2005) presents an argument concerning the power of the institution versus the power of online social collaboration and suggests a "change in equilibrium" of learning as institutions come under pressure from social networking. Shirky is interested in how groups are organized by an external agent or self-organized and how varying levels of coordination affect group outputs. He refers to this notion as "coordination costs" and suggests two options: (a) use the institution to coordinate the group, and (b) build cooperation into the infrastructure. In the first option, the institution has the responsibility to enforce goals and to maintain the structure, and it is exclusionary (some people are excluded in order to build a professional class). Institutional managers have to plan strategically how to create and coordinate the groups. By contrast, in the cooperative infrastructure model, the approach is to create an opportunity for group effort and then deal with the outcome as it occurs. The cooperative infrastructure model also supports the standard 80/20 rule of contribution. This standard suggests that in group contexts 20% of the individuals within the system create much of the output whilst 80% of individuals create very little, at least in terms of quantity. In an unconstrained system, anybody can contribute as much or as little as s/he chooses. It is often the case that institutions highly value the 20% output of individuals who create a lot and discount the work of individuals who contribute less regularly. By contrast, in a cooperative system, contributing a little is acceptable if the contribution is worthwhile.

Cooperative systems include open-source file sharing. Basically, these are systems where experts find one another and share their knowledge, distribute their knowledge, and gain knowledge about their shared practice. This schema may be appropriate for a self-interested, self-motivated group of experts. However, these ideals are problematic when we are talking about an educational institution where it is not acceptable to contribute as little or as much as you like and where expertise is less likely to be distributed evenly across a group. Here the institution may be an obstacle as institutionalized education is not designed to operate in a social networking format. The hidden discourse of a higher education institution supporting the use of social sites (the education as "fun" discourse) is the fear of not attracting a clientele that now has an increased range of learning options. Cooperative systems are highly appropriate for groups of experts, but what about groups of individuals who are not experts, for example some first-year students who may have trouble engaging with course material and who treat university learning very pragmatically (students are "pressured consumers of higher education who often engage with their studies in ruthlessly pragmatic, strategic, and tactical ways" [Selwyn, 2007, p. 88])? The central question of this paper is how can an emergent learning environment, which aims to have knowledge created and distributed by learners, be formed for a non-specialized pragmatic cohort of students such as first-year education students?

Interactive Artworks: Conceptualizing the Relationship between Artist and User

In the collaborative practices of interactive artists, the viewer of the artwork is transformed into a *participant* who is "actively involved in the construction of the artwork, its design, content, and behaviour" (Weibel, 2008). By exploring the relationship between the participant and the artist in an interactive artwork, we may gain some insight that will further an understanding of the nature of the relationship between the teacher and the student in the context of an emergent learning environment. Interactive artists do not create a product but a "framework" where the viewer is allowed to "play" with the artwork (Shaw, 2008). In this framework a viewer can explore the artwork, rearticulate it, and reform it, and thus the artwork becomes a performance, dependent upon the particular person who happens to be performing the work (Shaw, 2008). Furthermore, audience participation in an interactive artwork is integral to the work, and without the audience there simply is no artwork. Bosma (2006) contends that the relationship between the audience and the artists is one where the artist "uses" and "guides" the audience within the work and in this way manipulates how the artwork is interpreted. The work is designed to be experienced by the user, so the work is said not to possess meaning but rather to afford meaning in its relationship with the audience. Thus, meaning is generated only in the moments of interaction (Feingold, 2002).

Interactive artists' artistic strategy is the provision of an experience for the viewer/participant/audience. The focus of interactive art is on the articulation of meaning through the work; meanings are not static and predefined but co-created in the process of interaction. What interests us in this context, and what remains to be further articulated, is the pedagogical significance of such encounters. What does the artist gain from the participant? What does the participant gain from the artist? To begin to answer these questions a conceptual model of interactivity of artist/user control is proposed.

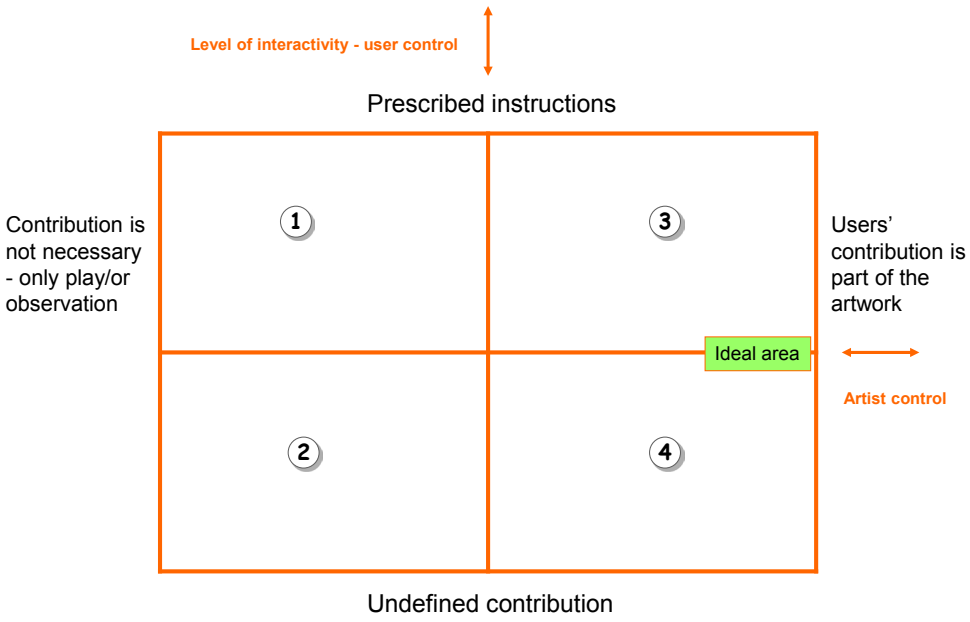


Figure 1. "Interactive space" visualization (Kawka, 2009).

The above visualization represents the relationship between the audience and the artist, conceptualized as existing within the dialectic of artist control versus user control. The positioning of the "ideal area" on the figure is not meant to qualify the artworks as successfully interactive, but rather to place the focus on the participants and to question at what point the participants begin to feel a sense of agency and collaboration with the artist.

In Quadrant 1, the interactive environment provides the user with an opportunity to make selections from predefined choices. Users do not contribute to the creation of the work as responses are not collected; they simply play or observe others interacting. It is far from the ideal position as the participant does not derive a sense of collaboration or sharing in the creative process. The interactive sound installation *Audiobar* (Jacobsen, 2006–2008) is an example of this type of interaction. In this work, users can combine bottle-like artifacts to generate combinations of sounds; however, these are not stored to become a component of the work.

In Quadrant 2, participant contribution is undefined. This means that there is no prescribed set of objects to be clicked and users can generally contribute anything that they want within the context of the environment. In this quadrant, users interact with the work, but their interactions do not form part of the artwork. An example of this style of interaction is Zack Lieberman's *Gesture Machines* (2000). Users make drawing gestures with their mouse on a web interface. The interface reacts to the gestures by creating various responses to the marks made on the digital canvas. Here users play with the work, but their interactions are

not stored or recorded.

In Quadrant 3, the participants interact with set parameters of the work and their contributions are stored to become components of the work. An example is Shaw's *T_Visionarium* (Bennett, 2008). In this work, participants enter a video clip database environment. Participants can select the video clips, rearrange them, and link them to create their own clips, which are then stored in the database. The storage of user-created video clips gives the sense that participants are contributing to the creation of the work. However, participants cannot just put anything into the system; they are interacting with what is already available to be interacted with.

In Quadrant 4, the participant experiences a sense of contributing to the work. However, because of the emphasis on undefined contribution, there is a sense that the artist does not care about the quality of participant contributions but only that such contributions can occur. An example is Andy Deck's *Open Studio* (1999), where visitors encounter a drawing software interface accessed on the Web. Using the available tools, participants can draw anything they like, and their movements are stored for later access. In this sense, when compared to *Audiobar,* the work is more collaborative as users' contributions are retained.

In the ideal area of the visualization we could situate a work like *A-Volve* (Sommerer & Mignonneau, 1994–1997). In this work, users contribute to an interactive environment by creating a creature that will survive within a virtual water habitat. In the relationship between the artist and the participant, the user control is somewhere between prescribed instructions and undefined contribution. With the possibility of creating their own creatures, users are not being manipulated through predetermined constructions. However, they can create a creature only from the available software tools, which means that there are limits to the undefined contribution. In relation to the artist's control, the users' creations are completely subsumed as part of the work rather than their merely viewing the results of their actions. There is a sense of ownership as users identify with the creatures they have created that become part of the artwork habitat. In terms of sharing the creative process with the artist, the participants are removed from the initial stages of creation. However, it may be claimed that in some sense the work is guiding them through creative product generations as they learn to design items that will be useable in a fictitious domain. When compared to *T_Visionarium* or *Open Studio*, *A-Volve* provides a more collaborative encounter as participant contributions become part of the work and they feel that their contributions are somehow significant to the existence of the work.

In terms of real collaboration, the examples discussed above suggest that a number of elements need to coincide to generate the ideal area (Figure 1) for the participant in an interactive artwork. The primary element is the utilization of the participant's contribution, which becomes a significant part of the work. However, a second element is required. The contribution cannot be anything the participant desires as this would mean that the experience of sharing the creative process is removed. This total freedom cannot be realized as it would indicate total absence of thought on the part of the artist who had created the initial work. A common feature of many interactional relationships between the artist and the

participant is that the relationship is largely mono-directional as the artist does not interfere with the work once it has been created. The real value of an interactive work is in the extent to which the artist has considered how the interactive process will occur. Artworks that rely on the audience to follow a predetermined sequence of events, where the artist has pre-specified the route to be taken, are not interactive artworks as "this is not interactivity; it is an interactive-style activity. There's nothing participatory about it" (Rushkoff, as cited in Stallabrass, 2003, p. 62). Genuine interactive artworks are those that provide "mutual and simultaneous activity on the part of both participants, usually working toward some goal" (Stone, as cited in Stallabrass, 2003, p. 63). Such genuine artworks exhibit qualities such that when participants are interacting, they have an impression of infinite choices and alternative paths are created at the point of interaction. This has been termed "second-order interactivity" (Couchot & Hillaire, as cited in Hansen, 2005, p. 153): whereas "first[-order] interactivity understood human–computer interactions on a stimulus–response or action–reaction model," and focused on the control of communication, second order interactivity deals with notions of "self-organization, emergent structures, networks, adaptation and evolution."

Krueger (as cited in Cameron, 2005, p. 18) contends that the evaluation of the work should be based on the quality of the interaction, "which may be judged by general criteria: the ability to interest, involve and move people, to alter perception, and to define a new category of beauty." Apart from the necessary engagement, the audience members make judgments about the quality and the success of the work as an interactive artwork.

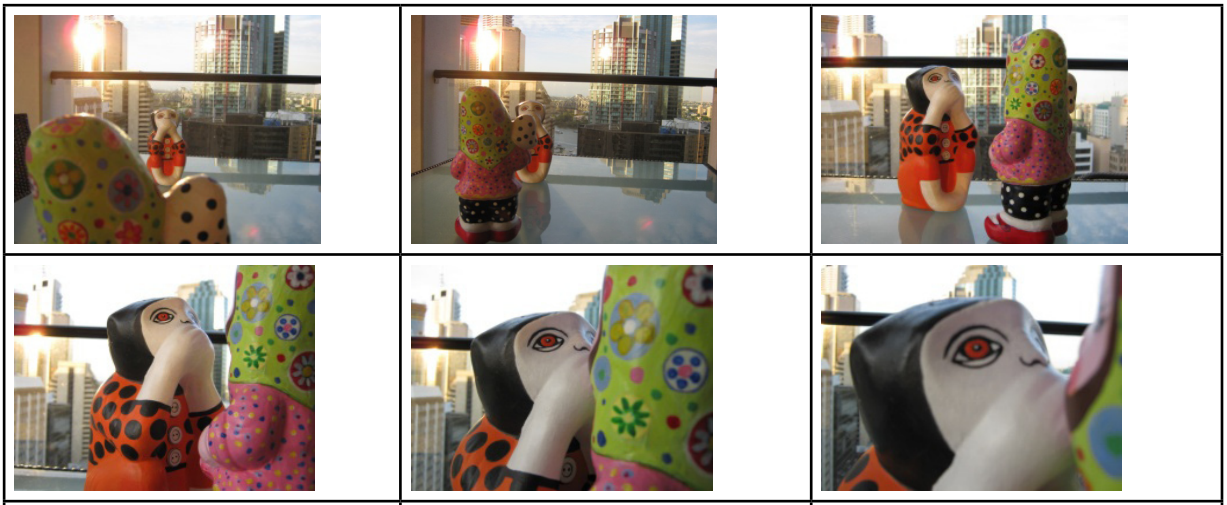
Interactivity as a Form of Emergent Learning

In the preceding section the nature of interaction in artwork was visualized in Figure 1 in terms of the parameters of artist control versus participant freedom. Interactive artworks that afford collaboration with the artist and allow a sense of agency were identified as genuine sites of interaction and located in the ideal area of Figure 1. Genuine interaction depends on the extent to which the artist has considered how the interaction will occur. The artist of an interactive artwork provides a framework which guides the audience, draws the audience in, and allows the audience to explore, rearticulate, and reform the work. The participation of the audience is integral to the meaning of the work. Multiple meanings are formed in the interaction of the audience with the work. The separation between the artist and the user is reduced in an interactive artwork, and there is a perception of infinite choice and alternative pathways during the process of interaction.

We now investigate how the above interactive art practices can be applied in a pedagogical context where a framework for student interaction is used to encourage student learning. Increased interactivity in interactive art practice facilitates the emergence of meaning from the participants, rather than a stimulus-response model; these notions can be applied also to designing for emergence in learning tasks for students. The educational framework suggested here is presented as a "proof of concept" in the sense that it has not yet been used in practice with students. It will be trialed with students in the second half of 2011. The key

difference between interacting with an interactive artwork and interacting within a learning environment is likely to be the quality of the interactive encounter and the quality of the contribution. Interaction in a learning environment necessitates the provision for *learning*. Students cannot simply opt not to interact as they need to demonstrate knowledge to be awarded a grade. Prior to investigating the notion of demonstrating knowledge within an interactive Web 2.0 task, we first outline the learning task in terms of the emergence/prescription dialectic (see Figure 2).

The learning task in question is situated within a media arts preservice teacher education course. According to the Australian Curriculum, Assessment, and Reporting Authority (2010, p. 5), "Media Arts is the creative use of communications technologies to tell stories and explore concepts for diverse purposes and audiences." To learn about the core content of this art form, students create media arts texts and lesson plans incorporating the media arts texts they create. The learning task suggested here is the creation of a particular media arts text, a photo-narrative, which students will create and share via Flickr. A photo-narrative is a sequence of photos that tell a story in the narrative genre (Picture 1).



Picture 1. Example of a media arts character photo-narrative (6 photos) (Kawka, 2011).

Flickr is selected as it is a Web 2.0 photo-sharing platform; it is an easy platform to use on an individual basis; and it caters to the increase in complexity that emerges through the interaction of multiple users. Our intention is to create an interactive online learning space that will increase in complexity as students interact with it. As students upload information and respond to one another's works, the information is transformed, "creating an interconnected, open-ended system featuring phased transitions toward more complex structures" (Sommerer & Mignonneau, 2002, p. 161). In this sense, Flickr is an ideal platform that will demonstrate levels of emergence versus prescription.

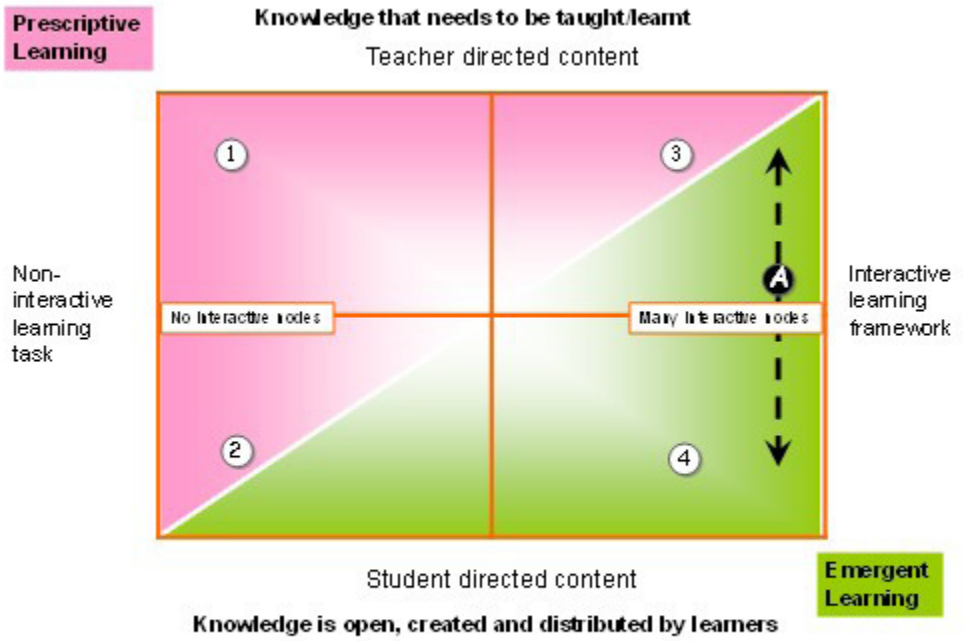


Figure 2. Emergent learning environment matrix.

Earlier in this paper, Figure 1 was presented as a means of mapping the control versus freedom dialectic for selected interactive artworks. We now adapt this conceptualization to map the nature of learning that can take place in a Flickr photo-narrative learning task. Figure 2 is a theoretical space that can be used to illustrate how a teacher might construct a learning task within an emergent learning environment. Following Williams et al. (2011), we describe emergent learning in contrast with prescriptive learning. Both can be further described in terms of how knowledge is maintained. In emergent learning the knowledge is open, created, and distributed by the learners. In prescriptive learning, the knowledge is largely predetermined for the learners. The question that emerges from these parameters for us is what will count as knowledge in our educational context? We now define the parameters of the matrix and provide specific examples of how a task might look in each of the quadrants and argue that the ideal area within an emergent learning environment sits along a continuum as indicated by the gray area in Figure 2. We theorize that this is the location on the matrix that allows knowledge to be "open, created and distributed by the learners."

The matrix has two knowledge parameters, "Knowledge that needs to be taught/learnt," including teacher-directed content and "Knowledge is open, created, and distributed by learners," including student-directed content, and also two interactive parameters, which we described earlier. The key knowledge that students need to gain from the course is the core media arts content as described by the Queensland Studies Authority, including using words to change interpretation of visual images, sequencing visual images to construct a narrative text, using different media shots and lighting to communicate a particular mood,

and creating media texts for a specific purpose for a particular audience (Queensland Studies Authority, 2008, p. 2). It is therefore assumed that this is the knowledge that students need to learn and that they will need to demonstrate their level of knowledge in the completion of the learning task. This core body of knowledge that needs to be learned is directly related to the matrix parameters of "teacher-directed content." When the learning is teacher-directed, the teacher provides material that specifies exactly what the students have to do in the task; for example, the set task is to be completed in a set order at a set time using a specific template. However, despite the directed nature of this activity, teacher-directed content is not a contradictory parameter in an emergent learning environment. That is, it does not necessarily imply prescriptive teaching practices. It may in fact be a necessary component, particularly if we are applying the notion of the interactive artist creating the framework for interaction. In this context the teacher is responsible for the authorship of the learning task that guides students via a sense of shared creativity. The teacher-directed content parameter needs to be particularly strong for a non-specialist, novice group of learners such as first-year students.

The "Knowledge is open, created, and distributed by learners" parameter is related to student-directed content. The students here would be responsible for creating the content of the learning task and they would specify what knowledge needs to be learnt. However, as we will be dealing with a novice group of learners with limited knowledge regarding course content, it is difficult to foresee their completely driving the learning in the course. Thus, the student-directed content may still involve a minimal amount of teacher input to initialize the process.

In the interactive learning framework parameter, the task is defined as being a holistic, interactive item (the system that will emerge and grow in complexity). All the students contribute to generate a shared media text. The text grows in complexity over time as a result of student interaction. This is the parameter wherein the students derive a sense that they are working toward the same goal as the teacher and there is a perception of multiple pathways during the process of interaction. Another feature of the interactive learning framework is the number of interactive nodes. This means that students do not interact only once with the system, but instead keep returning to provide multiple interactions with the system. In contrast to this is the non-interactive learning task. Here individuals create a text that is not interactive. Students may see what other students have done, but they do not engage with one another to any great extent. Students may not feel any agency over the direction of the entire system as they are provided with the opportunity for only one interaction. The interaction of these four parameters thus divides the matrix diagonally into "emergent learning" and "prescriptive learning" relative to student/teacher and interactive/non-interactive.

We now demonstrate how the matrix might be used to "ensure an effective balance between openness and constraint" (Williams et al., 2011, p. 39) in constructing an emergent learning environment. Each number on the matrix denotes a particular version of the same task when the four parameters interact. We then suggest an ideal position on the matrix (identified as A in Figure 2), dependent on context, which will best foster emergent learning.

1) Teacher-directed content/non-interactive task

In the task of creating a photo-narrative on Flickr, students are asked to create six photos. They are provided with a template for structuring their narrative which includes concepts to be covered. Students have to use a set number of different camera angles to tell their story. They are provided with a character to tell the story and are directed to a specific location where the photos are to be taken. The photos are then uploaded and descriptions are written. Students are assessed on their application of media techniques in the construction of their story. The task is teacher-directed as the teacher specifies all the content that needs to be covered. The task is non-interactive as students do not record their interactions with one another as part of the activity.

2) Student-directed content/non-interactive task

For the content to be largely student-directed in the Flickr photo-narrative learning task, students may select their own characters to photograph. As teacher input is limited at this point, the resultant demonstration of appropriate media strategies may not be robust. Students might create photo-narratives using particular media techniques and present them in an educational way. In this context, students view the various narratives and in so doing learn about a range of media strategies. In this sense knowledge is created and distributed by the learners. The teacher is still necessary to provide the initial impetus (and we can predict that the more effective the teacher guidelines the more effective the student presentations of the knowledge that they impart to others). As students do not interact with one another at this point or write comments about the presentations that they watch, this is a non-interactive learning task.

3) Teacher-directed content/interactive learning framework

In this scenario, the activity is interactive (let's say one interaction node) and also tightly directed by the constraints set by the teacher. The task might involve students selecting their own characters and following production procedures wherein media techniques are learned and applied in creating photo-narratives to upload. To afford interaction with others, students leave their texts open for contributions (for example, not providing an ending to the story). Students then select a photo-narrative for which they will create an ending. This task includes an element of randomness as students complete one another's stories. The stories contribute to a system of texts related to one another. However, one interaction with the system limits the level of complexity that can emerge in the system.

4) Student-directed content/interactive learning framework

Within this learning framework, students regulate how they will contribute to the task. There is limited teacher input and students may respond to others, but it is not specified in what manner students respond to one another. They may decide to respond once, or not at all, or can continue responding to one another on a regular basis as the interactive nodes

are limitless and grow as students continue to interact. This activity resembles many of the features of social networking. Even though something may evolve out of this process, it is also possible that this "something" will have little or no educational value. If students are able to do anything, this may not result in the generation of the knowledge that students need to learn to meet the prescriptions of the course. As no parameters are set for the level of contribution expected, it is conceivable that there will be little or no contribution from students. Therefore greater teacher direction in the task might be necessary and students might be encouraged to create photo-narratives that are designed to teach primary school students about media techniques and that are to be available for other students to interact with. Knowledge is still created and distributed by learners as students teach one another as part of the learning task. Although interaction occurs with minimal teacher intervention and knowledge is created and distributed by learners as the interactions are not perpetuated (by teacher direction), we do not consider that emergent learning has occurred as the learning outcomes are not emergent or complex, but expected.

A) Teacher- and student-directed content/interactive learning framework (multiple interactive nodes)

As was established above, a movement toward an emergent environment conducive to learning falls between teacher direction and student direction. At Point A, the version of the activity shares many of the features of Quadrant 4 in Figure 2; however, the difference is the presence of teacher-facilitated opportunities for numerous interactions with the system throughout the completion of the task. Accompanying the increased opportunities for interaction is the likelihood of increases in complexity within the system. At Point A the teacher creates the process or framework within the system that will facilitate the interaction.

