CHAPTER	15
TITLE	Sustainable Digital Ecologies and Considered Limits
AUTHOR	Lisa Lebduska
OVERVIEW	This chapter explores the challenges of sustaining digital ecologies within the context of a postmodern era that has been characterized by *limitlessness*. Rejecting a simple model of growth that looks only to increase resources (more computers, more hardware, more personnel), I propose a development model that engages the real material, social, and psychological limits of a digital commons. This model of a digital commons intersects Garret Hardin's ecological rivalrous commons with Lawrence Lessig's construct of the innovations commons. Hardin's work posits that shared physical spaces (like pastures) have material limits and that individuals will act in self-interest to maximize their use of such space, depleting resources until they disappear. Hardin advocates the imposition of limits (i.e., use laws) to protect the commons against destructive self-interest. Lessig contrasts this model with the "innovation commons" of the Internet, which depends on use. Open-source code, for example, encourages the exchange of innovation. The more that users can access and improve code, the more the innovation commons will improve. But intellectual property laws limit such exchange, consequently depleting the availability and development of ideas. A digital commons thus requires rivalrous as well as innovative commons for sustainability. The sustaining of such a complex commons must therefore engage with the panorama of limits, which are neither good nor bad, but, instead, warrant careful attention by those seeking to develop thoughtful, creative, and nimble pedagogical uses of cyberspace.
TAGS	compatability, complexity, cyberspace, development, digital ecological commons, digital ecologist, ecology, Everett Rogers, Garrett Hardin, growth, heuristic, human, ideational limits, innovation commons, innovations commons, Lawrence Lessig, limit of the commons, limit*, Lisa Lebduska, non-rivalrous commons, observability, pastoral commons, relative advantage, resource*, rivalrous commons, socio-cultural limits, sustain*, taxonomy, technolog*, theory of innovation, Tragedy of the Commons, trialability
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Technological Ecologies & Sustainability

Sustainable Digital Ecologies and Considered Limits

Lisa Lebduska

> The one constant theme in off-the-cuff discussions with [Computers and Writing] participants over the three days was the continuing resistance to the use of computers in instruction experienced on a wide range of campuses. People, at least at this conference, had a hard time understanding why rather simple processes using computers and the internet and databases (blogs and e-portfolios, for instance) repeatedly encounter sometimes virulent resistance among colleagues and even IT staff (though less and less from administrators). (Kemp, 2005)
>
> There is no box. (Amory Lovins in response to a reporter's use of "thinking outside the box"; Kolbert, 2007)
>
> After the final no there comes a yes
> And on that yes the future world depends.
> (Stevens, 1954)

Although "literacy" has been a contested term throughout institutional history dating back to Plato, within the last 20 years the proliferation of computers and digitized media has given it particular fragmentary force, with calls for new genres (e.g., Greg Ulmer's "electracy"; Cynthia Selfe's "layered literacy"; Kathleen Yancey's "textured literacy") and new pedagogies (e.g., the New London Group's "multiliteracies") that recognize the power and pervasiveness of digitized and audiovisual media. But, as Anne Wysocki and Johndan Johnson-Eiola (1999) noted, "literacy" has itself become a ubiquitous metaphor, invoked often as a means of neutralizing politically complex practices, implying that the making of meaning can somehow exist apart from socio-cultural considerations. This ideological erasure, they contended, intensifies when "literacy" is paired with a second term such as "computer" or "technological," again suggesting that individuals need only acquire a value-free set of skills to achieve success.

Richard Selfe's (2005) "digital ecologies"—the intersection between a socially contextualized set of complex practices involving reading, writing, and composing within various electronic environments and "the pragmatic strains that result as teachers, staff and administrators attempt to adjust to changing literacy patterns in classrooms, labs, online learning, and teaching environments" (p. 1)—has, in part, responded to Wysocki and Johnson-Eiola's critique. Sustaining these digital ecologies, as Selfe explained, depends on shifting from a *culture of blame* (e.g., claiming that others are responsible for failures in technological education) to a *culture of support* involving staff, faculty, students, and administrators as invested and important stakeholders. Although these digital ecologies contain literal computer networks, and, although "network," as Jeff Rice (2006) argued, resonates with metaphoric and literal significance for the types of literacies English Studies should pursue, I suggest that the sustaining of digital ecologies parallels the efforts needed to sustain biological ecosystems and that the "limit of the commons" offers a productive heuristic[1] for digital ecologists.[2]