The following photo-stream task is an example of how this might look. The students are asked to create a photo stream depicting the secret life of toys. Students identify their own character which will be the basis of the photo-narrative (a creature toy, for example). Students take a photograph of their character, selecting an appropriate shot type to match the character's personality, and then write a description of their character and upload the photo and description to their Flickr account. They then take a variety of shots of their character for other students to use in the next task. Students then select another character's photo stream and create a narrative about the two characters meeting (this begins the emergence of randomness, depending on the choices that students have made). Some characters might become popular because they have featured in many joint stories. The next interaction might involve making contact with another person, where a joint narrative is constructed and uploaded. Subsequent interactions might involve creating specific media tasks for others or creating galleries or favorites of particular shot types and meaning elements.

In the example provided above, the end result of the learning is the generation of an emergent network created via the use of various stories, meaning categories, and repositories of media concepts. It is undetermined at the outset what this network of stories will look like, and the complexity emerges from the number of interactions in the system. Various mean-

ing themes might be identified depending on how students have constructed their toys in their narratives. In terms of the defining factor of an emergent learning environment, knowledge in this activity is open, being created and distributed by learners. The knowledge still needs to be defined and maintained by the teacher for the learning outcomes for this particular course. If the course involves a largely specialized cohort with a large body of knowledge (for example, a masters-level course for media arts teachers), the knowledge parameters could be open. With a first-year cohort, with limited knowledge about the subject matter and the requirement to gain a particular set of knowledge in the course, the knowledge parameters may need to be largely closed. In this instance the activity will be more tightly controlled by the teacher. The teacher, as the master artist of the system, will set up the interaction nodes at the outset and provide students with a map to follow throughout the tasks that have to be completed. Clear criteria are set for how the work will be assessed (for example, contribution to the network, specified number of interactions, media techniques utilized). Once the training wheels have been established, the interactions can become more student-directed. Knowledge can then be jointly created and distributed by the learners, within a system that is complex, unexpected, and emergent.

Conclusion

The ongoing development of contemporary technologies presents multiple challenges and opportunities for learners and developers of learners alike. Certainly there is considerable potential for learners to benefit from the networks of knowledge and skills made possible by those technologies (Sims, 2008). Yet for those benefits to be realized, learning developers and instructional designers must enact principles and practices that facilitate forms of learning that move away from traditional assumptions of content prescription and linear delivery (Irlbeck, Kays, Jones, & Sims, 2006). Furthermore, those involved in the design and delivery of learning must become increasingly sensitive to learning that emerges from their students rather than imposing learning outcomes upon them.

This paper has elaborated one possible approach to implementing such principles and practices, based on bringing into closer alignment elements of emergent learning and interactive media artworks. Our use of Flickr, a sophisticated Web 2.0 technology, enhances the opportunities for connectivity, whereby learning is enhanced by the largely informal connections students make with one another. At the same time, the open and organic nature of Flickr does not limit the potential connections students can make as is likely to be the case with wikis or blogs created as part of many learning management systems (for example, Blackboard, Moodle) in use in higher education. The focus has been on design for learning directed at maximizing connections by means of articulating specific parameters of interaction for groups of novice learners, here exemplified by first-year education students. Figures 1 and 2 have encapsulated our contention that the interplay between contemporary technologies and emergent learning creates many pedagogical possibilities, but that those possibilities are inevitably constrained by such issues as learners' degrees of existing knowledge and educators' dispositions to engage wholeheartedly with emergent learning. We look forward to trialing the framework outlined here with our students, both to learn

from their experiences with the framework and to refine the framework as appropriate for potential future applications.

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Aligning the Quantum Perspective of Learning to Instructional Design: Exploring the Seven Definitive Questions



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Abstract

This paper builds upon a foundational paper (under review) which explores the rudiments of the quantum perspective of learning. The quantum perspective of learning uses the principles of exchange theory or borrowed theory from the field of quantum holism pioneered by quantum physicist David Bohm (1971, 1973) to understand learning in a new way. Bohm proposes that everything exists as wholes, rather than as parts, and that everything is connected. Similarly, the quantum perspective of learning proposes that individuals learn in holistic ways as they interact with temporal and in infinitely extending virtual worlds. Further, according to the quantum perspective of learning, learners have infinite potential. In this paper, the quantum perspective of learning is examined utilizing a combination of Schunk's (1991) and Ertmer and Newby's (1993) definitive questions for aligning learning theory with instructional design. These seven definitive questions focus on how learning happens, influential factors in learning, the role of memory, transfer of knowledge, modalities of learning that can best explain the quantum perspective of learning, applicable assumptions, and a discussion of how instruction can be organized to optimize learning. Examples of strategies that facilitate the quantum perspective of learning are provided.

Keywords: Learning; the quantum perspective of learning; quantum state; quantum leap; quantum dimension; quantum memory channels; memory, instructional design; photovoice; artistic pedagogical technologies

Introduction

Learning theorists not only refute and negate one other, they also "tend to narrowly define knowledge and learning" (Yang, 2004). While constructivism (Vygotsky, 1978) and most recently connectivism (Siemens, 2004) have emerged and been embraced by educators and academics, these theories still stand in isolation, finding little common ground with each other.

If it is accepted that there are multiple ways of knowing (Netzer & Mangano Rowe, 2010) then it follows that there are multiple ways of learning. If there are multiple ways of learning then multiple ways of explaining how individuals learn must be requisite. Considering how consilience has integrated knowledge across disciplines (Morris, Urbanski, & Fuller, 2005), it is posited that the creation of a learning theory or perspective that has the potential to integrate theories of learning is long overdue. Further, this integration would bridge theory and practice (Netzer & Mangano Rowe, 2010).

The purpose of this paper is to apply selected principles of quantum mechanics, in particular quantum holism (Bohm, 1971, 1973), to learning theory in order to explore the creation of a new integrated learning perspective called the quantum perspective of learning. A full description of aspects of the quantum perspective of learning has been presented in a series of papers currently under review. This paper further examines the quantum perspective of learning by posing Schunk's (1991) and Ertmer and Newby's (1993) seven definitive questions for aligning learning theory with instructional design.

To provide background for the examination of Schunk's (1991) and Ertmer and Newby's (1993) questions, properties of the quantum perspective of learning are briefly described. Each of the seven questions is examined in relation to the quantum perspective of learning. Examples of teaching strategies that facilitate the quantum perspective of learning are provided. Implications for e-learning are presented.

Properties of the Quantum Perspective of Learning in Brief

The quantum perspective of learning is predicated on the work of David Bohm (1971, 1973) related to quantum holism. Human beings share connections with themselves, other individuals, the environment, and the universe (Hare, 2006). Quantum holism suggests that this interconnectedness extends infinitely in all things, in all places, and at all times.

This interconnectedness is exemplified in a posture of holism. In short, everything is connected, entangled, and in constant communication from the tiniest of structures (neutrons and quarks) to the largest of structures (planets, universe-multiverse) (Aczel, 2001). Connection, entanglement, and constant communication configure the basis of the quantum perspective of learning.

Connection can be thought of as an expansive multidimensional fabric which exists through time and space to which all things belong or are a part of. In this quantum fabric there is no independent existence. Rather, all existence is interdependent and entangled. Entanglement is indicative of each aspect touching or bordering all others. Further, constant communication suggests that on some level each particle (large or small) can communicate with all others.

These constructs form the basics of the quantum perspective of learning. Schunk's (1971) and Ertmer and Newby's (1993) seven definitive questions assist in clarifying the properties of the quantum perspective of learning. Each question is explored in detail.

Exploring the Seven Definitive Questions

Question 1 - How Does Learning Occur?

While Siemens (2006) suggests that learning consists of making connections between nodes within a larger network, the quantum perspective of learning proposes instead that learning is the process of discovering connections which already exist ubiquitously. While individuals each have a learning network of connections that they are aware of, the network that forms the total learning milieu extends from structures smaller than the sub-atomistic to the vast expanses of the universe. These structures can be represented through four realms of learning: quantasic, atomistic, temporalistic, and universalistic.

The quantasic realm of learning consists of the spaces that represent the purest and most primary forms of intelligence or learning. An example of this is quarks, which are considered to be the most fundamental unit of the universe upon which all else is built or predicated (Olive, 1981). The atomistic realm reflects the sub-atomistic domain of the electron or neutron. This refers to learning which can be explained through neurobiology, where there is constant communication and learning within an expansive neural network (Shahaf & Marom, 2001).The temporalistic realm pertains to learning and knowledge that are found temporally or in our existence as human beings in our everyday lives. The temporalistic realm includes learning that arises through and within technology. The universalistic realm of learning is found within spaces which exist outside the boundaries of our earth and extend into the cosmos. The universalistic realm is further explained by the laws of classical quantum mechanics (Raković, 2007).

It is proposed that these four realms of learning are all connected, continually communicate, and are entangled with each other. Further, through these connections, communication, and entanglements, learning exists in a posture of holism as part of an implicate order where all is connected rather than existing solely in discrete or distinct parts of an explicate order (Bohm, 1971). For the purposes of this paper, learning is primarily discussed within the temporalistic realm.

While in a holistic sense learning is always occurring within, between, and throughout all

realms of learning, human learning is experienced when a connection is discovered. Consider a hologram of infinite dots and connections. The dots represent all knowledge and the lines, connections, or vehicles that connect all knowledge. In essence the dots are already connected and learning provides the vehicle to discover and provide answers as to how, why, when, where, and what connections exist.

For example, consider learning related to causes of illness. At one time illness was believed to be caused by the presence of evil spirits. Through advances in science, the discovery of a link or connection between bacteria and illness paved the way for other discoveries that, for the most part, have vastly improved the health of the human race. While this connection between bacteria and illness always existed, learning (framed as discovery) had to occur for the relationship to be identified and understood. In this way, learning, or the discovery of single or multiple sets of connections, can be considered an ongoing process which continues throughout human mortality.

Question 2 - Which Factors Influence Learning?

Learning is filtered or influenced by various planes or dimensions that humans encounter in their everyday lives. Naming these planes or dimensions has been expanding since the early seventeenth century when behaviouralism was first identified by Locke (Davis, Edmunds, & Kelly-Bateman, 2010). Cognitivist theory proposes that learning only occurs on a single intellectual plane (Piaget, 1960, 1981), while social constructivism suggests that learning is influenced by social, historical, and cultural factors (Vygotsky, 1978). Connectivism goes further and recognizes that learning is influenced by multiple dimensions including technology (Siemens, 2004). Connectivism represents the first learning theory that recognizes the presence of a multitude of dimensions.

The quantum perspective of learning takes the concept of multiple dimensions one step further and suggests that there are innumerable dimensions that exist that influence learning. The dimensions include those that can be named at this time and those that remain unnamed or are yet to be discovered. In the quantum perspective of learning, dimensions that have been named include technology, culture, sociality, behaviour, cognitions, spirituality, corporeality, and the intersecting vision of teacher and learner. There are more dimensions that influence learning yet to be discovered. It is posited that even time and space in terms of Einstein's theory of relativity exist as dimensions which influence learning, although we do not at this time fully understand how. The multiple dimensions in the quantum perspective of learning are referred to as quantum dimensions.

Question 3 - What Is the Role of Memory?

Memories are first encountered as infants and normally develop exponentially as individuals reach and continue through adulthood (Conway & Pleydell-Pearce, 2000). Memory in children is entwined within several worlds: "imaginary worlds formed through various media," "an ongoing social world," and a "wider experienced world" (Dyson, 1988, p. 355). Dyson goes further to explain that

> ...tensions [exist] between these worlds [and] that the . . . developmental challenge is to not simply create a unified, 'disembedded' world but to differentiate and coordinate these multiple worlds" which exist within the various dimensions of time and space. (p. 355)

With the development of technology these findings could be applied to adult learning within a millennial world where humans increasingly experience virtuality within a "technosocial" reality (Fuchs, 2010, p. 788). Further to this, the role of memory in learning can be viewed as an active process of coordinating temporal, social, and virtual worlds and unfolding the resultant reality that ensues.

Three more principles guide the understanding of memory in the quantum perspective of learning context. First, memory in the quantum perspective of learning is posited to be highly connected through the passage of time and space where it becomes identified and mediated by the past, present, and future. Second, memory can be either conscious or unconscious. Finally, memory is felt to be formed through decoding and encoding within a continuous cycle of inputs and outputs.

Question 4 - How Does Transfer of Knowledge Occur?

The quantum perspective of learning occurs in a quantum state. A quantum state is abstracted as a state of readiness to learn and can also be expressed as a way of being-in-the-world (Heidegger, 1962). All knowledge, by virtue of being connected, in constant communication, and entangled, exists in quantum states. In the temporal realm of learning, or in our everyday world of human learning, these quantum states can be either conscious or unconscious.

While input can be understood as stimuli, the quantum perspective of learning suggests that stimuli are expressed chiefly as input. This input is carried across an intricate pathway of neural nets. The neural nets are all connected by virtue of constant communication and interference patterns which arise through this communication (Walonick, 1993). Learning is composed of infinitely occurring streams of input and output (Kretschmann & Werner, 2005). In a larger sense, teaching reflects all input while learning represents all output. Learning can be conceptualized in terms of either unconscious storage or immediate utilization of input. Teaching and learning can ultimately be expressed cyclically. This is the quantum perspective of learning cycle. The starting point and ending point of the quantum perspective of learning cycle is input. Input culminates as learning or output, which is then in essence "recycled" as the learning is again reflected as input to self or others.

All learning can be conceptualized in this cycle, where there is continuous input and output of information. It is suggested that all input passes through dimensional filters (i.e., technology, corporeality, culture, sociality, etc.) before transmission or transfer. This filtering can alter what is inputted. The dimensional filters are viewed as lenses through which individuals interpret input much as they do while wearing glasses. Subsequently these lenses/dimensions reflect or refract input in unique ways.

The transfer of learning occurs primarily through quantum channels (Cirac, Zoller, Kimble, & Mabuchi, 1997). These quantum channels are conduits through which memory-based and memoryless-based (Kretschmann & Werner, 2005) inputs pass and are decoded. Decoded memory subsequently becomes encoded and stored. The storage and encoding of the input manifests itself as internalized learning. As internalized learning is needed, concatenated memory channels (Kretschman & Werner, 2005) act to put memory back into a recognizable form where memory is once more decoded and becomes output. The outputs are exhibited as externalized learning which is reflected in changes or expansions in some capacity in one or all quantum dimensions that influence learning.

Question 5 - What Types of Learning Are Best Explained?

The quantum perspective of learning suggests that all learning is holistic in nature. Learning holistically, therefore, necessitates that quantum dimensions and quantum states exist ubiquitously. Ubiquitous properties of the quantum perspective of learning have ties to holistic learning in education.

Holistic learning, in an educative sense, refers to the "education of the whole person" (Hare, 2006, p. 301) rather than focusing on a single dimension. Holistic learning focuses on several areas of personal growth within an individual, which include "interpersonal awareness, self-awareness, disciplinary and interdisciplinary knowledge and understanding, and cultural and intercultural awareness" (p. 315). The quantum perspective of learning, as it recognizes all facets or dimensions in which humans learn, may be considered as a bridging perspective between all contemporary learning theories. While there may be no perfect type of learning that addresses all quantum dimensions simultaneously, there are several types of learning that may best typify the quantum perspective of learning. Examples include science-based learning, creative learning, emotional intelligence, and arts-based learning. These types of learning are explored further.

Science-based learning.

Science-based learning is traditionally expressed in terms of the acquisition of knowledge of scientific properties and equations (Bohm, 1971). An example of science-based learning is classical quantum mechanics. In classical quantum mechanics, rules prevail, represent constants, and explain scientific phenomena such as relativity. Science-based learning, which has long been understood as chiefly cognitive (Klahr & Nigam, 2004), can also be explained through the quantum perspective of learning and the principle of holism.

Science-based learning can be explained in terms of holism as "direct instruction" and is associated with "diffuse authentic reasoning and modelling" (Klahr & Nigam, 2004, p. 661). Through the inclusion of other modes of learning, "explicit [or cognitive] knowledge [does not exist independently as] meaningless facts and figures or bytes of information [but rather is supported by the] other facets [or dimensions that exist holistically]" (Yang, 2004, p. 243). In science, learning occurs "through time and space" and within a dynamic interplay of "relationships and artefacts" (Bleakley, 2006, p. 150). Science learning is felt to be "co-produced, context bound," socially constructed within a "reciprocity of perspectives," and

largely framed within outcomes of making or creating meaning (Sarangi & Candlin, 2001, p. xiii). Thus science learning is thought to be consistently transformative, highly innovative, and creative in nature (Kress, Charalampos, Jewitt, & Ogborn, 2001).

Creative learning.

Groves (2009) suggests that as a human race we are leaving the information age and entering the creative age. No longer will technology and current modes of teaching and learning be solely adequate for the millennial learner as "the age of logical, computer-like abilities [gives way to an age and] society based on invention, conceptualization, creativity and design" (p. 5). Creative learning, as a holistic endeavour, is purported to "bridge theory and practice" (Netzer & Mangano Rowe, 2010, p. 125). Creative learning is defined as learning that embraces "both rational and intuitive epistemologies" (p. 141), which are expressed though a "dance between inspiration and reason, logic and symbolic expression, [and] expansive and structured ways of knowing" (p. 123). Creative learning espouses the principles of the quantum perspective of learning especially through its emphasis on kinaesthetic intelligence (Simons & Hicks, 2006).

Netzer and Mangano Rowe (2010) propose that creative learning "opens learners to multiple ways of knowing [by] developing [learners] experientially [and thus] increasing the capacity for reflective awareness of self in relationships to a larger scope of being in the world" (p. 125). These relationships include, and recognize, the interconnectedness of self, others, and the environment (Hare, 2006). Creative learning encourages holistic growth in a multitude of dimensions. These include emotional, cultural, physical, aesthetic, moral (Hare, 2006), social (Yang, 2004), and spiritual dimensions (Netzer & Mangano Rowe, 2010).

Creative learning addresses possibility and potentiality (Simons & Hicks, 2006). Simons and Hicks cite several benefits of using the creative arts such as music, dance, movement, and drama to facilitate learning. For example, music helps to "connect and reconnect feelings with emotions, reconnect with memories [hence] deepening relationships and offering opportunities for personal experience" (p. 83). Drama encourages the occupation of differing roles, which increases students' abilities to enlarge their perceptions of the world and others in the world. Further, movement and dance appeal to kinaesthetic intelligence with outcomes such as (a) "freeing expression and developing creativity, and integrating emotion and intellect" (p. 84); (b) "building trust, gaining confidence and valuing differences" (p. 85); (c) acting as an adjunctive "assessment skill" where "knowing becomes indisputable" (p. 85); and (d) developing "communication skills, questioning skills, team skills, problem-solving skills, lateral thinking, flexibility and adaptability" (p. 87).

Emotional intelligence.

As whole beings, humans have many dimensions, which include not only intellect but also emotions. Emotional intelligence (EI) refers to "the ability to monitor one's own and other's feelings and emotions, to discriminate among them and to use this information to guide one's own thinking and actions" (Salovey & Mayer, 1990, p. 189). Intellectual learning alone

does not prepare students for the realities of the workplace in today's globalized world (Graham, 2009). Graham notes that today's world of "web-based communication illuminates the connectedness and interdependence" of individuals (p. 773), making adequate levels of EI even more important.

In view of this, the development of EI is necessary, if not imperative, in integrating both "technical [skills and the more] qualitative skills" of social competence and empathy (Morris et al., 2005, p. 892; Sherlock, 2002). In this integration ideas and emotion meet (Sherlock, 2002). The result is the creation of virtual-techno-social environments wherein individuals are self-aware, possess self-understanding, demonstrate self-regulation and therefore exhibit the "social competencies of teamwork, communication and conflict resolution" (p. 139). Morris et al. (2005) identify the use of the visual arts and poetry as particularly effective in operationalizing EI.

> The visual arts and poetry can be thought of as the competency of using words and images charged with their utmost meaning. It is within these meanings that powerful and significant evocations of emotion and feeling can be found. Because poetry and the fine arts have the power to shape minds and give meaning to what is seen and heard, they provide a rich contextual background for developing components of EI. (p. 893)

Arts-based learning.

Dewey (1934) was one of the first theorists to suggest that a link existed between the arts and learning that was larger than either. This connection is part of an unidentified whole (Dewey, 1934) which can now be understood in Bohm's (1973) notion of an implicate order where everything is connected. The arts could be understood as a linking mechanism in which intellect, emotion, and "embodied transformation" (p. 141) entangle on multiple levels such as "intuition, imagination and contemplation" (Netzer & Mangano Rowe, 2010, p. 125). In doing so, arts act as a conduit to exploring and linking emotional and real-world issues (Biley & Campney-Smith, 2003).

Arts-based learning uses various art forms as learning modalities. These include poetry, painting, sculpture, guided imagery, journaling, music, dance, and drama (Lane, 2005). Lane reports that using the arts in education has physical benefits as well as cognitive and social benefits. Physical benefits are a result of stimulation of the parasympathetic nervous system, which decreases heart rate, blood pressure, and respirations and results in a shift to "deep relaxation" as endorphins and neurotransmitters are released into the body (p. 123). Additional outcomes of utilizing the arts have been identified. These include amplified energy, compassion, enriched understanding of self (Lane, 2005), increased self-awareness, increased reflexivity (Freshwater & Stickly, 2004), increased ability to communicate experiential knowing (Yorks, 2001), refinement of writing abilities and accuracy (Biley & Campney-Smith, 2003), promotion of meaningful engagement, and facilitation of "shared

understandings of concrete lived experience" (Biley & Galvin, 2007, p. 800).

Staricoff's (2004) review of the medical literature frames additional benefits of utilizing the arts in education such as increasing the ability to think multidimensionally, stress and anxiety reduction, enhanced cognitive task execution, decreased aggression, improved communication, empathy, and heightened understanding of the needs of others. Learners who have engaged in arts-based learning also "respond in a more humane and thoughtful manner to ethical and social needs," resulting in a "powerful way of expressing self and understanding the world" (p. 10). Further, arts-based learning is felt to "re-humanize" the world through "meaningful engagement" with various art forms (Biley & Galvin, 2007, p. 800).

Question 6 - What is the Relevance to Instructional Design?

The quantum perspective of learning is predicated upon five assumptions:

1. Learning is multidimensional;
2. Learning occurs in various planes simultaneously;
3. Learning consists of potentialities which exist infinitely;
4. Learning is holistic/holographic and is patterned within holographic realities;
5. Learning environments are living systems.

The assumptions of the quantum perspective of learning are relevant to instructional design. Designing instruction necessitates that, first, a determination of the properties of that instruction be explicit. This can be understood in terms of five key aspects: what, who, why, where, and when. The "what" of instruction represents course materials that are tailored to fit online curricula and extend to the learners' need for knowledge. The "who" is the online learner. It is of note that defining the characteristics of that learner is a process that is continually evolving. The "why" has ties to both learning outcomes in the various disciplines and to student motivation. The "when" of learning in online instruction has been largely shaped by online and/or mobile technology, which allows almost unlimited access to course materials and interaction forums. It is the "how" aspect with which the quantum perspective of learning is primarily concerned.

The quantum perspective of learning principles apply to instructional design.

1. Online learning needs to be multidimensionally constructed. If it is accepted that humans are holistic beings, then learning must be able to reach the learners' multiple dimensions.
2. Online learning must occur in various planes/dimensions in order to access holistic development. Reaching the learner simply in one quantum dimension (i.e., cognitive or social) is not sufficient to promote learning that extends beyond the confines of the online classroom. Learning that reaches multiple dimensions becomes learning that is

accessed for life.

3. Humans have infinite potential to learn and develop in all dimensions.

4. Human potential for learning is ubiquitous. Geographic separation and asynchronous learning are not limitations in online learning.

5. Online instructional design should encourage learners to reach beyond temporality and virtuality into holographic realities. Holographic realities (which encourage interaction with and between learners, instructors, the learning environment, and technology) become the essence of holistic online education.

6. Online learning environments are living systems which grow, evolve, and develop through the passage of time and space. Online learning environments are dynamic spaces which support the needs of learners, instructors, and educational institutions.

7. Online learning can result in transformation for teachers, learners, and the educational environment. Ultimately through this transformation, technology is potentially both directly and indirectly transformed.

Question 7 - How Should Instruction Be Structured to Facilitate Learning?

Online instruction can be structured to facilitate learning through linking technology to learning strategies that exemplify holism. In doing so, the quantum perspective of learning environments are created. These quantum perspective of learning environments reach students holistically. This holism is created as educators reach toward providing innovative and creative strategies for teaching and learning.

As Yang (2004) stated, "most of the existing adult learning theories tend to narrowly define [what constitutes] knowledge and learning" (p. 260). The quantum perspective of learning environments provide a balance of challenge and skill (Groves, 2009), creativity and interaction, and become an expression of multi-modal strategies for reaching and developing students holistically (Kress et al., 2001). For education to be truly holistic, students must have opportunities to participate, conceptualize, contextualize, systematize (logic and reason), validate, legitimize, transform, interpret, and materialize (action) (Yang, 2004). Ultimately, it is through teaching and learning strategies that the quantum perspective of learning environments are created to provide a path to holistic learning.

Online teaching and learning strategies.

Teaching and learning strategies that facilitate the quantum perspective of learning environments can be found within contemporary educative literature. These include strategies that have been investigated in both traditional and online learning milieus. This section of the paper describes online strategies or strategies that can easily be adapted to the online

environment that facilitates the quantum perspective of learning. Strategies are categorized as they relate to creative learning, EI, science-based learning, and arts-based learning. These strategies are felt to be particularly effective as they model the principles of the quantum perspective of learning and promote the development of the quantum perspective of learning environments.

Creative learning strategies.

Barrett (2006) provides several strategies for enhancing creativity through collaboration. These include encouraging goal setting (both in the short and long term), self-analysis through writing/sharing, providing possibilities to extend thinking through the use of well-placed questions, the provision of multiple alternatives, joint problem finding and problem solving, offering social and emotional support, encouraging risk-taking, assisting students to find their own voices, and finally, modelling "ways of being" (p. 210). In addition, encouraging students to "take control over their own work. . . takes advantage of [and promotes] 'serendipitous' discoveries as they [arise]" (p. 209). Music, dance, and movement have also been found to be powerful tools to stimulate creativity in that they provide conduits for connecting feelings, emotions, and memories through activities aimed at "personal expression" and "engaging with multiple senses" (Simons & Hicks, 2006, p. 83).

EI strategies.

Armstrong (1994a, 1994b, 2009) identifies a multiplicity of instructional strategies that can be adapted for online use to enhance EI. These include the use of metaphors, visualization, analogies, music or environmental sounds, colour, art, and visual organizers in course work (Armstrong, 1994a). Further, Armstrong (1994b) suggests peer sharing activities, cooperative groups, games, one-minute reflection periods, connecting the course materials to the student's own life through reflective writings, giving students choices around lesson content and strategies, providing opportunities to share feelings, and having students adopt one another's perspective for a period of time.

Morris et al. (2005) lend support in emphasizing the use of visual arts such as paintings, photography, and poetry to develop EI. Photographs or paintings can be used to teach students to identify non-verbal signals, while instructor-or student-generated poems or song lyrics which "have identifiable emotional content and imagery" can be used to assist students in recognizing thoughts and feelings (p. 896). Reflective journals that help students to relate subject matter to their experiences, as well as the use of case analyses, composing "gratitude letters," and requiring students to engage in service work in their communities, have been found to help students develop EI (p. 898). Further, Graham (2009) claims that the use of email, blogs, and text messaging "increase opportunities to use EI" (p. 779).

Science-based strategies.

Science can be explored from various perspectives, including aesthetics, history, philosophy, bibliography, economics (van Rooyen & de Beer, 1994), and ethics (Hartsell, 2006).

Online group work and discussion forums are teaching strategies that can help students work through ethical dilemmas. Hartsell notes that online forums are particularly effective "for the purpose of analyzing and describing solutions to difficult problems" (p. 270). Art such as paintings, poetry, and photography can be used by students, instructors, or both (van Rooyen & de Beer, 1994) to supplement discussion forums and/or course materials. Instructors may need to instigate the use of these augmenting strategies. Klahr and Nigam (2004) emphasize the role of modelling from instructors as pivotal in promoting "diffusion and authentic reasoning" in students (p. 661).

Arts-based learning strategies.

Many of the preceding strategies have ties to arts-based strategies. In addition to those already presented, artistic pedagogical technologies (APTs) (Perry & Edwards, 2010) are arts-based teaching strategies utilized in online postsecondary learning environments. APTs encompass a variety of teaching strategies that use drama, literature, music, film, and photography to promote interaction, enhance community, and encourage participants to become "real" to one another in online courses (Perry & Edwards, 2010; Janzen, Perry & Edwards, 2011). The uses and benefits of these online strategies have been explored in several studies (Perry, 2006; Perry, Dalton & Edwards, 2008; Perry & Edwards, 2010; Janzen et al., 2011; Perry, Menzies, Janzen & Edwards, 2011; Perry, Edwards, Menzies, & Janzen, in press).

Photovoice (PV) is an example of an APT that facilitates holistic learning. PV as a teaching strategy consists of a photograph and reflective question posted to an online discussion forum on a weekly basis during a course. Each photo and question dyad is relevant to a specific course topic. PV activities are optional and non-graded. Students are invited to respond to the image and question. An example of a PV activity from a course on organizational change includes an image of a tree in autumn (see Figure 1). The accompanying reflective question is, "How has change impacted your workplace?" Students use the metaphor of the autumn tree to describe and discuss aspects of transition and change in their professional lives.

In the online milieu PV has been found to assist students to move beyond the dimensions of technology and virtuality and become "real" to one another as they interact in these spaces (Janzen et al., 2011). Students share their thoughts and feelings as multidimensional persons as they move through PV activities in successive course units. Students often describe "aha" moments when learning in these spaces is wrapped not only within the cognitive and social, but in other dimensions as well. PV in this way encourages holism and holistic development. PV encapsulates three types of learning: holism-based learning, creative learning, and learning that is arts-based. The effectiveness of this teaching strategy may be explained using the quantum perspective of learning.

Figure 1. Photovoice image (Image Otto F. Mahler, 2010, used with permission).

Implications

There are several implications which arise from a discussion of the quantum perspective of learning. As the world continues to shrink geographically through the expansion and discovery of technological connections, creation of knowledge and learning is likely to accelerate. Those learners who were previously not able to be reached through time or space limitations can be party to increasing opportunities to connect with other learners and educational institutions in new ways. The quantum perspective of learning in essence is about helping learners to discover the connections that will ultimately enrich their lives as learners and as human beings in a wide array of dimensions such as culture, corporeality, and sociality.

Online learners have instant access to vast amounts of information in real-time as they are learning. The Web becomes an integral part of this learning. Online learners, through searching ideas, terms, topics, and keywords, have the capacity for a breadth and depth of knowledge that in times past was only reserved for a select few who had access geographically to educational institutions. With this instant access, a holistic view of topics may be more achievable. In this way learning can become infused with infinite possibility.

Courses can be designed that encourage the discovery of the multiple connections that already exist. In terms of learning design, courses can be developed that have less prescription in terms of "assigned" readings. Instead learners can be provided with topics and themes and encouraged to seek out information sources and resources to inform themselves. In this way, courses reflect benchmarks while providing student engagement, and perhaps increased immersion, in specific connections that are important for the individual student. Preparing learners to know how to select credible online resources remains a precursor.

Students, being multidimensional, learn using different learning styles. Some learn by listening and some by doing, while others are visual learners. The quantum perspective of learning involves encouraging learners to select resources that meet their learning style preferences. Examples include podcasts for auditory learners and online videos or e-books for visual learners. Learning designers need to lead the way in providing learning opportunities so that learners discover their meaningful connections through their preferred way of learning. In this way educational institutions and instructors create partnerships with students that co-create accountability, creativity, and discovery.

The quantum perspective of learning environments often consist of virtual classrooms that can be designed to accommodate the quantum learner. The virtual classroom has the potential to merge virtuality and temporality with several advantages. Online learners have private space and time for thinking and learning. In some ways the relative "isolation" of their learning environments is an advantage with respect to undistracted thinking and reflection. Learners have the silence needed to dwell and reflect. Further, online learners have the freedom to learn at a time and place that is right for them. That is, they have more control over their learning environments. Learning can be engaged in comfortable, personally motivating spaces and places that become their individualized classroom.

In the quantum perspective of learning, learning is influenced by a myriad of factors including culture, sociality, behaviour, cognition, spirituality, and others. In some ways it may be an advantage for online learners to learn in their own spaces as these spaces are rich in cultural and spiritual cues important to their learning and understanding. In other words, taking students from their home environments and placing them in an alien environment (a traditional university classroom) may inhibit learning as the cultural and spiritual foundation of their being is not present. Learning at home in comfortable, familiar surroundings may, from the quantum perspective of learning, be an advantage as the student is in context.

Conclusion

The quantum perspective of learning was examined utilizing a combination of Schunk's (1991) and Ertmer and Newby's (1993) definitive questions for aligning learning theory with instructional design. Four types of learning, which may be best explained by the quantum perspective of learning, were delineated. Strategies that can enhance and create the quantum perspective of learning environments were provided. Implications were discussed.

The quantum perspective of learning provides an opportunity to view learning, learners, and learning environments in a new way. If all exists in holographic realities and all is connected, it may become even more important that learning environments which espouse the tenets of the quantum perspective of learning be created. These environments are dynamic and continue to evolve over time in keeping with the plethora of connections that are discovered every day. The quantum perspective of learning may provide a bridge to understanding more fully how we learn.

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A Pedagogy of Abundance or a Pedagogy to Support Human Beings? Participant Support on Massive Open Online Courses



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Abstract

This paper examines how emergent technologies could influence the design of learning environments. It will pay particular attention to the roles of educators and learners in creating networked learning experiences on massive open online courses (MOOCs). The research shows that it is possible to move from a pedagogy of abundance to a pedagogy that supports human beings in their learning through the active creation of resources and learning places by both learners and course facilitators. This pedagogy is based on the building of connections, collaborations, and the exchange of resources between people, the building of a community of learners, and the harnessing of information flows on networks. This resonates with the notion of emergent learning as learning in which actors and system co-evolve within a MOOC and where the level of presence of actors on the MOOC influences learning outcomes.

Keywords: Connectivism; networked learning; media affordances; learner autonomy; presence; roles; educator

Introduction

The emergence of new technologies and their effect on the volume and nature of information on the Web are influencing the context of education and learning (Bouchard, 2011). The structure of the learning environment, the place and presence of learners and educators within institutional boundaries, and the nature of knowing and learning are all challenged by the fast pace of technological change. Weller (2011) highlights the changes involved in moving from a learning environment of scarcity, based around the lecture model and books, to a web-based environment of abundance and examines different models of pedagogy to deal with these changes. Not so long ago, educators would find resources and information and would distribute these to learners in their care, perhaps by displaying them

in a learning management system (LMS). They would try to help learners in the development of conceptual frameworks by direct communication and social interaction within a classroom community, be it virtual or face-to-face. Emergent technologies provide different models and structures to support learning. They disrupt the notion that learning should be controlled by educators and educational institutions as information and "knowledgeable others" are readily available on online networks through the press of a button for anyone interested in expanding his or her horizon.

Of course this puts the responsibility for information gathering, the validation of resources, and the learning process in the hands of learners themselves, and one should question if all adult learners are capable of taking on this responsibility. The Web no longer consists solely of hyperlinked text pages, but has evolved into a complicated mesh of interlinked sites, consisting of human communication, writing, and digital artifacts. To manage this vast network of resources effectively requires learners to be autonomous in their learning and to have advanced analytic and synthesis skills to distill relevant information from the "noisy" network. Moreover, a high level of competency and interest in using a vast array of tools is required to do so effectively. Being able to distinguish the wheat from the chaff of information clearly becomes important as educators might no longer be available. Some argue that people's information behaviour should change from receiving information from a few "super nodes" on networks to moving into the information stream themselves and pulling just-in-time information off the networks, perhaps by receiving validation from other users (Boyd, 2010). The challenge includes not only the validation of the information but also the generation of ideas and thoughts that the organized institutional social setting of the past might readily provide, and which is much harder to achieve on a network with much weaker ties. We would argue that one of the major challenges is to create a pedagogy that supports human beings in their learning where the social connections people make on the network provide their learning support.

This paper will examine how emergent technologies might influence the design of the learning environment and in particular the roles of educators and learners in creating learning experiences on online networked learning environments. It will do this through the lens of a case study of massive open online courses.

Complexity, Resilience, and the Need for Agility in Learning

Barnett (2002) highlighted that we now live in a world characterized by "super-complexity," uncertainty, and change: "Work, communication, identity, self, knowing, and even life: the meaning of fundamental concepts are no longer clear in a world of change" (p. 9). Barnett (2002) had his own interpretations of knowledge in relation to uncertainty and change. He would like to see curricula and pedagogy move away from knowledge and skills to be a "pedagogy for human beings." He discussed a form of knowledge that would involve learners thinking about and confronting themselves with the uncertainties and dilemmas in their own lives. Learning is at the heart of personal change and transformation, and the learner needs to take risks and deal with changing situations in his or her environment.

Folke (2010) emphasized the need for resilience, so people will anticipate change then influence developments to achieve societal and personal goals. At the heart of sustainable change is developing and helping people to build up an "inner resilience" that guards them from experiencing every change that comes their way as disruptive. Instead, this resilience ensures that they learn to cope with these changes more as part of their continuous "agile" development and learning (Cashman, 2009), recognizing patterns in one situation and making sense of them and applying them in another.

However, this is easier said than done, and some questions spring to mind when relating resilience and change to emergent technology where the use of new technologies and the application of the information they produce is part of the continuous process of lifelong and lifewide learning. For instance, how to help and support fellow learners in dealing with the new realities of an abundance of information? How to make the most effective use of the tools? How best to position oneself in the continuous stream of information and communication and learn from others? What would motivate people to regulate their learning? In short, what would be the important factors in the design of a learning environment to support learner self-direction on online networks, and what should be the place and role of the educator?

Presence and the Role of the Educator in Open Networked Learning Environments

Shedroff (2009) argued that in current design practice, the main focus should be on creating environments that encourage relationships with individuals, experiences that connect on an emotional and value level. It is not enough to introduce some tools to create an effective working environment; one should also design for the building of connections, collaborations between resources and people. In a learning environment characterized by change, the tools and applications it recommends to learners and the connections it facilitates to other learners and knowledgeable others are vitally important to create learning experiences. The learning flow might be visualized as done by Kop (2010) in relation to a personal learning environment (PLE) and shown in Figure 1.

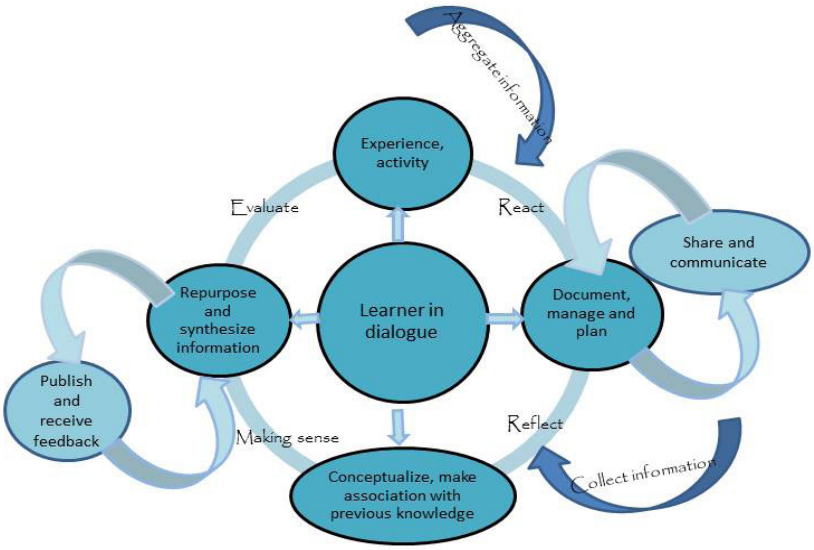

Figure 1. Model of learning on an open networked learning environment (Kop, 2010).

Kop based the model on the Kolb learning cycle (Kolb, 1984): The learner has an experience or a thought and would like to find out more or might want to get involved in an activity that requires exploration. He or she then aggregates information, plans the learning activity, and might call on others to discuss the generated ideas and ask for assistance. The learner would quite likely be engaged in a thinking process where links are made with other knowledge. This might in turn lead to a repurposing of the information and resources, for instance by using them to produce something or publish an artifact that might receive comments and feedback from others then leading to an evaluation of the learning process and the development of a further learning cycle.

In support of the learning cycle model, Kop (2011) puts a high value on the creation of a "place" where learners might feel comfortable, where there is a certain level of trust between participants in that environment—a community. She argues that the development of a place or community would be reinforced by a level of "presence" of the participants. Research by Garrison and Anderson (2003) and Jézégou (2010) emphasized the importance of presence in online learning environments. Presence is mostly defined in the literature as the "illusion of non-mediation" (Lombard & Ditton, 1997). In other words, there is a high level of presence when a participant in an online activity experiences the activity as if it were taking place in real life, without the mediation of the computer. Garrison and Anderson (2003), in their research on communities of inquiry, identified three interlinked forms of presence that heighten the engagement of online learners: social, cognitive, and teaching presence. Social presence is characterized by affective engagement, open communication, and a high level of personal address by and between participants. Wenger, Trayner, and

de Laat (2011, p.10) highlight that "the social fabric of learning" is supported in important ways through collaboration both in a "community" and on the "network." Added value to learning comes not only from the development of trust and confidence in a community, but also from social engagement on networks in producing and re-using discourse and artifacts. Cognitive presence is characterized by a triggering event, an exploration of ideas and points of view, a consensus on the points of view (reached by communication with and feedback from others), and then a testing and discussion of the found solution. Teaching presence involves the design and organization of the course, the facilitation of the course, and direct instruction.

There is a relation between these forms of presence (Annand, 2011) if we connect Garrison and Anderson's findings related to presence to the model of learning on an open networked environment in Figure 1. It becomes clear that social presence and cognitive presence could easily form part of the learning experience of a learner in such an environment through the formation and engagement both in communities and, more loosely, on networks. Teaching presence is much harder to facilitate as learners do not necessarily have contact with the educator, but it is the teaching presence that heightens cognitive presence (Annand, 2011). People learning on open networks could have access to knowledgeable others to support them, might find videos to inspire their thought processes, and could also self-regulate and organize their learning. This would, however, require a high level of self-direction by the learner. Researchers of learning on online networks can see new roles emerging for educators, such as those of curator, learner, facilitator, supporter of "repurposing" and "remixing" of information, coach, moderator, provider of technical support, lecturer, and "sharer" of resources (Siemens, 2008; Downes, 2010). In this context, the MOOC acts as an environment in which new forms of distribution, storage, archiving, and retrieval offer the potential for the development of shared knowledge and forms of distributed cognition. Characteristics of learning based on a conversational framework emphasize tutor–student dialogue and actions based on dialogue and reflection (Laurillard, 1993). In this sense, the MOOC allows a new model of learning based on adaptive responses to both discursive and active feedback from facilitators and participants, with the potential for engagement in a continual flow of dialogue and exchange and for reflective action on the part of the learner.

In the case study that follows, these are the roles that were taken on by facilitators on MOOCs. We will report on research in such learning environments and highlight how participants experienced the support provided and how they took on supporting roles themselves to heighten levels of presence. We will also provide some recommendations based on learner and facilitator experiences.

Context of the Research

A massive open online course (MOOC) engages networked learning methods but not within the typical structure of a traditional course. More like an online event, MOOCs invite open online participation around a topic of interest and a schedule or agenda, facilitated by people with a reputation or expertise in the topic of discussion, relying on successful

formations of learning networks to assist people studying the topics. In this context, we will focus on MOOCs as an opportunity to conduct research on networked learning in an open environment.

This next section presents findings from two MOOCs, offered as a joint venture between the National Research Council of Canada's (NRC) Institute for Information Technology and the Technology Enhanced Knowledge Research Institute (TEKRI) at Athabasca University. Findings will be drawn from the Personal Learning Environments Networks and Knowledge course (PLENK2010) and the Connectivism and Connective Knowledge course (CCK11), consisting of a vast amount of data as part of networked learning in an open environment. Two of the facilitators in the MOOCs were the founders of *Connectivism*, earmarked as the latest theory of learning and knowledge (Siemens & Downes, 2008, 2009). The facilitators, highly visible and knowledgeable in the field of study, were active on the course, found resources and speakers, and participated in all aspects of the course. MOOCs in this context did not consist of a body of content and were not conducted in a single place or environment. They were distributed across the Web. This type of learning event is called a connectivist course and was based on four major types of activity: *1) Aggregation* – access to a wide variety of resources to read, watch, or play, along with a newsletter called *The Daily*, which highlighted some of this content; *2) Remixing* – after reading, watching, or listening to some content, it was possible to keep track of that somewhere (i.e., by creating a blog, setting up an account with Delicious and creating a new entry, taking part in a Moodle discussion, or using any service on the Internet); *3) Repurposing* – participants were encouraged to create something of their own; in these MOOCs, the facilitators suggested and described tools that participants could use to create their own content, and it was envisaged that with practice, participants would become accomplished creators and critics of ideas and knowledge; and *4) Feed Forward* – participants were encouraged to share their work with other people in the course and with the world at large.

The courses included several tools. Elluminate is an online synchronous collaboration system for hosting live weekly sessions. Archived recordings were accessed 10 times more than participation in the live sessions. PLENK2010 included a course Moodle (an LMS), a platform that was much too centralized, according to one of the course facilitators (Siemens, 2011). One of the significant changes in the latest MOOC offering, namely CCK11, was the move away from the centralized Moodle environment toward aggregating and collating artifacts or meaningful resources into a single dashboard, viewed by some to be a more personalized medium. This was accomplished with the gRSShopper application (Downes, 2008). gRSShopper, an RSS aggregator, and the Daily newsletter derived from it were used to overcome an identified limitation of a more rigid structure for forum discussions in the Moodle environment. gRSShopper allows a networked conversation to emerge from the personal learning spaces of individual learners through a connect-and-collaborate dynamic that facilitators found to be well suited to the just-in-time collection of information prevalent in MOOCs. The support offered through gRSShopper was significant, as evidenced by a participant who commented,

> It helps learners to map the terrain of the conversation without telling them where to go. Aggregation of independent points of view is one of the key mechanisms to cultivating and harnessing the wisdom of crowds, and gRSShopper does that.

When a connectivist course is working well, one can see a great cycle of content and creativity that begins to feed on itself with people in the course reading, collecting, creating, and sharing. Participants were encouraged to create their own spaces. The main driver was to wrap the social elements around the course content, such as the readings, resources, and Elluminate sessions (Siemens, 2011).

Research Methods and Tools Used

Various approaches to researching MOOCs have been adopted across course offerings, including surveys of participants, tracking of activities, and artifacts produced with the course tag identifier. A mixed-methods approach and a variety of research techniques and analysis tools were used to capture the diverse activities and the learning experiences of participants on MOOCs. Surveys were carried out to capture information on learning experiences during the PLENK MOOC, more specifically an End of Course survey (N = 62), an Active Producers survey (N = 31), and a Lurkers survey (N = 74), as well as a Research into the Design, Delivery, and Learning in MOOC PLENK2010 survey (N = 55).

In addition, qualitative methods in the form of virtual ethnography have been used. A researcher was an observer during the course, collecting qualitative data through the observation of activities and engagement and also carrying out a focus group in the final week of the course to gain a deeper understanding of particular issues related to the active participation of learners. Because vast amounts of discursive data were generated and collected, computational tools have been used to represent large networks of activity in the PLENK, to identify themes in the data, and to analyse and interpret the qualitative research data. For the data analysis on PLENK2010, the Moodle data-mining functionality was used and provided participant details, their level of use and access of resources, information on course activities, and discussions taking place in the course forums. The gRSShopper aggregator statistics functionality provided details on course-related use of blogs and micro-blogging tools such as Twitter.

Findings

Participants in a MOOC

Demographic data from PLENK2010 revealed that the professional background of participants included education, research and design, and development of learning opportunities and environments. Individuals participating in PLENK2010 had comparable profiles to those on previous and subsequent MOOCs and were employed as teachers, research-

ers, managers, mentors, engineers, facilitators, trainers, and university professors. Chart 1 shows the distribution for age of PLENK2010 participants, and Figure 2 shows a Google Map, instigated by one of the PLENK participants, representing participants' places of residence.

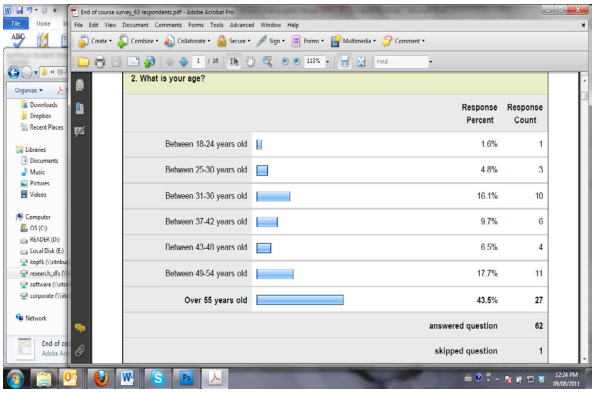

Chart 1. PLENK2010 participant age.

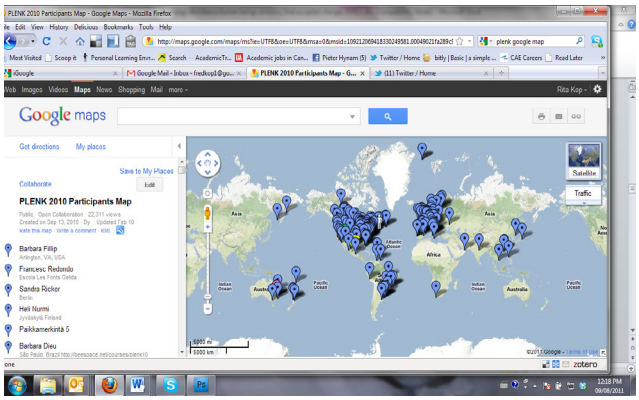

Figure 2. PLENK2010 participant place of residence.

Participation in a MOOC

The purpose of the PLENK2010 course was to clarify and substantiate the concepts of personal learning environments and networks. Course facilitators and participants would analyze the research literature and evaluate it against their own experience with the intent of developing a comprehensive understanding of personal learning environments and networks. The purpose of the CCK11 course was to explore the concepts of connectivism and connective knowledge and to explore their application as a framework for theories of teaching and learning. Neither course included formal assessments of learning outcomes as the learning objectives for each learner on the MOOCs was different, dependent on his or her context. In general, people participated on the MOOCs to learn more about certain topics and technologies and at the same time build a personal network.

Typically, the number of registered participants on MOOCs is high, but the nature of participation in course activities is varied and changes over time. When PLENK2010 started, 846 had registered, and that number steadily increased to 1,641 at the end of the course. In addition, global participation and multiple time zones influenced who participated actively in the MOOCs, especially during the live Elluminate sessions. A high number of blog posts (949) and an even higher number of Twitter contributions (3,459) were generated in relation to the PLENK2010 course. The course identifier, #PLENK2010, facilitated the easy aggregation of blog posts, Delicious links, and Twitter messages produced by participants, which highlighted a number of resources and links back to participants' blogs and discussion forums, thus connecting different areas of the course.

Although the number of course registrations was high, an examination of contributions across weeks (i.e., Moodle discussions, blogs, Twitter posts marked with the #PLENK2010 course tag, and participation in live Elluminate sessions) suggested that about 40–60 individuals on average contributed actively to the course on a regular basis by producing blog and discussion posts, while others' visible participation rate was much lower, indicating a consuming behaviour. PLENK2010 surveys indicated that active participation through the production of digital artifacts and interaction with others was conducive to positive learning outcomes as it helped participants to reflect and involved them in a creative process that stimulated their cognitive processes.

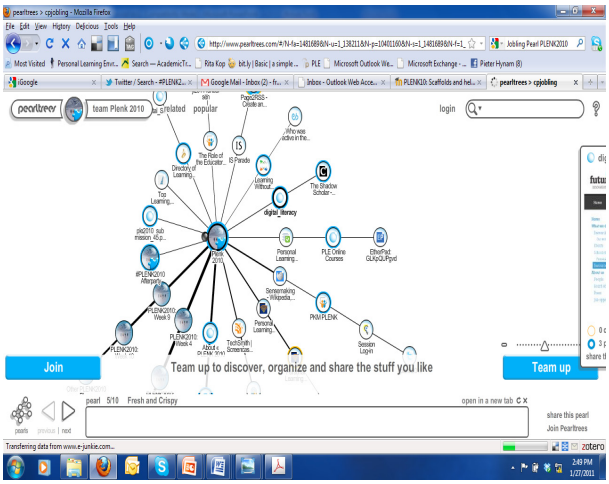

Figure 3. Pearltrees as a curation tool.

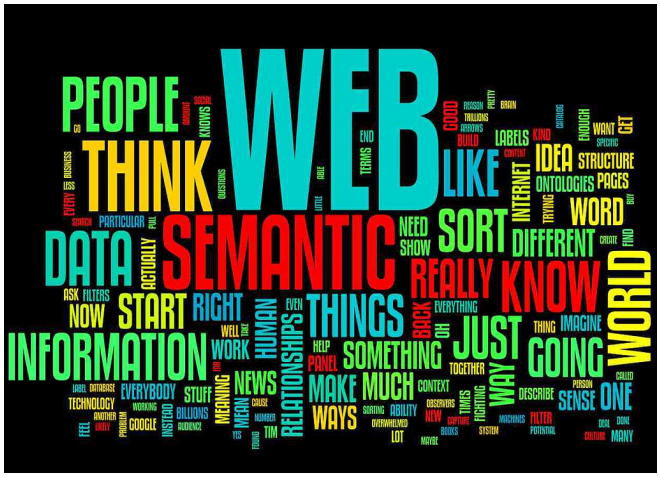

Figure 4. PLENK2010 Wordle.

Some people with previous experience in learning in a MOOC were very active and involved in the course. For instance, one participant's Google Map, shown in Figure 2, has received 22,267 views so far, and her blog has been read in 68 countries. Another participant created his own RSS aggregator and used Pearltrees both as a curation tool to collect information and resources related to the course and as an exploratory learning object and social network builder (Figure 3). Some learners used Wordle to "skim-read" papers and visualize the content of a paper (Figure 4), while another created an animation video about PLENK2010, dubbed "The Most Awesome Course on Planet Earth." PLENK groups were created in Second Life and Facebook to discuss topics and participate in the course from other vantage points.

Analytics tools were used to visualize complex networks between people. The social analysis tool SNAPP was used to produce online network visualizations of discussions, such as interactions between participants in the course Moodle forums. Figure 5 presents a complex network of interactions between participants in one Moodle forum discussion in which the facilitator acted as a key instigator of activity. This visualization shows the presence of the facilitator and of a number of active participants on the network who played an important role as well. Figure 6 illustrates the complexity in making sense of all the interactions on a network, for 1 out of 10 weeks of discussion in the Moodle forum.

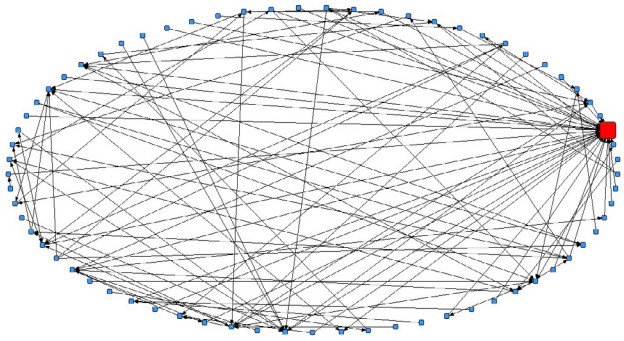

Figure 5. Complex network for one facilitator post.

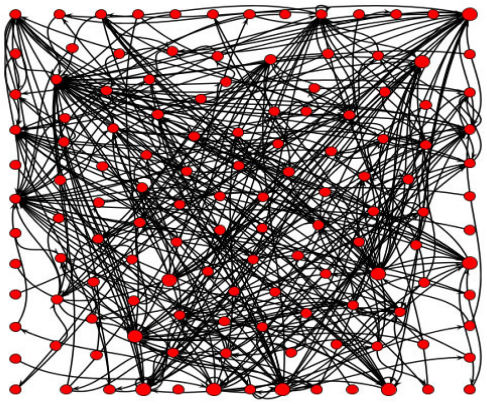

Figure 6. Visualization for Moodle Discussion—Week 1.

Connecting on the network was important to support the active participation of learners. One PLENK participant expressed the following:

> To be a connectivist is to choose your network, any network, and then use whatever personal tech tools are out there to take your node (also known as your brain) and absorb the information you are seeking in order to create, solve, perform in both virtual reality and location-based reality.

Another learner highlighted in her blog what activity she perceived to be required in a connectivist course: "Networks are then the structures through which knowledge is created, shared, and improved during a MOOC, particularly by participants."

Importance of Outside Groups and Networks

MOOC participants left the environment structured by facilitators and congregated elsewhere by using social media. A Facebook (FB) group was set up by the participants of some MOOCs (CCK11, PLENK2010) and was run by the participants as a case of self-organised learning. Much of the participants' educational use of FB was based around topics of interest, postings, comments related to blog posts or artifacts, post-hoc critiquing of learning experiences and events, and instances of moral support with regards to assessment or learning. A few credit-bearing participants of CCK11 used FB for posting links of their assignments for comments.

However, only a limited number of participants joined the FB groups (8.2% of 1641 PLENK2010 participants and less than 18% of 700+ CCK11 participants), and only a small proportion of FB group members were active at any one time during the course. Subtle concerns and issues arose. Some participants did not join the PLENK or CCK11 FB group for privacy and personal security reasons. Others who joined the FB groups remained as peripheral participants for the duration of the course. Participants also highlighted the need

for a sense of trust and feeling comfortable and confident to be able to participate, as well as a sense of presence and community. Some learners preferred the Moodle forum over FB as they expressed that they were able to learn more about the background, ideas, and beliefs of other participants than in FB. The CCK11 MOOC did not have a Moodle environment, and an excerpt from a blog post of a participant of CCK11 highlights some relevant issues:

> The relative "character" anonymity of participants in the CCK11 as compared with the PLENK2010 cohort was an obstacle. The PLENK (Moodle) forum provided an easily navigated discussion interface. From the contributions on a wide variety of topics, I learnt a lot about the passions, the character, the beliefs of the participants. We were fellow learners, not just network nodes, and I would imagine a certain degree of trust was established between many of the participants. Facebook, the seeming preferred CCK11 gathering place, does not provide the same level of personal connection for me, so I am not currently feeling particularly nodish.

This highlights the need of participants for social presence, but in a self-determined way. Learning under MOOCs is an interactive experience best achieved in a climate of relatedness, care, mutual respect, and support. Such care is offered, not imposed, and respects humans' need for autonomy, self-determination, and challenge, as well as for security (Arnold, 2005, p. 18). PLENK2010 and CCK11 participants made use of Twitter, a Web 2.0 micro-blogging tool that enhanced social presence by providing a mechanism for just-in-time social interactions. It provided authentic opportunities to connect and be perceived as "real" in ways that traditional LMS-contained tools could not. There were participants who valued Twitter and found it the best tool for learning, connecting, and interacting with PLENKers. A further survey in CCK11 revealed that participants ranked Twitter as the most important tool for interaction and communication in the MOOC. The feedback from some participants, however, suggests that Twitter was still too new and foreign to them in PLENK2010, and a significant number of participants were hesitant to use it in public:

> Twitter still seems too much another big distraction construction site for me yet . . . I merely use it to either retweet great tweets I stumbled upon, or to tweet valuable links via shareaholic, so "from outside," but I often follow #streams for events or topics, sometimes multiple, via tweet tabs though.

Observations of the use of Twitter, however, showed that it supported coherence and connections between different tools during PLENK2010 and CCK11, including back channels to synchronous sessions, updates of news and events, and links to recordings.

There seemed to be a gender difference in the perception of the value of community building

and the organization of communication. The research highlighted a difference between men and women in terms of their communication styles and preferences. Women tended to look for similarities or commonalities (i.e., in issues of language) that could become a source of bonding. In contrast, some men had a tendency to practice one-upmanship, in the sense of trying to keep one step ahead of other participants as competitors. Men were more task-oriented in their use of language, while women put more emphasis on socioemotional dimensions. For example, in one course activity that was taken up by PLENK participants, the female participant tended to play more of an assistant/supportive role and responded in an inclusive way, while her male counterpart tended to delegate tasks.

Deficiencies in Support Structures

It is clear, however, that there were deficiencies in the support structures of the MOOCs. The small number of facilitators (only four for PLENK2010 against 1,641 participants and two for CCK11 against 700+ participants) available to support learners in the MOOCs raised concerns about their level of interaction, participation, and engagement: "Too little participation and interaction by the facilitators. Be sure to provide a higher level of participation by facilitators." If teacher presence supports cognitive presence, then support by facilitators and experienced MOOC participants is clearly important to enhance the learning process. The open nature of MOOCs means a lack of advance knowledge about participant numbers and a difficulty in projecting facilitator requirements at the start of a MOOC

Some participants were expecting directions from the facilitators, while others found the course intimidating, overwhelming, and lacking in excitement as it progressed: "The course was essentially without directions. [...] The scale of things is always something that I find both fascinatingly cool and at times a bit intimidating and overwhelming."

The lack of a coherent and centralized structure and a lack of summary around learning in the MOOCs also presented challenges for some participants, in particular the novice learners. The choice of tools allowed learner autonomy, but was at the same time seen as a reason for a fragmentation of the conversation: "too much freedom in choice of tools unnecessarily fragments the conversation unless other tools are used to recombine the process." gRSShopper was used as a central tool for aggregation in CCK11 but was still not perceived as drawing resources enough into a meaningful conversation.

The difficulties in evaluating the course and its objectives were highlighted by some participants as they found it hard to assess learning outcomes. The objectives were not set by facilitators, but were personal goals set by individual participants, so they were different for each person. Other barriers to learning were time zone differences, language differences, difficulties in connecting with others in different spaces, lack of skills in the use of tools, difficulties in making connections with facilitators and/or learners, and power relations. Furthermore, a high number of participants mentioned personal reasons, such as lack of time to participate, as explanations for why they took on more of a consuming role in the course rather than an active, participative one.

Some support structures were perceived as positive by participants, who indicated that

course resources such as The Daily newsletter, the Moodle, and the wiki (for PLENK2010), and gRSShopper (for CCK11) were enough to feel comfortable in the course (Fournier, Kop, & Sitlia, 2011). Some new MOOC participants enjoyed the open structure: "This was my first course of this kind, and I enjoyed the open structure. It would not be suitable for just any content, but for this subject it seemed well suited."

Some experienced MOOC participants realized that the learning environment could be self-constructed. They also found improvements in the organization of content and instructions over past MOOCs: "Last year I would have said seeming lack of structure was a barrier. With experience the structure appears or can be self-constructed."

It was clear that experience with this type of learning increases chances of success and the level of activity and participation. Having a network of learners and a community to draw support from was considered important to enhance personal autonomy, as was revealed by one participant:

> While chaotic course structure was a barrier, it was also a benefit. It was difficult to keep everything about the course organized in my head. I later realized that I didn't need to worry about it so much. It just happened and the outcome for me was increased knowledge and a network of learners that I could draw from.

Participants also highlighted positive aspects related to support received. Respondents to the PLENK2010 survey were appreciative of how the facilitators led without directing and also of the work and engagement provided by the facilitators. Thus, teaching presence, especially exemplified through course design and the type of facilitation, turned out to have a powerful effect on student perceptions of support, inclusiveness, and overall satisfaction with the course. The participants valued greatly the autonomy on connections and participation in networks: "We were given free choice and allowed autonomy about our ways to connect and participate in the network. I greatly value this approach to learning and working together."

Many participants realized the importance of connections with other learners and of relationship building to advance learning. However, in a MOOC, they found these things extremely hard. Some learners did manage to be connected with a few others and interact in small groups: "I still feel like I struggle to make collaborative relationships online and asynchronously. It is as much a need to improve my relationship-building skills and perfect my organization abilities with existing tools."

Connections with people for learning could then be experienced through the support, help, and inclusion in groups.

> I was pleasantly surprised that others took my questions seriously and were willing to give me a hand. Everyone

> seems to be very generous of their time and knowledge. Then I was given invitation to join groups. That was very good.

However, there were some participants who didn't feel confident or secure when connecting in blogs or forums in PLENK2010. This impacted their level of participation and engagement in the course, as exemplified by this comment:

> I was very afraid to step out into the world and blog. I learned that my recent overflow prohibits me to write good posts, but I stepped out after all. Due to the quality of my posts I only tried to connect them slightly, but this worked very good and I am grateful for the chance to explore and the people I met.

Some participants of PLENK2010 and CCK11 were also concerned about some anonymous contributions and incidents relating to personal criticisms of facilitators and participants, possibly highlighting cultural or gender differences in perceptions of acceptable power relations on the course network.

Conclusion

This research showed the importance of making connections between learners and fellow-learners and between learners and facilitators. Meaningful learning occurs if social and teaching presence forms the basis of design, facilitation, and direction of cognitive processes for the realization of personally meaningful and educationally worthwhile learning outcomes.

Different learning objectives and different life contexts of learners in an open course lead to different levels of participation in learning activities and subsequently to different learning outcomes. The current research pointed to a maturing of e-learning users; the more experience in networked learning and through MOOCs, the higher the level of participation. People produced artifacts and created learning networks when confident with the technology and with the topic under discussion, while among new MOOCers there was a higher level of consumption of resources created by others. These results confirm research by Mak, Williams, and Mackness (2010) showing an emerging and growing practice across learners to develop those new affordances in innovative and nuanced ways. The challenge in a MOOC is whether the levels of support by facilitators and other learners and the affordances of a complex emerging learning environment will align and aid participants in such sense-making, and whether the openness, diversity, and interactivity of MOOCs aids participants on their personalized learning journey.

The type of support structure that would engage learners in critical learning on an open network should be based on the creation of a place or community where people feel comfortable, trusted, and valued, and where people can access and interact with resources and each

other. The new roles that the teacher as facilitator needs to adopt in networked learning environments include aggregating, curating, amplifying, modelling, and persistently being present in coaching or mentoring. The facilitator also needs to be dynamic and change throughout the course. Scaling up to the majority in networked learning requires facilitators to adopt a multifaceted role so as to guide or influence the learners and communities to get involved and embrace social media practices. The significant role of the knowledgeable others or other learners is to share part or all of the roles of the facilitator and support other learners by taking an active, participative, and critical role in connectivist learning by communicating, sharing, cooperating, and collaborating with and providing feedback to each other in the communities or networks.

Novices can best be supported through a series of activities that are structured on connectivist learning principles with a goal to enhance autonomy and the building of personal learning networks. Such scaffolding is necessary to build confidence and self-efficacy and to ensure novices will feel confident and competent in using technologies and are supported throughout the course.

Future MOOCs could be based on the learner-in-dialogue model as shown in Figure 1 and on the co-creation of the MOOC environment as a "place" with activities that would reinforce the orientation for learners, such as the development and practice of peer facilitation, mentoring, and coaching, the development of a personal network and digital literacies, and the building and development of personal and social networks and communities. These would encourage learner-centred approaches and match the affordances of new and emergent media. These would encourage new, active, and participatory forms of communication and collaboration and would also ensure that space is made available for substantial, self-motivated, self-organized, emergent learning to occur.

A challenge associated with the educational use of the Web, social networking, and media, based on the MOOC distributed learning model, is that the open, emergent, chaotic nature of online interaction might conflict with the rigidly organized social structure of formal education, which involves prescriptive learning, standardized goals and curricula, fixed schedules, age-based grouping, classroom-based organization, and examinations. This formal view of education is problematic for professional learning and highlights a tension between learning in everyday life facilitated by emerging technologies and the philosophical stance and the pedagogies adopted by universities. A change in the thinking, philosophy, design, and pedagogies of institution-based online courses may be necessary if the affordances of emerging technologies are embraced and adopted within formal educational institutions. Considerable efforts will also be required to ensure an effective balance between openness and constraints when an online institutional course is fused with social networks. The adoption of MOOCs in formal education institutions is challenging, though it opens up new opportunities to experience the co-creation of networks within communities and new and participatory forms of communication and collaboration for both learners and educators.

Further research will be conducted to explore the role educators and learners should play

in adding value to the learning experience through the matching of informal and formal learning by the creation of a symbiosis between the educational social community and the more open collaboration on online networks.

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Using mLearning and MOOCs to Understand Chaos, Emergence, and Complexity in Education

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Abstract

In this paper, we look at how the massive open online course (MOOC) format developed by connectivist researchers and enthusiasts can help analyze the complexity, emergence, and chaos at work in the field of education today. We do this through the prism of a MobiMOOC, a six-week course focusing on mLearning that ran from April to May 2011. MobiMOOC embraced the core MOOC components of self-organization, connectedness, openness, complexity, and the resulting chaos, and, as such, serves as an interesting paradigm for new educational orders that are currently emerging in the field. We discuss the nature of participation in MobiMOOC, the use of mobile technology and social media, and how these factors contributed to a chaotic learning environment with emerging phenomena. These emerging phenomena resulted in a transformative educational paradigm.

Keywords: Mobile technology; complexity; mLearning; MobiMOOC; MOOC; collaborative learning; chaos theory; emergence

Introduction

In December 1972, Edward Lorenz presented a paper to the National Academy of Sciences in New York, titled "Predictability: Does the Flap of a Butterfly's Wings in Brazil Set off a Tornado in Texas?" This paper introduced what we now know as chaos theory. Chaos theory was only emerging at that time, but it shook the scientific world as it helped describe outcomes for complex systems that were impacted by a variety of factors. As chaos theory became more widely accepted, experts in other fields, including educational research, started to employ it to predict future frameworks.

In the reality of the 21st century's second decennium, education is molded by a variety of new factors. The use of social media, new mobile technologies, and pedagogical formats has a major impact on the learning and teaching processes of today. Due to these new technologies and emerging formats, education has been forced into a process of transformation, and that causes an imbalance at first. However, Reigeluth (2004) writes,

> Chaos theory and the sciences of complexity can help us to understand our present systems of education, including (a) when each is ready for transformation, and (b) the system dynamics that are likely to influence individual changes we try to make and the effects of those changes.

Once we understand the dynamics of these new processes, we can find a new educational balance.

In these times of great complexity, we believe a pedagogical format that embeds and even embraces this complexity, combined with a prevalent emerging technology, can be the means to arrive at a new educational order. In this case, the pedagogical format is a massive open online course (MOOC) and the emerging technology is mobile learning (mLearning). We are certain combining technologies that embrace the complexity of knowledge production with pedagogical formats that allow learners to build knowledge by filtering that complexity will encourage a new educational balance to emerge. This balance will possibly enable the construction of a redesigned educational landscape that better fits this Knowledge Age. We use the word "possibly" to refer to Davis and Sumara's (2008) statement that "an education that is understood in complexity terms cannot be conceived in terms of preparation for the future. Rather, it must be construed in terms of participation in the creation of possible futures" (p. 43). It is our belief that the MOOC format allows massive participation leading to the creation of possible educational futures.

Research Methodology

The research methodology of this study is a research-based case study. The research-based design is the mobile massive open online course (MobiMOOC). For the case study research, we collected data from the final survey completed by MobiMOOC participants at the end of the six-week course. The survey posed questions on participation, level of familiarity

with mobile technology, profession, gender, and other demographics. These data were then used to evaluate the hypothesis that MOOCs and the innovative elements of mLearning and social media can add to a new educational equilibrium based on an analysis incorporating chaos theory, emergence, and complexity theory. We were participants and researchers in the MobiMOOC.

The Problem

"The beginning of the new millennium has been described variously as an Information Age, a Digital Age, or a Knowledge Society" (Moore & Kearsley, 2005, p. 288). No matter which label it is given, we agree with McNeely and Wolverton (2008) when they stated that "we are living through one of the recurring periods in world history when far-reaching changes in economics, culture, and technology raise basic questions about the production, preservation, and transmission of knowledge" (p. 7). This shift also has a profound effect on the leading education model used in the Industrial Age that has served as the balanced pedagogical framework for the past century. While the educational model of the Industrial Age focused on the linear transmission of information and knowledge, educators of this era search for a system dynamic enough to complement the new realities of the Knowledge Age. Chaos theoreticians argue that the nonlinear characteristics of the human mind and social interaction render the Industrial Age paradigm of teaching ineffective and deeply flawed (Cafolla, 2008). But if the education provided in the Industrial Age system is flawed, then educational researchers have to develop one or several new educational system(s) that fit this Knowledge Age and take into account the emerging technologies and learning/teaching realities of today. One such example, the MOOC, is addressed here.

There are currently two major technologies that have great influence on contemporary educational discourse, social media and mobile technologies, both of which impact learning in a profound way. Since 2005 mobile devices, social media, and the related learning that is facilitated by these new technologies have grown exponentially. The design for learning with mobile technologies is still tentative and exploratory, as mentioned by Kukulska-Hulme and Traxler (2007). However, several characteristics of mobile learning have emerged, including the importance of networks.

This rise of new educational forms (both from a pedagogical and technical point of view) has resulted in a quest for new learning methodologies and frameworks (McAuley, Stewart, Siemens, & Cormier, 2010). "As new systems arise, so do new possibilities and new laws that cannot be anticipated, even with the most intimate knowledge of the components or agents comprising the new system" (Davis & Sumara, 2010). If we look at the rise of social media and technology and the increased information production resulting from the read-write Web, we cannot help but turn to complexity theory for ways to develop new educational systems that incorporate this dimension. MobiMOOC brought together three innovations linked to the Knowledge Age: mobile technology, social media, and the MOOC as its learning and teaching format. We acknowledge that an investigation of a MobiMOOC will not result in a complete educational framework for this era, but it will reveal many of

the factors that impact contemporary education. By analyzing the MobiMOOC's complexity and emerging behaviors, we hope to add valuable information to the quest for a new educational framework and equilibrium.

In the first part of this paper, we will describe the MobiMOOC. In the second part, we will analyze the MobiMOOC and its components in relation to complexity theory while looking at activities that emerge from the course.

Background: The MobiMOOC

General Overview of the Course

The MobiMOOC (see http://mobimooc.wikispaces.com/) was organized by Inge de Waard, running from 2 April to 14 May 2011, and she remained present throughout the duration of the course both as one of the facilitators and the overall coordinator. The six-week course focused on mLearning and used the MOOC format to deliver course resources and interact with all the participants. The course was free to anyone interested in the topic of mLearning, placing it within the principles of open educational resources (OER), and after completion of the course the content was made available via open source content platforms.

The MobiMOOC lasted six weeks, and each week focused on a different aspect of mLearning. Each week, a different mLearning expert facilitated the course. To ensure that participants were all on the same level, the course started with an introduction week on mLearning (facilitated by Inge de Waard), followed by mLearning planning (Judy Brown), mLearning for development (Niall Winters), leading edge innovations in mLearning (David Metcalf), interaction between mLearning and a mobile-connected society (John Traxler), and mLearning in K-12 (Andy Black). All the facilitators were *guides on the side*, each putting forward as many learning actions and follow-ups as they wanted because each was voluntarily engaged in the course.

Some MobiMOOC Numbers

By 14 May 2011, at the end of the course, the following activity was observed:

- 556 participants had joined the Google group over the six weeks when the course was running; however, only a limited number of them actively posted ideas or comments to the group discussions. After taking out those MobiMOOC group members who did not post anything (potential lurkers) and those who only posted a welcome message, there were 74 active (contributing) members.

- 1,827 discussion threads were started.

- There were 1,123 tweets on Twitter with the #mobimooc hashtag (see Figure 1). This is particularly interesting as it demonstrates the highs and lows of activity for #mobimooc tweets, as well as SMS text messages, voice calls, and Web site submissions.

Clearly, the highest concentration of activity occurred during the weekly synchronous MobiMOOC presentations that happened on Monday. The class was given on Brussels, Belgium time (CET).

- 335 mLearning links were shared among the participants via the social bookmarking site Delicious.
- 32 participants completed the course as memorably active participants.
- 40 participants completed and submitted the final MobiMOOC survey from which we will draw conclusions.

After the course had ended there were 74 actively contributing participants (that is, individuals who wrote more than just the personal introduction comment). Forty participants completed and submitted the MobiMOOC survey (0.53%).

Figure 1. MobiMOOC crowdmap punch card, including #mobimooc tweets.

Taking into account the diversity of MobiMOOC interactions, one can see it or any MOOC as a complex system. In the next part of the paper, we analyze the MobiMOOC as a complex system with its emerging phenomena and focus on dialogue forming the center of the class's meaning.

The MOOC as a Complex System

> Organic pedagogical models correspond to and embrace vital conditions of self-organization, including fluid realm, openness to the information flow, turbulences and changes; freedom within flexible boundaries, richness of possibilities, interconnectedness of all parts of the system, and collective emergence. (Laroche, Nicol, & Mayer-Smith, 2007, p. 74)

We believe these vital conditions of self-organization—openness of information flow, freedom, interconnectedness, and collective emergence—can all be found in MOOCs. In this section of the paper, we look at a MOOC as a complex system embracing these vital conditions, using the data of the MobiMOOC as an example.

If a system is out of balance—in this case, the overall educational framework—numerous factors are influencing it in order to establish a new, sustainable equilibrium. Attaining a new balance is challenging, as chaos theory dictates that any seemingly small factor can have a major impact on the outcomes of the newly changed world. Hence the smallest change can affect, often negatively, the larger system. As such, it is important to analyze the characteristics of the MobiMOOC. By examining the characteristics of emerging educational formats, researchers can find a better direction to move in to obtain a new educational balance fitting the Knowledge Age.

A MOOC is Self-Organizing

A MOOC can be defined as a complex system that, in order to survive and develop, is continuously in search of new ways to interpret the events of the external world. As a consequence of the feedback it receives from the environment regarding its actions, the MOOC self-organizes, displaying emergent properties to interact with the environment in which it finds itself (Bertuglia, 2005). Reigeluth (2004) mentioned that systems require three characteristics: openness, self-reference, and freedom for people to make their own decisions about changes. He continued by stating that in order for a system to be open to its environment, it must actively seek information from its surroundings and make this knowledge widely available. This is exactly what happened in the MobiMOOC and what happens in MOOCs in general. The participants, by using open knowledge distribution repositories like the Web, share their experiences with others. These others can then give feedback to the MOOC, either positive or negative. This affects the learning system as it changes its structure to respond to the participants' dynamics. Such a reaction is interesting for in order for the system to adapt, it must be pushed out of balance first. This fits with what Laroche et al. (2009) wrote, "self-organization can occur in the realm of fluidity if the system is pushed out of equilibrium via some turbulence, gradients, or tension. The further the system is from equilibrium; the stronger the chance for self-organization" (p. 5).

An example of self-reference from the MobiMOOC is an interesting discussion that emerged on the issue of copyright. Some papers provided by instructors during the course were only accessible via paid library subscriptions. This resulted in a discussion about the belief that resources in a MOOC should be freely accessible to all. The freedom participants had to make their own decisions is illustrated by their ability to choose which tools they would use to disseminate or capture their thoughts about the course. This freedom and self-reference both reveal the MOOC as a self-organizing system.

A MOOC is Connected and Open

Iannone (1995) wrote that using a chaos theory framework, today's curriculum should be

flexible, open, disruptive, uncertain, and unpredictable, but it must also accept tension, anxiety, and problem-creating as the norm for the transformation process. The format of a MOOC is by definition open and online. In order to allow as many participants as possible to join the course, its resources are accessible via the Web. Laroche et al. (2009) added that "fluid environments have fuzzy and penetrable boundaries; they blur distinctions between schools, universities, nature and society, while juxtaposing formal and informal educational settings. Fluid environments are conducive to emerging non-orthodox forms of educational research" (p. 6). This fluidity can be placed within the connectivism theory from which MOOCs emerged. Additionally, this openness implies that a system should be willing to transform, indeed embrace the process as a natural product of openness and self-organization.

Connectivism and MOOCs

MobiMOOC was built on the concept of the massive open online course (MOOC). Two separate individuals, Bryan Alexander and Dave Cormier, first mentioned the term MOOC. The concepts behind MOOCs were first introduced by Stephen Downes and George Siemens while they were developing a course format to fit with the theory of connectivism; this course came to be known as Connectivism and Connective Knowledge (CCK). "In connectivism, the starting point for learning occurs when knowledge is actuated through the process of a learner connecting to and feeding information into a learning community" (Kop & Hill, 2008, p. 2). Kop and Hill (2008) went further, stating, "connectivism stresses that two important skills that contribute to learning are the ability to seek out current information, and the ability to filter secondary and extraneous information" (p. 2). This connectivism embraces complexity theory when referring to the organization of the course, which enables participants to connect outside of the learning environment and influence the course simultaneously. Mackness, Mak, and Williams (2010) found that when the theory of connectivism is used in the practice of a MOOC, its network principles of diversity, autonomy, openness, and emergent knowledge are included, giving it the characteristics of a complex system.

Transformation of the MOOC System

> To stay viable, open systems maintain a state of non-equilibrium . . . they participate in an open exchange with their world, using what is there for their own growth . . . that disequilibrium is the necessary condition for a system's growth. (Wheatley, 1999, p. 78–79)

This constant flux is an inherent part of a MOOC. Nevertheless, even in this supposed chaos we can find stability in the seemingly strange attractors that occur.

According to Wheatley (1999) transformation is strongly influenced by "strange attractors,

which are self-portraits drawn by a chaotic system" (p. 123). Reigeluth (2004) mentioned that "fractals are patterns that recur at all levels of a system, called self-similarity" and added some examples:

> ...the autocratic control of education which appears in universities across the globe, the uniformity with which courses are formed in colleges and universities. Top-down control and uniformity are but two of many fractals that characterize our factory model of schools. (p. 8)

Strange attractors started to emerge in the new educational reality as well. Reigeluth (2004) mentioned that "one example of a strange attractor in education is empowerment/ownership, which entails providing both the freedom to make decisions and support for making and acting on those decisions" (p. 8). He added that "these core ideas stand in stark contrast to those that characterize the industrial-age mindset about the 'real school': centralization and bureaucracy, standardization (or uniformity), and autocratic management." We saw learners empower themselves and take ownership during the MobiMOOC not only by applying principles of self-organization but also because they were able to build their own mLearning project, giving rise to emerging knowledge and personalized learning. MobiMOOC participants indicated that they did indeed make use of what they learned in the course, pointing to the fact that knowledge acquired was directly applicable and beneficial to the advancement of their education in the mLearning field (see Figure 2).

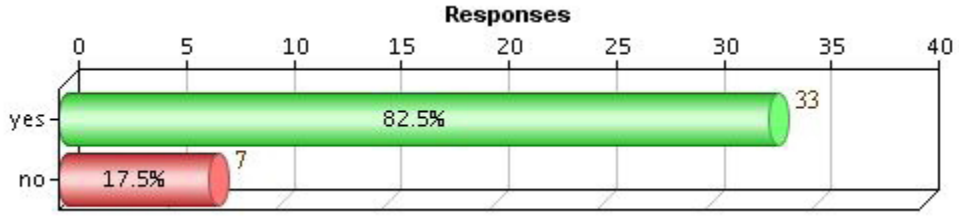

Figure 2. Have you been able to apply concepts or ideas that you encountered during the MobiMOOC in your own professional or personal context? (*N* = 40).

MobiMOOC also offered the participants the opportunity to develop their own educational project. In the final survey, many participants indicated that they worked on a personal project as well (Figure 3).

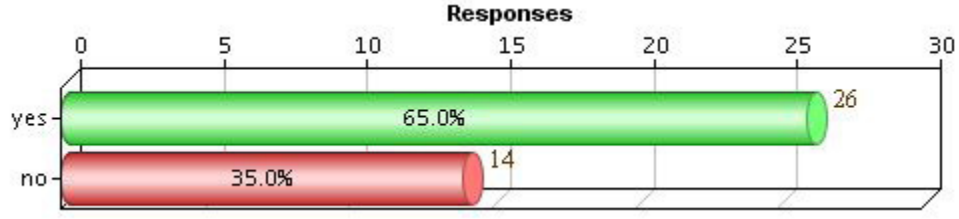

Figure 3. Did you work on a personal research-based mLearning project during the MobiMOOC? (*N* = 40).

A second example Reigeluth (2004) mentioned is customization/diversification. This is ubiquitous on the Web, with people diversifying their reading and writing and their use of social media. Although that use seems to be very diverse, there are similarities in the use of social media for affordances are starting to become clear, such as perpetual connectivity, asynchronous interaction, unforeseen collaboration, and emerging learning opportunities. These social media affordances are already being embedded in MOOCs; for example, course syllabi are often offered to MOOC participants in the form of a course wiki, which was the case with the MobiMOOC as well.

In this section, we established the MobiMOOC as an example of an open and adaptive, complex system. This is important in the Knowledge Age because a wide variety of factors influence the learning/teaching process. If education is redesigned in order to suit the Knowledge Age, these self-organizing and open characteristics will be crucial.

Due to the openness of MOOCs and their ability to transform depending on the needs of the course or curriculum environment, we see new phenomena emerge which we will describe in the next section of this paper.

Emerging Phenomena in MOOCs

Emerging Actions

Minsk (1986) stated that very few of our actions and decisions depend on any single mechanism. Instead, they emerge from conflicts and negotiations among societies or processes that constantly challenge one another. "Interactions of many sub-components or agents, whose actions are in turn enabled and constrained by similarly dynamic contexts, result in emergent phenomena" (Davis & Sumara, 2008, p. 34). Davis and Sumara (2008) have investigated the conditions that must be in place to allow these possibilities to emerge. They mentioned four important conditions linked to the MobiMOOC:

- internal diversity,
- internal redundancy,
- neighbor interactions,
- decentralized control.

Internal Diversity

Although diversity is an important factor, its impact cannot be foreseen. As Davis and Sumara (2008) wrote, "One cannot specify in advance what sorts of variation will be necessary for appropriately intelligent action, hence the need to ensure and maintain diversity in the current system" (p. 39). Davis and Sumara saw this diversity as an enhancer for fruitful discussions and successful knowledge creation, stating that an "intelligent response to the same circumstances might arise among the interactions of a network" (2008, p. 39). In

the case of our research, the diversity of the MobiMOOC resulted in new insights that we shared.

MobiMOOC participants also showed diversity in both age (Figure 4) and gender (Figure 5), possibly indicating that the format attracts people from groups that typically don't interact.

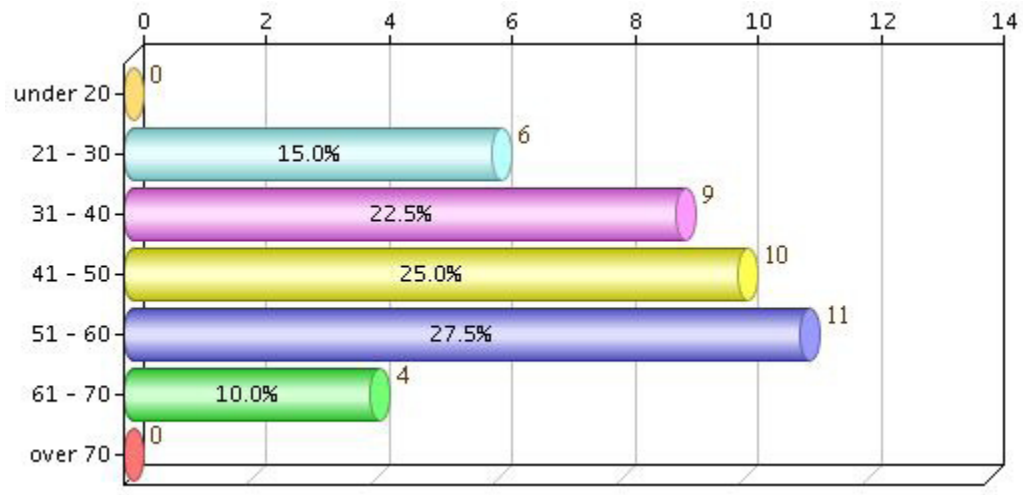

Figure 4. What is your age group? (*N* = 40).

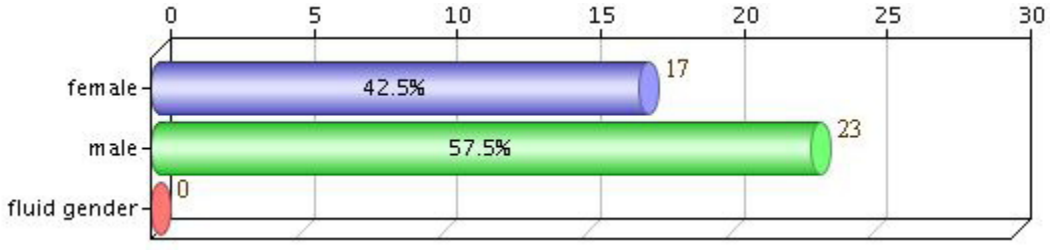

Figure 5. What is your gender?" (*N* = 40).

We saw diversity in the dispersion of the MobiMOOC participants across the globe as well. Figure 6 illustrates visits to the MobiMOOC crowdmap: For the MobiMOOC crowdmap there were 1,424 page views, 468 visits, and 372 unique visitors from 29 countries.

Figure 6. Overview of people accessing the social media tool MobiMOOC from countries

around the world.

In the final survey it became clear that although MobiMOOC participants had a wide diversity of backgrounds (health professionals, K-12 teachers, corporate training managers, language teachers, et cetera) most learned from mLearning concepts and insights from participants in other fields of expertise (see Figure 7).

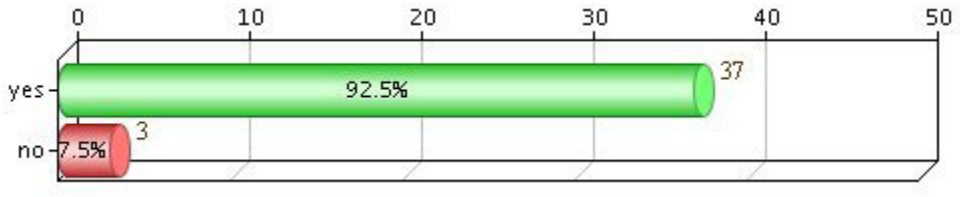

Figure 7. Did you discover new interests or new ideas from people in other areas of expertise than yours? (*N* = 40).

Internal Redundancy

The complement of internal diversity is internal redundancy, which refers to "duplications and excesses of those aspects that are necessary for complex co-activity" (Davis & Sumara, 2008). In the MobiMOOC internal redundancy included, among other factors, a common language (although not everyone was a native English speaker, English was understood and used by all), a common interest in one specific educational technology (mLearning), the willingness to share ideas, and a certain digital literacy that enabled participants to follow the online course. This redundancy permits complex coactivity by fostering diversity.

Davis and Sumara (2008) stated that "among humans, there is vastly more redundancy than diversity," adding that "redundancy enables interactions among agents" (p. 39). Agents must be able to affect one another's activities in order to activate the internal dynamics of a collective learning system, hence our look at neighbor interactions.

Neighbor Interactions

When Davis and Sumara (2008) mentioned neighbor interactions, they specified that "the neighbors that must interact with one another are ideas, hunches, queries, and other manners of representation" (p. 40), in the hope that these interactions will trigger other insights. They also said "the critical point is that mechanisms be in place to ensure that ideas will stumble across one another" (p. 41). MOOCs support free interaction among participants, establishing a critical point of idea interaction and a place for the creation of knowledge.

Even though knowledge can be seen as residing in both humans and non-human appliances, it is what we do with that knowledge, and how we construct new knowledge, that is important. This is where a Vygotskian perspective is quite useful. According to Vygotsky (in Nassaji & Swain, 2000), knowledge is social in nature and constructed through a process of collaboration, interaction, and communication among learners in social settings. We saw this happen in the MobiMOOC repeatedly. Through a process of collective scaffolding (Donato, 1994) some participants assisted others to expand their understanding of mLearning

and in some cases also helped them implement their own mLearning projects. In many cases, participants received constructive feedback from their classmates on projects that they were either implementing or designing. This collective scaffolding enabled participants to work within the zone of proximal development (ZPD) (Vygotsky, 1978) and to expand their capabilities with the help of more knowledgeable peers. MobiMOOC ascribed to the Vygotsky principles of collaboration, interaction, and communication, revealed most clearly in the assistance participants offered to one another throughout the course.

Decentralized Control

Although there was a centralized coordinator and each MobiMOOC week was facilitated by a different mLearning expert, the participants had control over part of the advancement of the course. The MobiMOOC participants could, for instance, put forward discussion topics that were then taken up by others.

"One of the properties of complex systems is that they allow emergence of smaller complex systems within them" (Laroche et al., 2009). This happened as a result of decentralized authority and the fact that the participants were in control of their own learning. The dynamics of the MobiMOOC resulted in smaller complex subsystems that arose. This paper, for example, is a result of MobiMOOC participants who volunteered to join and engage in an emerging, unplanned action. Such an act is related to what Jenkins et al. (as cited in Davis & Sumara, 2008) described as educational research based on complexity, for it

> must be interpreted as participatory—meaning that there are opportunities for expression and engagement, there is support for creating and sharing creations, there is some type of teaching so the most experienced can mentor new members, members believe their contributions matter, and members feel social connection with one another. (p. 43)

Other emerging connections also occurred and resulted in participants setting up new collaborative projects, shown in Figure 8.

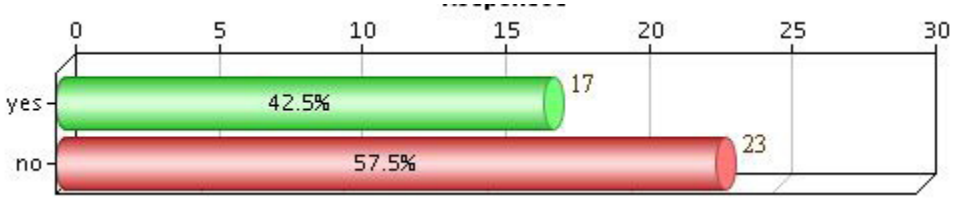

Figure 8. Have you connected to any other MobiMOOC participants in order to collaborate on projects after the MobiMOOC? (N = 40).

Emerging Technologies

"Transformation occurs through a process called 'emergence,' by which new processes and

structures emerge to replace old ones in a system" (Reigeluth, 2004). When looking at the read-write Web, we can see that knowledge creation happens in different ways now than it did during the Industrial Age. The possibility for individuals to create knowledge and share it online replaces the old classroom exchange where the teacher knows and transmits, and the learner in turn absorbs. Looking at phenomena emerging from technologies can point us in the direction of a renewed educational equilibrium. The MobiMOOC offers the chance to look at two emerging technologies, mobile technology and social media technology, that have a major impact on the learning/teaching process.

mLearning in MobiMOOC

"mLearning has attracted a great deal of attention from researchers in different disciplines who have realized the potential to apply mobile technologies to enhance learning" (Özdamar & Metcalf, 2011, p. 1). This focus on mobile technology-driven learning is only just emerging. "Early definitions of mobile learning were too technocentric and imprecise . . . they merely put mobile learning somewhere on e-learning's spectrum of portability," remarked Traxler (2009, p. 3), which sells mLearning short. Laurillard (2007) made a strong point when she mentioned that "the point of turning to new technologies is to find the pedagogies that promote higher quality learning of a more durable kind than traditional methods" (p. 158). This "more durable" brand of learning is what we explored with the combination of the MOOC format and the pedagogy of mLearning.

Participants used mobile devices during the MobiMOOC. Although they did not always have to access materials via mobile devices, many did use them to interact with course materials (Figure 9). In the final survey of the MobiMOOC, participants indicated the reasons they preferred to use mobile devices to access course materials (Figure 10). The predominant reason participants gave for using a mobile device was the location independence it afforded. Participants were not tied to a desk in order to take part in class, rather they could contribute wherever they were. Closely tied to the location independence was the temporal independence. Participants were able to access materials at both a time and place convenient for them. Another reason why participants used mobile technologies to access the course was simply because they were there, and people exercised their ability.

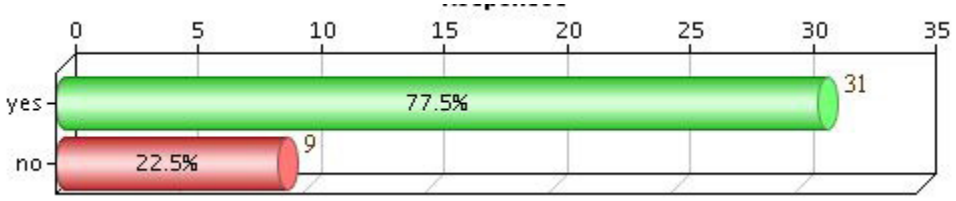

Figure 9. Did you use a mobile device to access MobiMOOC course materials? (*N* = 40).

Result	Responses	Percentage	Graph
time flexibility (no matter when)	25	56.8%	
location flexibility (no matter where)	27	61.3%	
the information was accessible through a mobile device	13	29.5%	
other	6	13.6%	

Figure 10. If so, what was the reason to access the material with a mobile device (please check all that apply)? (N = 40).

mLearning first emerged as a strong technology-driven field but quickly garnered the interest of educational researchers for mobile devices and their use had an impact on knowledge creation. The fact that mLearning allows learners to access information and share knowledge no matter what time or place makes it a useful new addition to the learning/teaching process. Additionally, mLearning enables the learner to embed their own context, thus personalizing the learning path. Interestingly, some of these mLearning characteristics can be found in social media technology as well.

Social Media Tools

Social media has opened up spaces for learning. Learning discussions used to be confined to traditional classrooms or study groups within the physical university campus. Even in online courses, discussions were segregated behind the walls of the virtual classroom, but this is now changing rapidly. This shift in learning spaces puts pressure on the older, more limited learning spaces from the Industrial Age.

The use of social media is central to a MOOC as it allows the critical aspects of connectivity, communication, and interaction. Connectivity is important due to connectivism (from the theory perspective) and because MOOCs are online (the practical aspect). Communication and interaction are a part of connectivism and constructivism since learners can't cocreate knowledge if they can't communicate and interact. As such, we designed the MobiMOOC to include a variety of web-based tools. The coordinator chose to centralize the course around two web-based spaces: a MobiMOOC Google group and Wikispace. Both also had an RSS feed to keep participants informed about the latest inputs. The coordinator set up the Google group to centralize discussions, while the course wiki functioned as an online syllabus. Participants used other social media spaces, such as YouTube, Twitter, Facebook, and Delicious throughout the course for sharing specific content. In addition to the official MobiMOOC web spaces, some of the participants added other spaces during the MobiMOOC as well. Examples of these are the MobiMOOC Crowdmap, a MobiMOOC LinkedIn group, MobiMOOC Posterous blogs, the Zotero MobiMOOC group, and a MobiMOOC map based on Google maps. All of these web applications underline the complexity inherent in a MOOC that gives rise to emerging subsystems.

Bringing mLearning and Social Media Together

Due to the pervasiveness of mobile devices in society, connecting to a community across space and time is becoming more relevant.

> Mobile phones have created "simultaneity of place," a physical space and a virtual space of conversational interaction, and an extension of physical space, through the creation and juxtaposition of a mobile "social space." This affects people's sense of time, space, place, and location, their affiliations and loyalties to groups and communities, the ways in which they relate to other individuals and to groups, their sense of their identity, and their ethics. (Traxler, 2010, p. 2)

But the same can be said of social media, or the rise of ubiquitous learning. Due to the use of social media, people, and learners in particular, can surpass time and space. As Siemens (2005) wrote, learning is now happening "through communities of practice, personal networks, and through completion of work-related tasks" in an environment in which "know-how and know-what is being supplemented with know-where (the understanding of where to find knowledge needed)" (p. 4).

This is the first time in history that learning content can be accessed via mobile devices and social media. These tools expand knowledge acquisition beyond traditional classrooms and libraries, redefining those spaces and adding to knowledge spaces overall. When describing mLearning, Winters (2007) listed three interesting aspects: mLearing enables knowledge-building by learners in different contexts, it enables learners to construct understandings, and the context is about more than time and space. Indeed, the same can be said about learning through a MOOC. A MOOC surpasses time and space as all the class resources are centralized in the cloud, accessible for those who are willing and technologically able (that is, those who have the right devices, sufficient training, and physical/mental ability). Similar to mLearning, a MOOC fits the learners' context(s) and enables knowledge construction. Like Bell (2011) said, "knowledge can be viewed as residing in networks of humans and non-human appliances, whilst leaving space for human agency."

In this part of the paper, we have shown that a MobiMOOC includes both new learning actions and the integration of emerging technologies. This openness to stimulating emerging phenomena and incorporating them into its structure is essential in a Knowledge Age where technological development and peer knowledge creation is at the center of the new educational environment.

Dialogues at the Center of Meaning

The successful development of online communities also requires "common goals or interests, repeated participation, discussions and feedback, multiplicity of possibilities, flexible

thinking structures, interpersonal connectivity, collaboration, interactions, distributed leadership, assigned roles, and shared outcomes" (Abel, 2005; Farrior, 2005; Kelland, 2006; Kim, 2001 as cited in Laroche et al., 2009). If we analyze these requirements—discussions, feedback, collaborations, et cetera—it becomes clear that conversations between people are at the center of those online communities. This exchange of ideas that goes back and forth between members of a community is essential, because "more than any other way, people learn not from courses or Web sites but from each other . . . through dialogue" (Rosenberg, 2006, p. 158). Dialogue has always been integral to human communication and growth.

"The rapid development of technology and exponential growth in the use of the Internet, along with the Web 2.0 and mobile developments, make new and different educational structures, organizations, and settings a possibility" (Kop & Hill, 2008, p. 9). But due to all these societal changes, the dynamics between people are growing more complex as well. As the Knowledge Age becomes more of a reality, that complexity reaches the field of learning and education and trickles down to MOOCs. Communication, dialogue, and living through experiences in a collaborative way are central to the idea of a MOOC. Since one of the central content spaces in the MobiMOOC was a Google group which promoted discussions, the coordinators incorporated dialogue in the core of the course.

Traxler's belief that "mobile technologies are redefining models of learning that often rest on a Socratic or dialogic base" (Traxler, 2010, p. 13) adds to Sharples' (2005) idea that learning is a conversation in context. This emphasis on dialogue and conversations is also mentioned by Siemens (2008), who wrote that learning and knowledge "rest in diversity of opinions" (para. 8, as cited in Kop & Hill). Diversity, as previously established, is a core component of the MobiMOOC experience.

Cultural theorists (Vygotsky, 1962; Derrida, 1976; Bakhtin, 1981) have suggested that all of our understandings are situated in and emerge with complex webs of experience, so we can never discern the direct causes of any particular action. Learning is also strongly contextualized. Davis and Sumara mentioned (1997) "as the learner learns, the context changes, simply because one of its components changes." As such, they conclude that "any teaching/learning situations are intricately, ecologically, and complexly related" (p. 414).

As a MOOC is a gathering of people with almost no prior connection, it has a unique social edge which relates to a more open and connected way of thinking and conversing. This coincides with what Downes (2007) wrote, that the "activities we undertake when we conduct practices in order to learn are more like growing or developing ourselves and our society in certain (connected) ways.

Dialogue is also at the center of constructing knowledge since "dialogue is the primary mechanism for maintaining connections and developing knowledge through them" (Ravenscroft, 2011). While a MOOC is an ideal place for dialogue to take place and, as such, for knowledge to be constructed or appear, the same is true for mLearning, as

> with mobile devices the learning environment is enhanced and the ability to share knowledge through online discussion is strengthened through social media. The sharing of experiences in a network facilitates the transformation of learning outcomes into permanent and valuable knowledge assets. (de Waard & Kiyan, 2010, p. 5)

Learning is not a linear process; it is a continued iteration which links to prior knowledge. That knowledge can then be modified after evaluating the new information and integrating it. As such, learning and knowledge are in a constant state of flux. This fluctuating state of knowledge is even more emphasized in informal learning for the learner is taking his or her own interpretation and testing it against the ideas of other participants. In the MobiMOOC, this sharing of new ideas was clearly not limited to the course participants. Participants took the new information and ideas out of the course and tested it in other learning networks as well. This multiplication effect is shown in Figure 11.

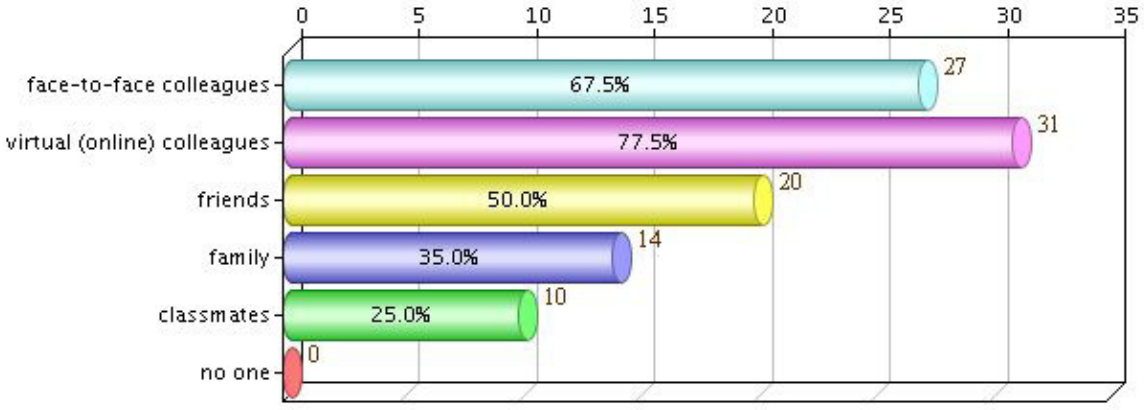

Figure 11. With whom outside of the MobiMOOC did you share what you have learned in the MobiMOOC? (N = 40).

And when we asked participants how they shared information, again they listed a mix of face-to-face, mobile phone, and social media dialogues (see Figure 12), once more pointing to dialogue as a core feature of learning in any world, whether face-to-face or digital.

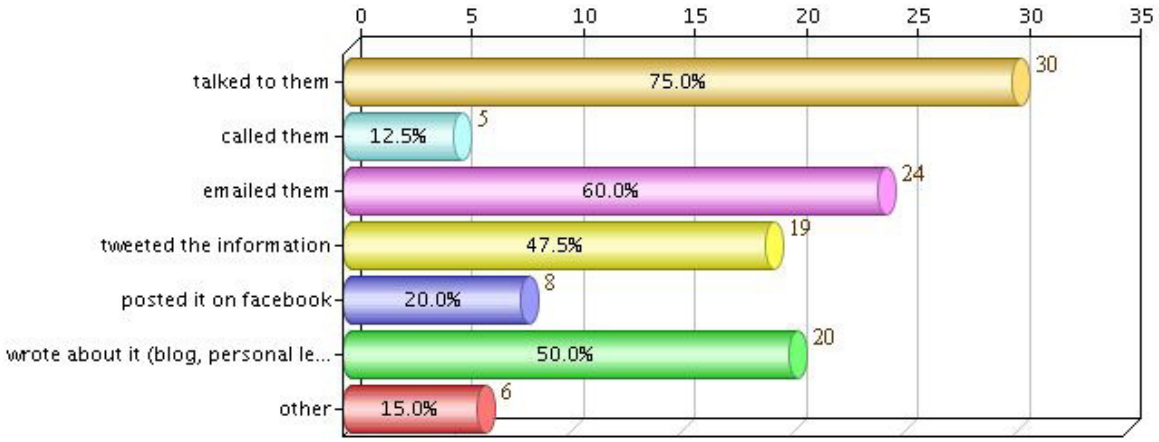

Figure 12. If you shared information with others, how did you share it? (*N* = 40).

Our understanding that dialogue is a human aspect of both communication and learning results from the belief that the MOOC format could also benefit other learning communities due to its very open nature of constructing new knowledge and its very human characteristic of connecting to peers. This belief was strengthened by the result from the final survey shown in Figure 13.

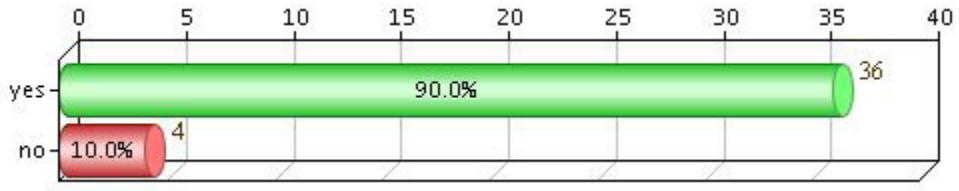

Figure 13. Do you think the MOOC format is appropriate for your learning communities? (*N* = 40).

Based on our findings in this study, we can see that dialogue has always been at the center of knowledge exchange. However, it has never before been possible to include large parts of society in the conversation. Patterns of meaning can be formed across regions and institutions if a network of connected people comes together. If educators want to form a new educational framework, it needs to be stimulated by dialogue emerging in virtual, online spaces. The MOOC format enhances dialogue, and, as such, it strengthens educational combinations of contemporary technology and pedagogy.

Further Research

Chaos theory in education is still in its infancy when we take into account the new technologies and formats that are rising in this Knowledge Age. Devices and programs continue to change, so there is considerable uncertainty about what will be the best new educational framework for the Knowledge Age, and attempts to address this question form an interesting research strand.

mLearning and MOOCs consist of a variety of factors, and each might influence the success of a MOOC as a new educational format. More research should be undertaken into the realities, benefits, and challenges of MOOCs and mLearning in order to map all of their contributing dynamics.

Further research is needed to determine whether MOOCs are attracting a specific learner profile not linked to age, gender, or cultural background, but rather to intrinsic and extrinsic motivations.

We found the retention rate of the MobiMOOC interesting as after the course closed, the network between the participants remained active, indicating that they feel the MobiMOOC community is more useful than we previously anticipated.

There is also a need to determine design principles for MOOCs to effectively maximize their self-organizing, self-referencing, and knowledge-producing capabilities. We believe it would also be helpful to see the ethnic and socioeconomic breakdown of participants in a MOOC to determine whether this format is actively promoting participation from any particular demographic. Finally, the affordances of mLearning and social media need to be investigated in order to use them in the new educational environment.

Conclusion

Reigeluth (2004) already pointed educational researchers in the right direction when he wrote that chaos theory and the science of complexity can help us to understand and improve the process in which educational systems engage to transform themselves. When looking at the shift in learning which is happening as a result of the rise in social media, ubiquitous cloud computing, and new technologies, a MOOC complements all these changes, and mLearning offers the devices and characteristics to realize them.

The MobiMOOC we ran was an example of an open and adaptive, complex system. The technologies that we used gave rise to emerging phenomena in its activities. Additionally, dialogues were central to knowledge creation within the MobiMOOC. This combination of factors that characterize MOOCs which use new technologies make them a possible solution in the search for new educational environments that fit this Knowledge Age. Education is changing under the influence of a wide variety of factors, and there is a need to further investigate all of them so that the research community can come up with a redesigned framework in which emerging technologies enrich educational institutes, tools, and formats.

In this paper we have embedded MobiMOOC and MOOCs in a framework of chaos theory, complexity, and emergence.

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Chaos Rules Revisited

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Introduction

Keywords: Instructional design; chaos and complexity theory

About 20 years ago, while lost in the midst of my PhD research, I mused over proposed titles for my thesis. I was pretty pleased with myself when I came up with *Chaos Rules* (the implied double meaning was deliberate), or more completely, *Chaos Rules: An Exploration of the Work of Instructional Designers in Distance Education*. I used the then-emerging theories of chaos and complexity to underpin my analysis. So it was with more than a little excitement that I read the call for contributions to this special issue of IRRODL. What follows is a walk-through of my thesis with an emphasis on the contribution of chaos and complexity theory.

The Thesis

The first chapter of *Chaos Rules* discussed the research problem, which was, in essence, an answer to the question, "But what do you actually do?" asked of instructional designers. The thrust of the research was therefore "an investigation of the work practices of instructional designers, with particular attention being given to the practices they adopt when working with academic staff in the preparation of distance learning materials." (Murphy, 1995, p. 3)

But what did all this have to do with chaos/complexity theory? It had been my experience that the work of instructional designers (or educational developers) bore little relation to the theories that they espoused to support their practice. New "conceptual lenses" were thus required to make sense of the theory and practice of instructional design. With a background in mathematics, I was getting excited about the emergence of chaos theory, fractal geometry, and so on, first inspired by reading James Gleick's *Chaos* (1987), and then moving on to the more challenging and lesser-known *Order out of Chaos: Man's New Dia-*

logue with Nature (Prigogine & Stengers, 1984), which was originally entitled *La Nouvelle Alliance* before translation, indicating a newfound relationship between science and the humanities.

And so the seed was sown. I kept reading and researching and found that fascinating insights were emerging from a variety of disciplines, the best at the time coming from Katherine Hayles, an academic with background in both thermodynamics (Prigogine's area of expertise, in which he was awarded a Nobel Prize) and literary theory. She describes chaos theory thus:

> Chaos theory . . . can be generally understood as the study of complex systems, in which nonlinear problems . . . are considered in their own right, rather than as inconvenient deviations from linearity. Within chaos theory, two general emphases exist. In the first, chaos is seen as order's precursor and partner, rather than as its opposite. The focus here is on the spontaneous emergence of self-organization from chaos. . . .
>
> The second branch emphasizes the hidden order that exists within chaotic systems. Chaos in this usage is distinct from true randomness, because it can be shown to contain deeply encoded structures called "strange attractors." Whereas truly random systems show no discernible pattern when they are mapped into phase space, chaotic systems contract to a confined region and trace complex patterns within it. The discovery that chaos possesses deep structures of order is all the more remarkable because of the wide range of systems that demonstrate this behavior. . . . The strange-attractor branch differs from the order-out-of-chaos paradigm in its attention to systems that remain chaotic. For them the focus is on the orderly descent into chaos rather than on the organized structures that emerge from chaos. (Hayles, 1990, pp. 9–10)

I therefore focused my analysis of and theorizing about the work of instructional designers on elements from the branch that discusses "the organized structures that emerge from chaos" and "the spontaneous emergence of self-organization from chaos."

The Chaos Literature

The origins, emergence, and development of chaos theory are at least partially found in the work of Edward Lorenz (1963), who analyzed the solutions and patterns of nonlinear differential equations in his pioneering research on weather modeling, which led to the now-famous notion of the "butterfly effect" (the term used to describe the extreme insta-

bility that can result from slight changes to initial conditions). This and other associated discoveries, developments, and theorizing led many to a different way of thinking about our world, providing a new perspective that is comfortable with the idea of turbulence, envisaging it as the natural order of things. As Hayles has succinctly surmised,

> Where the eighteenth century saw a clockwork mechanism and the nineteenth century an organic entity, the late twentieth century is likely to see a turbulent flow. The importance of chaos theory does not derive, then, solely from the new theories and techniques it offers. Rather, part of its importance comes from its re-visioning of the world as dynamic and nonlinear, yet predictable in its very unpredictability. (Hayles, 1990, p. 143)

What exactly, though, are we talking about? Chaos theory is the popular name now used to describe "the exploration of patterns emerging from apparently random events within a physical or social system" (Griffiths, Hart, & Blair, 1991, p. 432). The term was "playfully introduced into mathematics in 1968 (and earlier in the nineteenth century by Ludwig Boltzmann in the context of thermodynamics)" (Knoespel, 1991, p. 105) and, in fact, is seldom used by theorists and researchers in the physical sciences, where the designation is usually dynamical systems methods or nonlinear dynamics. At a basic level the theory claims that, "even within ostensibly stable systems (such as a swinging pendulum), chaotic behaviour can be observed, and within systems which seem chaotic, order can arise" (Murphy, 1995, p. 12).

The branch of chaos theory that particularly interested me was based on the work of Ilya Prigogine, focused on phenomena that exhibit the emergence of order from disorder, or chaos. Prigogine named such phenomena dissipative structures, defining them as self-organizing systems in conditions far from equilibrium, that transform from chaos to order through a process called bifurcation.

> We now know that far from equilibrium, new types of structures may originate spontaneously. In far-from-equilibrium conditions we may have transformation from disorder, from thermal chaos, into order. New dynamic states of matter may originate, states that reflect the interaction of a given system with its surroundings. We have called these new structures dissipative structures to emphasize the constructive role of dissipative processes in their formation. (Prigogine & Stengers, 1984, p. 12)

This notion is explained more vividly, and with a direct reference to the social sciences, in Alvin Toffler's foreword to *Order Out of Chaos*:

> Most phenomena of interest to us are . . . *open* systems, exchanging energy or matter (and, one might add, information) with their environment. Surely biological and social systems are open, which means that the attempt to understand them in mechanistic terms is doomed to failure. This suggests, moreover, that most of reality, instead of being orderly, stable, and equilibrial, is seething and bubbling with change, disorder, and process. In Prigoginian terms, all systems contain subsystems, which are continually "fluctuating." At times, a single fluctuation or a combination of them may become so powerful, as a result of positive feedback, that it shatters the preexisting organization. At this revolutionary moment—the authors call it a "singular moment" or a "bifurcation point"—it is inherently impossible to determine in advance which direction change will take: whether the system will disintegrate into "chaos" or leap to a new, more differentiated, higher level of "order" or organization, which they call a "dissipative structure." (1984, p. xv)

It was these ideas and others from chaos theory, and emerging complexity theory, that underpinned my research. I wanted to show that instructional designers worked in open rather than closed systems, that the environment was essentially chaotic (in Prigogine's sense), and that instances of order emerging from chaos could be observed. More than that, I wished to illustrate that an induced chaotic state might lead a course development team to move to a higher, more creative state. What would I see when I looked at the practice of instructional design through the conceptual lens of chaos theory?

The Instructional Design Literature

The start of my journey was an examination of instructional design theory and practice as espoused by others, from the US postwar theorists Briggs (1977) and Gagné (1979) (with others applying their successful military training techniques more generally) through to the then-emerging theory of constructivism. Not surprisingly, there was little for me to identify with in early theories because they essentially adopted a closed system approach, the antithesis of chaos and complexity. Grumbling about early theories increased in the 1980s as constructivism took hold, and mention of chaos theory with respect to instructional design was made by Jonassen (1990), who summarized its challenges as

- the assumed determinism of instructional systems design (ISD);
- the unpredictability of learners and the learning process;

- the relatively linear sequence of procedures that course designers perform in hopes of affecting learning outcomes; (and the fact that)

- information processing models frequently depict learning as an essentially linear process of short-term to long-term memory, which naturally suggests a linear instructional process. (Jonassen, 1990, p. 33)

Jonassen counseled against eliminating chaos, encouraging instructional designers to employ techniques that accommodate it. He claimed that

> we cannot conquer chaos and render the learning process completely predictable. Rather than controlling the instructional process, we should be integrating those factors, including chaos, that affect learning in our systems. Instructional systems need to be made more dynamic by accommodating or integrating the learner's intentions, political exigencies, social realities, and other chaotic fluctuations into the instructional systems, rather than trying to isolate the system from all these other factors. Technologists need to become more integrative and less analytic. Learning can never be completely predictable, but designers as integrators may make it less doubtful. (Jonassen, 1990, pp. 33–34)

Implicit in Jonassen's viewpoint was a sense that chaos is a reality we must live with; his position was one that attempted to "cope with chaos." He did not recognize that chaos might be something to celebrate because of the opportunities it presents for learning systems to move through chaotic states to higher levels. Jonassen thus ignored the dissipative structure branch of chaos theory.

More productive was the literature on how instructional designers actually did their work. The work of Gordon Rowland and Judith Riley proved to be particularly helpful to my research. Neither of them explicitly referred to chaos theory, but the way that they described the working world of instructional designers (Rowland, 1993) and the process of course design and development at the UKOU (Riley, 1984) resonated clearly with many of the fundamental tenets of chaos and complexity. As I outlined in my thesis,

> In examining the nature of the design process, Rowland contrasts designing with mathematical problem-solving, which may be extremely complex, but in general has fixed initial conditions, a single solution, and a limited number of methods by which to obtain that solution. Not so with a design problem:
>
> > A nearly infinite number of different solutions to this same problem are possible. . . Neither the initial conditions nor the most appropriate and efficient process to obtain

> a satisfactory solution are entirely clear. (Rowland, 1993, p. 83)

So the designer has to locate relevant key points from a vast array of information, some of which can help in locating the problem and in [facilitating] the process. To attempt to impose a rigid, systems engineering model on such situations

> severely restricts the designer's ability to understand the problem. They feel that . . . understanding is developed through efforts to solve the problem. The two processes are interdependent and simultaneous or cyclical, and goals are gradually uncovered in the context of solution attempts. . . . the process is thus dynamic and unpredictable. (Rowland, 1993, p. 84)

This view, known as "exploratory" design (Robinson, 1986) or "soft-systems analysis" (Holt et al., 1985) claims that not only is this an accurate reflection of the design process but [also] that it results in a clearer understanding both of the problem and its solution. Further, it also assists [in] the revealing of subproblems, perhaps unrecognised in the initial stages. It thus assists in unpacking the layers of a design problem, of locating eddies of turbulence within the larger chaotic domain. This might also be called an "open systems" viewpoint, allowing as it does for greater consideration of alternatives and other influences.

The issue of subproblems was further explored, especially as systematic methods typically attempt to solve subproblems in isolation, emphasising the parts rather than the whole and resulting in badly integrated solutions to design problems. An exploratory, or open systems view means that the designer

> balances resources and organizes the design process according to relationships between the subproblems, and a series of problem-solving cycles is implied. . . . Rather than defining all problems prior to attempting to solve any of them, the designer may await the emergence of subproblems during preliminary solution attempts, and, by focusing on subproblems as they occur, may find a more elegant solution to the whole. Again, the process implied is much more dynamic. Cycles of problem solving are derived dynamically during the design process, vary in duration and extent, and address subproblems when and in whatever forms they present themselves. Neither the subproblems nor the means to address them are felt to be completely specifiable at the beginning. (Rowland, 1993, p. 85)

The essence of these notions sits comfortably with the balance between the forces operating in open systems far from equilibrium conditions and Prigogine's self-organising systems, described earlier. Rowland proceeds to use such terms in outlining a recent conceptual description of the designer. Earlier conceptions had moved from that of a magician, with the emphasis on creativity, to the "designer as computer," with logic and rational processes reigning supreme. The conception propounded to replace these two is

> the designer as a self-organizing system. . . . Design expertise is thought to lie not only in knowledge and skill, but in the designer's ability to reflect on his or her own actions. . . . The designer must be a self-organizing system capable of controlling both rational and creative processes, knowing when to apply each and varying strategies and tactics as the situation demands. (Rowland, as cited in Murphy 1995, pp. 47–49)

Added to this was the revealing work of Riley (1984), whose focus was more specifically on distance education. As I explain in my thesis,

> The key features that Riley identified within course production, as experienced by course writers, are that the process is complex, individual and emotional. Additionally, she was critical of lists of essential tasks prepared by instructional designers for course writers, preferring a more problem-oriented approach. Riley wisely concludes that the preferred base for recommendations to course writers should be professional practice—that is, "recommendations based on what experienced and successful distance educators actually do" (Riley, 1984, p. 52).

Interestingly, what such educators "actually do," as reported by Riley, has sympathy with the notion of searching for order within chaos. As she explains concerning the drafting behaviour of a particular writer,

> In the second quotation, the Mathematician was trying to write the final words of his lesson out in full. Although he had completed two previous drafts which had been approved by his colleagues, his head was still full of a great diversity of concerns and criteria, and he kept changing his mind and seeing that one decision meant that another piece of the text had to be changed to fit. (Riley, 1984, p. 6)

The ideas of interconnectedness and iteration are also implicit in her analysis of the behaviour of those preparing distance education materials. Thus we find in her comments concerning her observations:

> When the roles are not formally separated, many experienced authors find that they change their plans as they write. As the Open University Social Scientist quoted above said, ". . . beyond a certain point, the only thing to do is start writing and see if it will work out." . . . If major new insights come during drafting, then the planning of distance education materials should not be separated from the writing stage, and putting the teaching into words cannot be seen as a subsidiary process. (Riley, 1984, p. 11)

The iterative nature of the process is explicit in the following comment, wherein Riley's notion of spiralling might well be equated with the recursive symmetries exhibited by chaotic systems.

> A common way in which experienced writers of distance lessons cope with this complexity is to adopt a strategy which I call spiralling. By this I mean that on their first attempt at a draft, they will only allow a few concerns to intrude on their search for a way of tackling their lesson. At each subsequent draft, they are able to take a few more ideas on board, until the final version has been checked against their full range of criteria. (Riley, 1984, pp. 21–22)

The outcome of these iterative cycles is movement towards far-from-equilibrium conditions, given recognition by Riley as the out-of-step phenomenon. She describes it thus:

> . . . many of the changes that the author made between one draft and another could not be traced to any comment made by his colleagues. This can be understood by reference to what I have called the out-of-step phenomenon, which adds to the complexity of receiving numerous differing reactions. When an individual goes off to work on the first draft of a lesson, he and his course team usually share several ideas about what he is trying to produce. However, as the author works on his draft, his ideas develop and he sees other ways of dealing with his topic, and other objectives that the students might be asked to achieve. When he brings his first draft back to the course team, they are bound to be out-of-step with his new thinking. Some of them may have changed their views of the role his lesson should play in the course, as a result of working on their own lessons, and some of them will have

> been so busy with their own work that they have not given his lesson another thought since the unit outline was first discussed. As a result of this divergence of opinion, the author and his commenters inevitably compare his draft with different images of what the lesson should be. (Riley, 1984, pp. 22–23)

At the same time as this divergence or disorder grows, pockets of order are apparent within the process, as the "increasingly sophisticated" efforts of individual writers produce more and more focussed drafts. This is explained by Riley as follows:

> This divergence of images will increase with every draft, for many team members cannot pay sufficient attention to each other's lessons even to catch up with the author's views at the time he wrote each draft; and they are getting more involved with the preparation of their own material, as time goes by, and so are increasingly reluctant to think about the course as a whole. . . . As the author carries on exploring the topic of his lesson and developing his expertise, the reasons for his drafting decisions become increasingly sophisticated and embedded into their subject matter context, even though the structure and argument of the lesson may be becoming clearer with each successive draft. One way of looking at this divergence is to see the lesson as a living thing, continuously growing and changing in its author's mind. At intervals he prepares a static account of this living entity, a "snapshot in time," in the form of a written draft, which he circulates for comment. (Riley, 1984, p. 24)

The notion of local rather than global theorizing is also explicit in Riley's findings. Each course is a product of particular people working at particular times in particular circumstances. Global generalizations are not viewed as helpful, as the following comments make clear.

> For it is my experience that the actual tasks done are very variable, between institutions, between teams, and between authors. It is not just a matter of whether the work is done by teams or not; there are also differences depending on the precise system of roles in use. (Riley, 1984, p. 36)

> . . . stress the importance of the individual creative role, that producing distance teaching materials cannot and

> should not be a simple technical task. I asked a question about this in my survey: "How different would a team's decisions be if, in the same context, a different set of individuals had formed the team?" Almost without exception, my informants were quite sure that individuals mattered. . . .
>
> "No, they wouldn't produce the same course, whatever the subject matter, the approach, etc. would be very different. . . . And above that you still get a lot of variation, because it grows out of interactions between people and between people and subject matter, it's an organic thing." (Riley, 1984, pp. 45–46)

The claimed resonance between Riley's work and elements of chaos theory is, of course, built on Riley's own analysis of her data, which was certainly not from a chaotic perspective. It is interesting to speculate whether examination of her original data and transcripts might reveal further congruence. (Murphy 1995, pp. 61–64)

Methodology

Based on the literature survey of both chaos and instructional design, I applied qualitative methods, underpinned by Eisner's (1991) notion of the "critical connoisseur," to investigate instructional designers at work. I used chaos theory to analyze the series of case studies that formed the empirical study.

More specifically, my aim was to

> search for evidence of patterns that reveal chaotic processes at work in the design and development of distance education courses. Are the circumstances under which instructional designers work rich in complexity? Do they have to function in open systems? Are such systems moving to far-from-equilibrium conditions? If so, how do they go about seeking order within the chaos of their working environment? Is there evidence of instructional designers using chaos and complexity to encourage creative outcomes? Can their work be categorized as a process of *becoming*, or is it simply a matter of *being*? That is, does time and its consequences have significant impact on their working environment? (Murphy 1995, p. 67)

The case studies that emerged were the outcome of the application of a modified form of participant observation, the diary–diary–interview method (Zimmerman & Wieder, 1982). The instructional designers I worked with were located in a number of institutions that provide distance teaching along with traditional classes in Australia and Hong Kong. Each participant allowed me to track his or her progress through the design and development of

one specific course, with the time periods averaging about six months. The core of the data was 26 extensive interviews I had recorded on tape, along with supplementary material comprising diary notes, letters, responses to transcripts, additional institutional material, and email messages.

Three chapters were devoted to analysis of the data. The first focussed on how the participants had come into their role as instructional designers, along with their perceptions of their role and status within their institution. The second picked up on the major emerging themes, including the "arrow of time," giving advice (also called working at the edge of chaos), and product emphasis. The third chapter detailed the participants' reflections on teaching and learning, discipline expertise, and the metaphors that were being used at that time to clarify their role (surrogate student, consultant, amicable guerilla, transformer, etc.). I concluded this chapter with the observation that

> they saw the need to be flexible in their work. The attitudes they exhibited displayed an open systems orientation, one ready to adapt to the exigencies of each project and situation, in terms of the demands of the subject, the personality and working style of those with whom they worked, and the perceived needs of the students. There was virtually no evidence of adherence to a model of instructional design or, more generally, a model of teaching. Rather, they were ready to come to terms with what often turned out to be complex and demanding design and development work, calling on them to display a wide array of skills as they charted their way through a project. (Murphy 1995, p. 189)

The Final Chapter

In the final chapter, I posited an emerging model that applied the language and concepts of chaos and complexity theory to the practice of instructional design. The following extracts (from pp. 191–193) pick up on comments from one of the participants:

> Nick: I want to stress that in this role it was like a jigsaw—you had to piece the pieces together, but you had to do the jigsaw over time. And it was like a flux jigsaw, it was changing from day to day. And not only did you have to get the pieces and stick them next to each other, link them up, the colour with the colour and the line with the line, but the jigsaw was forever changing, so that you had to put the pieces into a dynamic situation. (Interview transcript—3/3/93)

The focus, then, is on complexity and irreversibility—time, moving in one direction, is a key factor, helping to make chaos theory a science of change, or "becoming," rather than a descriptive theory of "being." Such an approach would clearly find resonance with a process like course development—Steve Worboys comment-

ed about his project at one stage that "it's in the process of becoming because it's a new environment" (Interview transcript—4/5/94). . . . time was a key issue for all the instructional designers, and influenced the projects in a complex pattern. It was not just a matter of tight deadlines, but also involved the problem of durational expectancies, producing a variety of outcomes for the designer and the distance education course materials.

One implication of this kind of work environment is the need for flexibility in instructional design. There is a sense of being ready for changes in the environment, an anticipation that, because of the open systems nature of the work, the instructional designer must be ready for anything. As Wendy Tsui commented:

> Wendy: If the author is too busy, then it will hamper the progress very much, and we can't have a schedule. Everything is upset. Then it makes the life of an instructional designer very uneasy. We can never anticipate what will happen tomorrow. . . . I think that an instructional designer needs to be very flexible, and has to be able to make decisions, rapid decisions . . . you have to make rapid decisions as to what to do. (Interview transcript—5/11/91)

Specific features of chaos theory have also found their parallels in the theory and practice of instructional design and development. Particular prominence was given in the thesis to the notion of the instructional designer as a chaotic attractor. As a chaotic attractor, the instructional designer acts as a focusing agent, maintaining the system in a state of agitation, endeavouring to find the creative balance between order and chaos.

Some examples of sensitivity to initial conditions have been mentioned. . . . Others can be identified within the experiences of the instructional designers participating in this research. Little did YL Cheung realise that, when early on he helped the writer by suggesting an activity, he would end up writing almost all of them. The pattern, once started in a small way, became an ongoing and integral component of his course design work with that writer. For Steve, the presence of a belligerent and initially uncommitted member of his development team caused him to adopt a "hands-off" approach that had significant, and seemingly positive, outcomes for the development process.

The presence of non-linearity as a feature of the projects is indicated by the quotations given above. Typically, most participants indicated periods of intense activity, such as the long meetings reported by Felicity Simmons, Wendy Tsui and Nick Little, where draft materials were examined and amended "on the spot" . . . the flow of ideas, upon which much course design work hinges, is clearly non-linear (Weissert, 1991). At the same time, patterns emerge as projects progress, developing into

iterative processes as subjects are prepared unit by unit or topic by topic. . . .

The development became slowly focussed on the iterative steps determined by the number of topics (units, chapters) into which the particular course or subject had been divided. These iterative processes invariably involved some form of feedback process, wherein the instructional designer would comment or add to drafts produced by a writer. The number of iterations would vary, depending on a number of factors, including the instructional designer's perception of the quality of the material as well as the ever-present pressure of time and scheduling.

The practice of instructional design that emerges from the case studies is thus that of "a holistic, interactive, spiralling, and dialectical form" (You, 1993, p. 26), more in line with a chaos theory approach than a traditional instructional design model. (Murphy 1995, pp. 191–193)

The Emerging Model

The final chapter of my thesis specifically addressed what a model of instructional design for course designers in distance education might look like. The following lengthy extracts from pages 196 to 201 of the thesis present the essence of an emerging model based on chaos theory.

First, there would be an acceptance of multiple world perspectives, coupled with a celebration of the complexity of the system in which instructional design operates, rather than an attempt to narrow down focus and isolate individual factors. Rejected are traditional design and planning models that stress order, predictability and linear patterns of change. The alternative requires an open systems approach (Chieuw, 1991), one in which forces acting from outside the system are viewed positively, as catalysts for change and the inspiration for new and novel views of crafting learning environments. The system is viewed, not as chaotic in the traditional sense, but [as] complex in the sense of being rich in information that has the potential for enhancing judgment and creativity. Coupled with Eisner's notions of educational connoisseurship and criticism, instructional design thus becomes the art and science of crafting effective learning environments.

In celebrating chaos, an instructional design model does not have to become complex in itself. Rather, it is based on simple iterative procedures across a range of scales within the course development system. Connected to this is the consequent ease with which instructional design can become more context-dependent, encouraging localised theorising within an overall globalised strategy.

The heart of a chaos model of instructional design is, however, the role of dissipative structures, the self-organising systems which, when far from equilibrium, transform from chaos to order through bifurcation. As was quoted in Chapter 2,

> far from equilibrium, new types of structures may

> originate spontaneously. In far-from-equilibrium conditions we may have transformation from disorder, from thermal chaos, into order. New dynamic states of matter may originate, states that reflect the interaction of a given system with its surroundings. We have called these new structures dissipative structures to emphasize the constructive role of dissipative processes in their formation. (Prigogine and Stengers, 1984, p. 12)

A clear implication of this modelling is that, rather than seeking simplicity, order and equilibrium, the instructional designer should be facilitating precisely the opposite state of affairs. That is, the early stages of design and development should be seeking complexity and disorder, pushing the system far from equilibrium to allow dissipative processes to come into effect and play their creative and constructive roles, pushing the system to a higher level of functioning. The creative forces of a team of developers will be strongest when the environment is freewheeling and open, not when the team is tied to a tightly structured, closed system approach to instructional design.

> There must be . . . a sense of indecision and indeterminacy. . . . The ends perceived are not so much ends as beginnings; they represent ends-in-view, or beacons, which act as guides before the curriculum implementation process begins. But once the course develops its own ethos, these ends are themselves part of the transformation; they, too, along with the students, the teacher, the course material, undergo transformation. . . . Here curriculum becomes a process of development rather than a body of knowledge to be covered or learned, ends become beacons guiding this process, and the course itself transforms the indeterminate into the determinate. (Doll, 1987, pp. 19–20)

The instructional designer's role then becomes one of encouraging an open environment, using accumulated experience and influence to open up possibilities and possible new directions, not [one that limits] the group down to a set mode of functioning. Returning again to Prigogine and Stengers, the situation is, somewhat surprisingly, much like that operating in certain specialized chemical processes.

> . . . the new constituents, introduced in small quantities, lead to a new set of reactions among the system's components. This new set of reactions then enters into competition with the system's previous mode of functioning. If the system is "structurally stable" as far as

> this intrusion is concerned, the new mode of functioning will be unable to establish itself and the "innovators" will not survive. If, however, the structural fluctuation successfully imposes itself . . . the whole system will adopt a new mode of functioning: its activity will be governed by a new "syntax." (Prigogine and Stengers, 1984, pp. 189–90)

In such a scenario, it is partly the instructional designer's responsibility to encourage the team to overcome the structural stability of the system, to allow "new constituents," which may originate from multiple sources, to influence the design and development processes. The designer thus becomes a self-organising system, with the ability to control "both rational and creative processes, knowing when to apply each and varying strategies and tactics as the situation demands" (Rowland, 1993, p. 86). Further, as a reflective practitioner in complex circumstances, the instructional designer's decisions are often "triggered by features of the practice situation, undertaken on the spot, and immediately linked to action" (Schön, 1983, p. 308). Their view of the task is that of "situated designing," where "unexpected things in the path are not only obstacles to be overcome, but also opportunities for new views on the problem, and can produce new elements for the designer to use in forming the next action" (Allen, 1988, p. 12). The combined effect of these factors was, as previously quoted, well described by Rowland (1993) as he concluded:

> . . . some level of situated designing, and of reflection-in-action, is apparently necessary for designers. In a sense, reflection-in-action may describe the process of controlling situated actions . . . and the mind engaged in both is a self-organizing system. (Rowland, 1993, p. 87)

Although such features are not immediately apparent in all the case studies outlined by the participants, they do feature most strongly in that described by Steve Worboys. He found himself holding back from imposing structure and process on the team, rather allowing the team to build up its creative forces—his job was to outline possibilities and to let the team find its own solutions. As he explained, part of the job was to give "people freedom that they didn't think they might have had." It was only after they had thrashed out numerous issues to do with structuring the new course that they came to him to help with translating their ideas into reality. Similarly, Wendy Tsui saw it as part of her role to "raise questions and initiate active discussion" among the team members.

Once the process does move from the initial design to development, patterns begin to form, a feature of all the case studies. These patterns form around the individual parts into which the course of study has been subdivided. It is here that the iterative processes begin, and the contribution of appropriate feedback mechanisms

comes to the forefront. Such feedback systems are not mere corrections of mistakes (negative feedback), but the use of imbalance, deviation and error to drive the system into "becoming" an effective learning environment. As argued in Chapter 3, "errors are seen as positive stimulants for the kinds of perturbations that create disequilibrium necessary for self-reflection and conceptual restructuring" (Lebow, 1993, p. 12). Further, as You earlier expounded, the aim is

> to base our ISD models on the positive or deviation-amplifying feedback loop in order to allow the instructional system to exchange information or energy between the system and environment, to initiate appropriate system response, and thus to regulate itself. In this way ISD models can adapt to changes in their internal structures and renew themselves, and thereby survive and continue to function. Positive feedback should be designed into the ISD model in order for the instructional system to continue becoming rather than simply being. (You, 1993, p. 23)

. . . . Numerous examples of patterns of positive feedback loops can be found within the case studies. Typical was the pattern developed by Jane Hammersby with Nicole—despite the occasional clash, in general the cycle of development had Jane providing positive input and suggestions to Nicole, who put them into effect in subsequent drafts of material. YL Cheung combined his skills in preparing activities with those of the course writer to create a series of feedback loops culminating in completed course materials. Nick Little encouraged Carole to take an open, free-wheeling approach to her initial drafting of material. The key to subsequent progress, as an outcome to the deficiencies of the drafts, was effective positive feedback and a close interactive partnership in developing the course.

. . . . The matter of scale levels and their interdependence was also of concern to most participants of the study, and needs to be built into a model for the development of distance education materials. The importance of attention to different levels is well illustrated in the differing project outcomes of Nick Little and Felicity Simmons. For Nick, his project came to a premature and abrupt end due to the untimely intervention of institutional authority. It is easy to surmise and be wise in retrospect that he would have been well served to have striven harder to establish a better working relationship with his college's principal. On the other hand, foreseeing potential problems due to drifting deadlines, Felicity contacted those in control in the medical foundation for their approval.

> Felicity: The author is extremely happy. Yes, she is very pleased to have gone through this process. The [medical foundation] itself, who will be footing the bill, are very concerned because it has taken so long. But I did get in

> touch at the right moment and make them make a decision between time and quality, and they went for the quality, so that is pretty good. (Interview transcript—15/12/92)

Different scale levels within the project were thus kept in harmony, and the work was able to progress quite smoothly. The different scale levels within Felicity's project might be viewed as, first, the institutional concerns between her university and the medical foundation. Then followed the project as a whole, its general structure and aims. At a third level came the working relationship between Felicity and Susan, with the next being the drafted materials, their flow and design. At a final level came the fine-tuning of the written work, in terms of language and layout. There is strong evidence that Felicity, like other successful instructional designers, gave attention to all levels of the project, showing awareness of the dependency of scale levels. Failure at one level can have significant repercussions, and small problems, through the butterfly effect, can spread uncontrollably throughout the system. (Murphy 1995, pp. 196–201)

Afterword

I'm excited about this special issue of IRRODL. At least part of my motivation for submitting this article is that I've never really come to a conclusion about the extent to which chaos and complexity theory can be applied to the social sciences in general and to education in particular. Is chaos theory just a nice metaphor, a conceptual lens with which to view the educational enterprise? Or are educational systems and the distance education institutions within them actually complex systems that follow the "rules" and patterns of chaos and complexity theory? My suspicion is that a mathematical expert in the field would be irritated by attempts to apply the theory to education, but perhaps the other contributions in this issue will allay my fears.

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IRRODL
THE INTERNATIONAL
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Emergent, Self-Directed, and Self-Organized Learning: Literacy, Numeracy, and the iPod Touch

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Introduction

This paper uses narrative and storying to retell how two girls ages 5 and 7 continue to make use of an iPod touch to expand their literacy and numeracy. The paper explores the stopwatch and alarm features within the clock application, as well as the weather application, and the Internet browsing capability of the iPod touch. It also explores some of the challenges and inequities inherent in using this type of technology. The paper concludes with the author's belief that it is important to allow learners freedom to explore and freely play with the technology and that emergent, self-directed, and self-organized learning is a natural and gentle approach to lifelong learning.

Becoming literate and numerate is infinitely complicated, yet very simple. It is infinitely complicated because there are so many variables within and without the individual who is learning these skills that understanding the process fully is nearly impossible. Yet, it is simple because so many successfully become literate and numerate so naturally. Relating to this point Schuerwegen (2011) writes,

> Ergo, when a child grows up in a reading, writing, counting environment, especially an electronically driven society such as ours, he will one day find the need to pick up all these skills, at least as much as he needs them. (p. 22)

Methodology

Methodologically this is an autobiographical narrative about technology and literacy and numeracy; specifically, it is about what the introduction of an iPod touch into the lives of two girls ages 5 and 7 has contributed to their ongoing never-ending process of becoming

literate and numerate. I use the term *becoming* deliberately because I see literacy and numeracy as a continuum that we are all on. Storying is a powerful qualitative methodology, and I believe that as we share and tell stories we learn a great deal from each other about our world and our lives. Webster and Mertova (2007) write that,

> Narrative records human experience through the construction and reconstruction of personal stories; it is well suited to addressing issues of complexity and cultural and human centeredness because of its capacity to record and retell those events that have been of most influence on us. (p. 1)

Clandinin and Connelly (2000) share how "Stories lived and told educate the self and others, including the young and those such as researchers who are new to their communities" (p. xxvi). And Bateson (1994) says, "Our species thinks in metaphors and learns through stories" (p. 11). These visionaries have helped legitimate stories and given me the confidence to share my story. For example, Leggo (2005) reminds us how although much research in education is empirical, we must ruminate on possibilities for research (pp. 443-4). Leggo (2005) writes the following:

> A significant part of my ongoing research program is autobiographical remembering and writing about my own experiences of years of study to be a teacher, and years of work as a teacher....I am convinced that by writing about our experiences, and ruminating on those experiences, and interpreting those experiences, we can become more effective teachers, as well as teachers motivated by more joy and hope. (p. 441)

Like Leggo, I am convinced that writing, ruminating, and interpreting our experiences is a legitimate, valuable, and necessary activity. Clandinin and Connelly (2000) add to the legitimating by emphasizing how "Narrative inquiries are always strongly autobiographical" (p. 121). For Clandinin and Connelly (2000), narrative inquiry is stories lived and told (p. 20). Narrative inquiry needs to include argument, description, and narrative (p. 155); however, there is flexibility. They say that, "It is always a matter of experimentation with narrative form" (p. 166). And they go on to say the following:

> As we tell our stories as inquirers, it is experience, not narrative, that is the driving impulse. We came to narrative inquiry as a way to study experience. For us, narrative inquiry is the closest we can come to experience. Because experience is our concern, we find ourselves trying to avoid strategies, tactics, rules, and techniques that flow out of theoretical considerations of narrative. Our guiding principle in an inquiry is to focus on experience and to

> follow where it leads. (p.188)

Williams, Karousou, and Gumtau (2008) also used learning narratives, in their case to explore how students actually went about their learning.

Context

Collins and Halverson (2010) acknowledge that, "even when students are in school, much of their education happens outside" (p. 19). It is clear that learning happens in various contexts. Williams, Karousou, and Mackness (2011) talk about two kinds of learning: prescriptive and emergent. Of prescriptive learning they write,

> Prescriptive learning, then, is based on knowledge which is pre-determined *for the learners* and duplicated and distributed at scale through traditional schools and universities, through print and other mass media, and through national quality-assurance institutions. This covers most formal education in the UK, as well as most traditional publishing and educational broadcasting, and many VLEs [virtual learning environments]. (p. 43)

They define emergent learning as,

> learning which arises out of the interaction between a number of people and resources, in which the learners organise and determine both the process and to some extent the learning destinations, both of which are unpredictable. The interaction is in many senses self-organised, but it nevertheless requires some constraint and structure. It may include virtual or physical networks, or both. (p. 41)

Williams, Karousou, and Mackness (2011) go on to say that, "Learning has always included both prescriptive learning (which is fixed and predictable) and emergent learning (which is unpredictable and arises out of the interaction between the learners and their context)" (p. 45). I think that these distinctions are useful for the purposes of this paper. I see prescriptive and emergent forms of learning not as being an either/or, but as constructs that can be approached but never fully reached. What I mean by this is that in the strictest sense there can never be a pure prescriptive nor a pure emergent learning environment. Even in the most fixed and predictable learning environments unexpected learning emerges. Similarly, with emergent learning there are always some things that are fixed and/or predictable. When we talk about these things it may be fair to talk about degrees of prescription and degrees of emergence. I believe this is consistent with the language that Williams, Karousou, and Mackness (2011) use, specifically when they write that, "The interaction is in many senses self-organised, but it nevertheless requires some constraint and structure" (p. 41).

The language that I have used in the past to describe a degree of emergent learning is *learner-centered democratic*. The way I use the term learner-centered is not so much in line with the constructivist notion and more in line with an emergent self-organized learning experience. So the learner-centered part refers to situations where learners can self-organize their learning, where they can decide what to learn, where, when, how, and whether to opt in or opt out. And the democratic part refers to a situation where learners have a substantive say in running their lives, whether they are in a school or being home schooled, or in any other context. Mitra (2010) also talks about self-organized learning environments.

The Technology

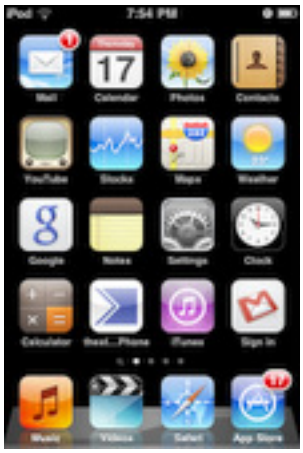

Figure 1. The iPod touch screen.

The iPod touch was first launched on September 5, 2007, and not long after on December 9, 2007, *The New York Times* published an article by Eisenberg, and this was the first mention of educators using the iPod touch for learning.

In December of 2009 we received an iPod touch. It remained mostly dormant because I did not have the time to sufficiently explore the device's potential; however, in May of 2010 I decided that it was time to explore the potential and power of the iPod touch, and in so many ways I have been and continue to be impressed with its uses. As mentioned, for the purposes of this paper I will share a few examples of how the iPod touch contributed to the ongoing process of becoming literate and numerate in the lives of a 5- and a 7-year old girl.

At this point our iPod touch has very few applications downloaded onto it and is essentially restored to the factory settings. I will describe how the iPod touch was embraced and enjoyed by the girls and how in the process of manipulating and playing with the device, impressive opportunities for learning literacy and numeracy were observed by me. The most interesting part in all of this is that the girls strengthened their literacy and numeracy skills incidentally. What I mean by this is that we did not purposefully seek the device as a learning tool, but merely stumbled across it and are now using it because it is what we want to do, and as a result learning is happening. This is in line with Holt's (1989) definition of edu-

cation where he writes, “Living is learning. It is impossible to be alive and conscious (and some would say unconscious) without constantly learning things” (p. 157).

This natural learning is not unique to the iPod touch but is evident in all forms of technology from a cereal box, to a television, to a television remote, to a laptop. Literacy and numeracy and learning constantly happen, sometimes when we least expect it. So, in what follows I will describe only a few of the basic applications that were preloaded on the iPod touch, and I will share what creative and imaginative uses the two young girls made of it and how those activities extended their literacy and numeracy.

Stopwatch

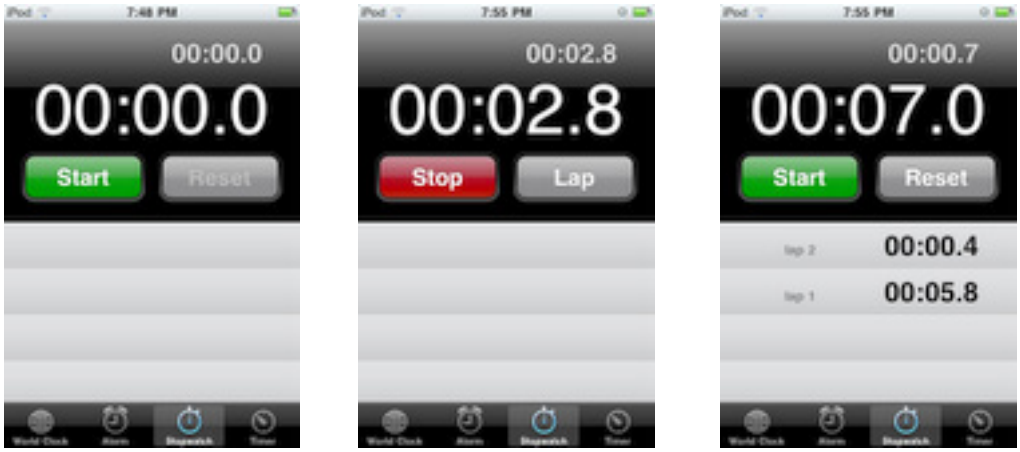

Figure 2. The stopwatch application.

The first application that the girls explored and that I want to share with you is the clock application; specifically, the stopwatch feature and the timer that is within the clock application. First, the stopwatch. The younger girl started running along a fairly long, narrow hallway on the second floor of a two-storey home. The total distance from one side to the other is approximately 50 feet. While they were doing this, I mentioned to them that the iPod touch has a stopwatch feature and if they liked we could use it to time how long it took them to run back and forth. They enthusiastically agreed. I mentioned to them that they had to tap the green *start* button to start. Once the start button is tapped it turns red and then reads *stop*, and so they needed to tap stop in order to stop the clock, and then they could read their time that is recorded on the screen.

I then noticed that once start is tapped there is a button next to it that reads *reset* and it turns into *lap*. I mentioned it to them and we decided to explore how that feature worked. The first time around, the younger decided that she would run three laps and the older would work the stopwatch; they then switched. This was a great learning experience for all of us and the contribution to our ongoing literacy and numeracy was inspiring. In sum, the girls would run their laps and the stopwatch recorded their overall time and below that it recorded their time for each lap. We were able to see if they ran each lap faster or slower or

the same.

By playing with and exploring the iPod touch many mathematical and language concepts naturally increased our understanding of literacy and numeracy regardless of whether we were consciously aware of it or not. Again, the object of our engagement was not to strengthen our literacy and numeracy skills, yet that is clearly what resulted. What the girls learned is beyond my imagination and so I cannot define it definitively, but they were using language like, "you ran it in 9.2 seconds." The use of decimals in this way is something I had not heard them use before.

This is a clear example of emergent learning as defined above by Williams, Karousou, and Mackness (2011). This is the case with the other applications that were explored on the iPod and that are referred to later on in this paper. I will spend some time here making the specific connection and then trust that the reader can transfer what is said here and apply it to the other examples because the connections are similar.

Specifically, the connection between emergent learning in this case is, first, that the learning arises out of the interaction between a number of people and resources. In our case the people were the two young girls and I, and the resources are included within the iPod; in this case it was the stopwatch feature which is a part of the clock application. Second, as participants we organized and determined both the process and to some extent the destination, both of which are unpredictable. In our case we decided that we wanted to time the girls as they ran laps. The learning that happened was clearly unpredictable because, in truth, we did not set this out as a specific learning activity, but the result was that learning happened. In other words we did not have any learning goals in mind before we started the activity, there was no prescribed curriculum, but by the end of it we could certainly share many things that we learned for having participated in the activity.

Third, the interaction was self-organized, yet there was constraint and structure. We decided the rules, and although they were fluid, we did have constraints and a structure. As we went along and discovered new things we made changes to the activity and so in this sense it was fluid. For example, we incorporated the lap feature. We clearly had our imposed constraints and structure, as well as the ones inherent within the resource we used. Finally, emergent learning includes virtual or physical networks or both. In our case, the networks were physical because we were in the same place.

I see this definition of emergent learning as being a useful guide, but not a closed recipe. For example, when Williams, Karousou, and Mackness (2011, March) write of emergent learning as, in part, "learning which arises out of the interaction between a number of people and resources," I can think of situations where learning can happen with a contemplative person and her thoughts or her self as the resources. Having said that, I agree that the definition provided is a very useful starting point to begin a conversation around what it means for learning to emerge. What resonated most with me is the need to self-organize and the understanding that the learning is not prescriptive, but unpredictable, emergent.

Alarm

Figure 3. The alarm screen.

Second, connected with the clock application is an alarm. The girls wanted to hear it ring and so they suggested we set the timer to one minute. They realized that that was the smallest option and did not want to wait an hour, for example, to hear the sound. They counted down along with the iPod and cheered when the number hit zero and the tone of the Marimba was heard. Quickly, they became a little disappointed at the sound and were excited when they realized that they could change the sound. The process was repeated for different sounds and they settled on the *bell tower*. Again, this application resulted in extending their use of literacy and numeracy.

Weather

Figure 4. The weather application.

Third, there is a weather application. The girls are very interested in what the weather will be like and in the past have used the television (there is a station that has the weather displayed for the day and forecasted for another four days in advance) and the weather feature

located on my laptop, so they are familiar with the weather feature. This did not limit their enthusiasm when they discovered that they could check the weather using the iPod touch. One advantage of the iPod touch over the other two mediums I mentioned is that on the iPod touch the whole word for the day is spelled out. So, for example, Friday is not shortened to Fri., but is spelled out. Again, this will, I believe, help with their literacy. I have to say that they are already well on their way to reading and the older girl is already reading short novels, while the younger is building her vocabulary and understanding of how letters work to form words and is moving along very swiftly. Nevertheless, as I mentioned earlier, I see literacy and numeracy as being on a continuum, and so we do not just become literate and numerate in one day, but we move along the continuum of literacy and numeracy and the iPod touch clearly extends skills in powerful ways along this journey.

With the weather application the girls learn to connect numbers to what they have to wear based on how hot or cold it is outside. As well, looking up the weather has introduced them to negative numbers and they are able to use them fairly skillfully. In part, the weather application has helped them learn the days of the week, the months (which they also learned about because of birthdays and other significant events that we talk about in advance and that they look forward to), and the year. The calendar application on the iPod touch has clearly helped with them learning these skills, but I will not go into detail about that except to say that they wanted to write their birthday, for example, within the calendar using the touchpad. The weather application also helps them understand daily highs and lows because they are clearly listed, along with the symbols used to indicate whether the day will be sunny, cloudy, and so on.

YouTube

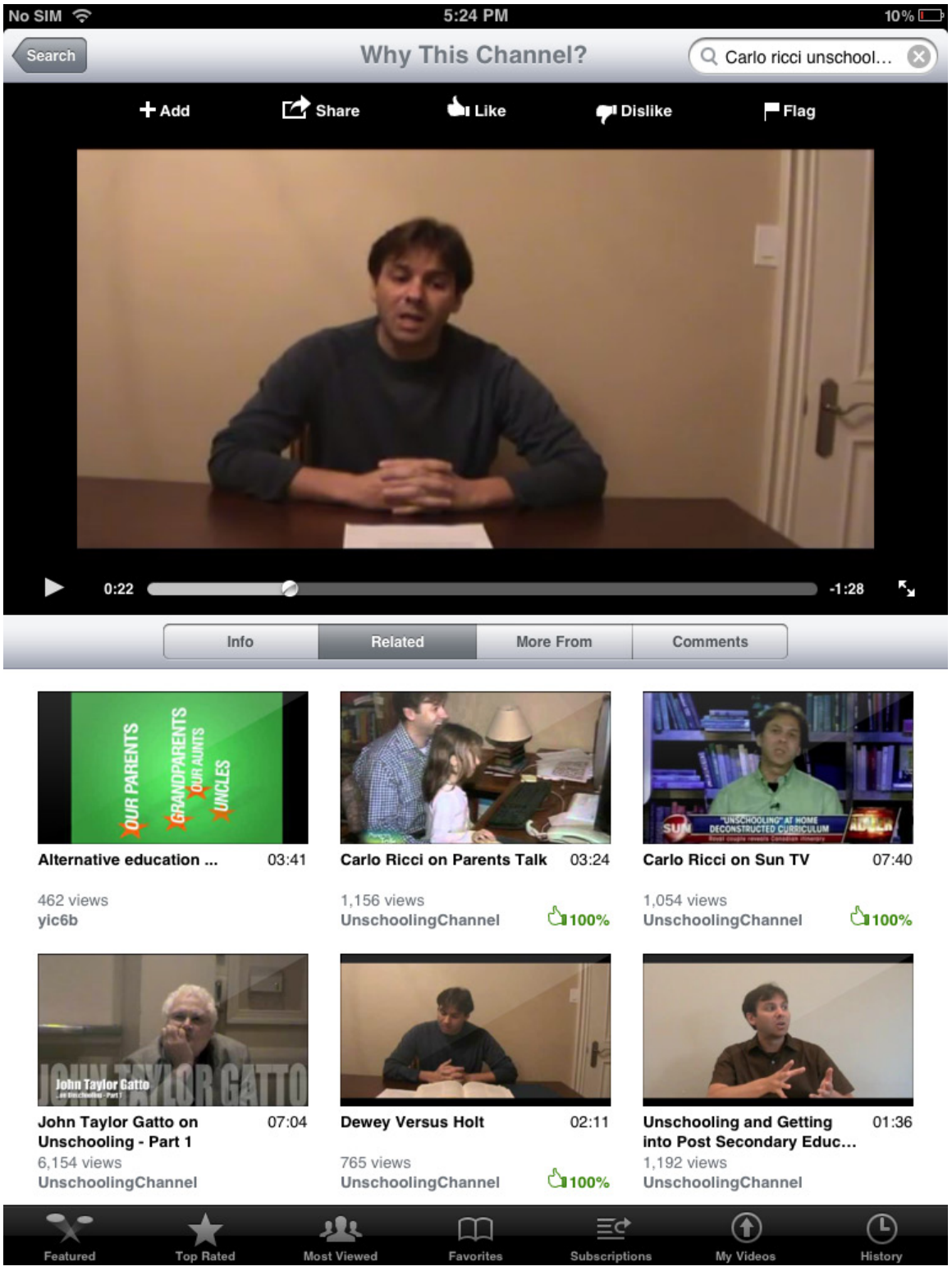

Figure 5. YouTube screen.

Fourth, the iPod touch has an application for YouTube. The girls wanted to hear songs from their current favorite artists and they needed to learn to spell the artists' names in the search field so that they could access the video they wanted. For this they knew how to spell Justin but were not sure about Bieber, and they went to get their compact disk so that they could spell it correctly; similarly, for the spelling of Montana, they went to get their Hannah Montana CD. While they are watching and listening to the video there is a continuum that displays how much of the video has been played on one side and how long the video is on the other, further enhancing their literacy and numeracy skills.

Discussion and Conclusion

Two questions remain: First, how sustainable will their interest in using the iPod touch be? And, second, how will it continue to increase their literacy and numeracy skills? One very serious issue for me is the financial cost to this type of technology, and related to this is the issue of accessibility. This technology is not cheap and it is constantly changing. The iPod touch is $199 for 8GB (also offered is 32GB for $300 and 64GB for $400); in addition, my monthly high speed Internet charge is about $500 a year. As well, the wireless system I put in to maximize use of the technology we have also comes at a cost. My wireless router cost $200 and I also had to purchase an extender for $79.99 so that I can boost the signal and extend the use of my wireless in a room that is a dead zone, but that we spend a fair bit of time in. Ideally, I would like to have the 64GB iPod touch and its enhanced features over the one I have, but cost is a factor. Even more wishful, I would like to have the iPhone with a data package to truly take advantage of mobile learning, where as Bonk (2009) writes, "Anyone can now learn anything from anyone at anytime" (p. 7). Again, cost is a factor. Collins and Halverson (2009) write about the digital divide, "the difference in access to computers and the web between rich and poor, and white and non-white people" (p. 106).

In conclusion, I hope my story helps others appreciate the fact that technology can enhance the learning of literacy and numeracy in very natural and powerful ways. Of course, in interacting with the technology, the girls also learned a great deal about technology itself. As I put the finishing touches on this piece my younger daughter came up to get the iPod touch and bring it downstairs so that she could "look at stuff." Awhile earlier she checked her email on it and sent out a few messages: one to her mom and another to her aunt. They also use the Safari web browser which again extends their learning.

The iPod touch has numerous other applications that can be downloaded, some for a fee and some for free. I look forward to continuing my exploration and observation around this powerful technology for not only literacy and numeracy, but learning of all kinds. Of the iPhone, Bonk (2009) writes that it "is yet another device that will add steroids to human mobility. You can check email, text message friends, browse, collect, and share information and pictures online, and handle phone calls" (p. 299). He goes on to say that through applications, smart phones "include things like quick guides for chemistry, the human nervous system, cell biology, and other important science areas as well as religious topics ranging from the Qur'an to the Bible to the gods of ancient Greece" (p. 299). He says that the

"iPhone and other smartphones represent a portable learning device that is a key driver for the current learning revolution" (p. 299). Given that the iPod touch is similar to the iPhone, albeit much less powerful, I believe that similar things can be said of it. Finally, and most importantly, I believe, is that we need to allow learners to freely play with the technology so that they can engage with and stumble on skills naturally and as they see fit. This is not to say that an external person cannot offer support, but that the learner needs to have a voice and she needs to be empowered to make substantive decisions and choices.

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Book Review - Telecollaboration 2.0: Language, Literacies and Intercultural Learning in the 21st Century

Editors: Sarah Guth and **Francesca Helm (2010)**
Peter Lang International Academic Publishers, 475 pp.
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As the title indicates, telecollaboration 2.0, or online intercultural exchange, is the focus of the book edited by Sarah Guth and Francesca Helm from the University of Padova (Italy). This volume, which is the first work that deals specifically with telecollaboration in a Web 2.0 context, marks the strong beginning of the new series "Telecollaboration in Education," which two key players in online language and culture instruction, Melinda Dooley and Robert O'Dowd, have launched for Peter Lang Publishing. The book aptly combines in-depth discussion of recent and emerging critical issues related to telecollaboration 2.0 with the experimental and critical approach to intercultural learning, mainly in the context of foreign language education, an area of expertise for the majority of contributors. The book's four parts unite research and practice findings from Europe, Latin America, Asia, and USA. The first part focuses on new trends and environments in telecollaboration. The second part highlights new skills and competencies of language learner 2.0, while the third part takes a look at language educator 2.0. The fourth part consists of the analysis of eight case studies that efficiently bridge research and practice and vividly illustrate changes in teaching and learning opportunities that technology brings and continues to bring to researchers, practitioners, instructors, and students all over the world. The contributors share a view of telecollaboration 2.0. as both a tool and mindset, shaped by the learners' desire to use new technologies to communicate and collaborate and to construct together knowledge and artefacts. In this context, teachers and students are engaged with a collective, constructivist approach to learning, which challenges boundaries between mutually enriching 'virtual' and 'real' worlds.

As Guth and Helm perceptively observe in their informative introduction, new technologies

define the social and technical contexts of learning and perpetuate the growing need for "multiple literacies." This concept is related to languages; it is instrumental for identifying three overlapping competencies, which are highly desirable for successful communication in telecollaboration settings: language skills, intercultural communicative competence, and new online literacies. The authors view "new online literacies" as a distinctive feature of telecollaboration 2.0, pointing out the need to develop new pedagogies to enhance preparation of the learners for participation in online community, the engagement, which increasingly becomes part of their multiple identities. The authors conclude that both the sociocultural potential as well as complexities that emerge in telecollaboration exemplify the increasingly complex, connected, global society in which learners do and will operate.

In the first part of the volume, the contributors explore new trends and environments in telecollaboration, with particular emphasis on creative ways of integrating informal online communication in language instruction. Opening this part with "Telecollaboration with Web 2.0 Tools," authors Guth and Thomas indicate that various modes of communication and new environments can be easily accessed with Web 2.0 tools. They notice that whereas some educators still prefer the "safe" environment of closed learning management systems (LMS), the 'real world' style communication available through the Web is increasingly chosen for collaborative projects. Stimulating examples of the use of social networks in telecollaboration vividly illustrate the advantages of the integration of 'real life' communication practices in education. In "The Multifarious Goals of Telecollaboration 2.0: Theoretical and Practical Implications," Helm and Guth discuss task-based language learning and a pedagogy of multiliteracies for telecollaboration 2.0, drawing on such competencies as play, performance, simulation, appropriation, multitasking, and distributed cognition. They distinguish four major components of the pedagogy of multiliteracy: situated practice, overt instruction, critical framing, and transformed practice.

In "Telecollaboration and Learning 2.0," Lamy and Goodfellow suggest that in order to identify and manage "the collision" of cultures of learning, a critical literacy stance on the power relations underlying both formal and informal interaction in social web environments is required. They suggest that this can be achieved through the successful combination of "epideictic" communication, defined by Barbara Warnick as a celebration of consensually held values such as social-networking practices and "power of the crowd," with "deliberative" critique of the cultural nature of such communication. The authors notice that this combination can be of value to practitioners of telecollaborative language learning who are engaged in Web 2.0. Outlining directions for further research, they point out the necessity to view telecollaboration as an educational culture, a potential subject to the critique that other educational cultures receive, including power relations.

Thorne argues that informal intercultural communication is an important element of this culture in his insightful chapter, "The 'Intercultural Turn' and Language Learning in Crucible New Media." He discusses intercultural networks, fan fiction, gaming, and language use in event-driven scenarios in order to demonstrate the aesthetic and stylistic shifts in contexts, purposes, and genres of expression associated with "new- media-in-the-wild" (p. 158). Thorne perceptively suggests that activities enhanced by the new media require a

response and proactive vision of educators. He states that it is necessary to support greater epistemological and linguistic pluralism that corresponds to the vision of language as an open, non-static system.

In "Virtual Worlds for Foreign Language Learning and Intercultural Exchange: Is it for Real?," Panichi, Deutschmann, and Molka-Danielsen explore the potential of a virtual environment, specifically of Second Life, for development of new approaches to learning and teaching in the context of telecollaboration. They indicate that boundaries between virtual worlds as well as between non-virtual and virtual worlds become more and more subtle. "How will this process affect our understanding of language and culture, and identity and place?" (p. 191). This important question remains open for future research.

The second part of the book, "Language Learner 2.0: New Skills and Competences," starts with the chapter entitled "Learner 2.0" by Guerin, Cigognini, and Pettenati. These authors focus on the analysis of basic and higher order skills required for life-long learning in the 21st century and discuss conditions related to individual, technology, and time management skills, which can enable their development. In line with such researchers as Lemke and van Helden, they emphasize the importance of the affective dimension in Learning 2.0.

In the next chapter, "Telecollaboration: At the Interface between Multimodal and Intercultural Communicative Competence," Hauck reflects on telecollaboration 2.0 as a product of the age of "Participatory Cultures." She suggests that multimodal communicative competence, which includes skills and knowledge about how to take part and how to invite participation in collaborative environments, is important for a critical understanding and assessment of new media and is a pre-condition for successful involvement in participatory cultures.

In the last chapter in this section, "The Multilingual Internet," Hughes suggests that adopting bilingual or even multilingual pedagogical and learning strategies is likely to increase language learners' ability to operate autonomously online. She argues that Web 2.0 opens up a wide range of computer-mediated human interactions that approaches what is available in the physical world. One may add that blurring the distance in time and space, computer-mediated interaction can enrich face-to-face communication by opening new routes for diverse interaction and collaborative work.

The focus of Part 3 is on the "language educator 2.0." In her chapter "Teacher 2.0," Dooley perceptively observes that Web 2.0 invites a more dynamic style of teaching that stimulates and orients students towards critical thinking. This style requires a change in the vision of the instruction, which is no longer associated with a transmission of knowledge. The emphasis is, instead, on knowledge building, where interaction goes in three ways: teacher-student, student-student, and student-teacher. A teacher's competence, therefore, becomes increasingly related to her or his ability to integrate 2.0 tools and to create a community of learners that extends beyond traditional classrooms.

In "Integrating Telecollaboration into the Language Classroom: Some Insights," Fursten-

berg and Levet share lessons learned from ten years of teaching French in a blended environment, "Cultura," designed at MIT as an intercultural project. They consider the construction of knowledge as an unfinished process and view the assessment of this process as a major challenge for educators. Facing this challenge with confidence and creativity, Furstenberg and Levet outline two constructive approaches to assessment. The first approach calls for evaluation of students' portfolios, or 'log books,' where students detail what they learn every week, what discoveries they have made about the other culture and their own, and what questions remain unanswered. In the authors' opinion, these assignments reflect learners' ability to do close reading or to come up with valid interpretations of the material. The second approach calls for evaluation of students' analytical skills, perhaps by asking them to apply a set of materials that they have studied in new contexts.

The topic of assessment is further addressed in "Issues in the Assessment of Online Interaction and Exchange," where O'Dowd describes assessment of online intercultural exchange, in particular intercultural communicative competence, as a particularly difficult task. He points out that the challenges involve ethical issues of assessing attitudes and skills of intercultural communicative competence, practical issues of 'calibrating' intercultural skills and new online literacies into levels, and pedagogical strategies of rewarding certain types of online activities over others. Nevertheless, the author asserts that these issues should be confronted by online educators, so that the assessment criteria reflect the attitudes, skills, and competencies they would like their learners to develop.

The book ends with case studies that illustrate different ways of implementing new forms of telecollaboration, enhanced by Web 2.0 tools. These include interdisciplinary collaboration, as in the Virtual Harlem Project, intercultural projects with exchange between students from Italy and Australia, USA and Japan, and Chile and the Netherlands, and the Solya Connect Program that involves learners in the West and in the Arab world. Each discussion is centered around the following aspects of telecollaboration projects: context, objectives, project phases and task types, assessment, and project evaluation. Though the case studies deal mostly with language and culture instruction, the guidance on project organization, task design, and the insights on pedagogical strategies and assessment can be useful for telecollaboration projects in different educational contexts.

An insightful discussion of practical and theoretical underpinnings of the emerging educational culture of telecollaboration through a variety of perspectives makes *Telecollaboration 2.0: Language, Literacies and Intercultural Learning in the 21st Century* an excellent resource for researchers and practitioners who are ready to use their imagination and open their minds to intercultural adventures in education without borders.

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