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[1] Any discussion of digital ecologies engages an intricate triple bind. Sustaining digital ecologies entails promoting their development, and such promotion often requires reducing resistance to these ecologies. But resistance is a form of agency deployed in response to domination, so reducing resistance risks treading the line of social coercion. Thus, we must

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With its need for contexts, interdependencies, and recognition of the global as well as the local, digital literacy movements have much in common with various ecological movements. Derek Owens (2001), for example, urged compositionists to remember that environmental sustainability requires us to think about the future. Anyone who has ever tried to sustain an electronic environment—whether teaching a class in a MOO, educating a colleague about wikis, or making a decision about whether to designate funds for a wireless lab—would find Owens' assertion familiar. To think with, through, and about technology is to think about what it will do and what it may become. Ecology, as Bonnie Nardi and Vicki O'Day (1999) observed, connotes the diversity and evolution needed to maintain responsible, equitable, and humane relationships with technology; for Nardi and O'Day, "this is a responsibility, not just an opportunity. . . . As users of tools we are responsible for integrating them into settings of use in such a way that they make sense for us" (p. 55). The shared nature of these tools—of servers and software, of computer classrooms and pedagogical understandings—comprise a type of commons, a shared resource that has some of the same characteristics as a public park.

This chapter offers digital ecologists the "limit of the commons" as a productive heuristic advanced through four key moves:

1. describing the ecological distinction between "development" and "growth";
2. demonstrating how the concept of development is linked to the concepts of "limits" and the "limits of the commons" as they have been used in environmental discourse;
3. exploring Lawrence Lessig's (2001) concept of an "innovation commons," which complicates the environmental concept of "commons" by examining it through the lens of cyberspace; and

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problematize exactly what we mean when we engage in discussions about overcoming resistance to the adoption of technological practices. How many technology support offices, I wonder, have a "resistance is futile" sign hanging above their doorways or taped to the side of a desk? To what extent, even in our most intense moments of building a technological commons, do we risk creating "docile bodies?"

As Michel Foucault (1984) has put it: "disciplinary coercion establishes in the body the constricting link between an increased aptitude and an increased domination" (p. 182). Widespread technological facility, in other words, may put users at risk of subjugation. But the limits of increased domination, I would argue, reside in the digital ecology movement itself. Digital ecologies expand individual choice, providing access to knowledge through cyber achievements such as distance education, digitized archives, and synchronous conversations with others from all over the world. Resistance, when constructed as a limit to be explored, understood, and engaged, provides potential moments of synergy and connection-building. For the cyber ecologist, resistance fosters continuous rethinking, renegotiating, and rejustifying of resources, philosophies, and pedagogies.

[2] A "digital ecologist" is a member of the faculty, staff, and/or administration who works to implement and sustain digital ecologies such as computer labs, up-to-date word-processing software, and other now-basic technological means in educational institutions. "Sustain," in this regard, covers a full spectrum of pedagogical activities, from designing and delivering curricula for credit, to educating communities about software and hardware, to maintaining and staffing computer facilities, servers, and networks.

4. examining how identifying the complicated notion of development and limit within the cyberspace commons can be used to sustain digital ecologies.

Sustenance Entails Development, Not Growth

For ecologists, all natural resources are more or less shared, because what happens to one resource anywhere on the globe inevitably impacts life everywhere. Consider, for example, that carbon emissions produced in one part of the world contribute to the greenhouse effect, which in turn creates conditions ranging from drought to floods all over the planet. The growth that economists measure in numbers of cars produced or new homes built within one geographic region also depletes oil reserves and forests in another area. In ecological terms, "bigger" and "more" do not necessarily translate smoothly into "better"; the view of increase is much more complex. As a result of the multifaceted nature of environmental change, sustainable development for ecologists differs considerably from unlimited growth. Owens (2001), who has developed a platform for ecological composition practice, quoted Herman Daly (1993) to present a useful distinction between growth and development:

> To grow means "to increase naturally in size by the addition of material through assimilation or accretion." To develop means "to expand or realize the potentialities of; to bring gradually to a fuller, greater, or better state." When something grows, it gets bigger. When something develops it gets different. The earth ecosystem develops (evolves), but it does not grow. Its subsystem, the economy, must eventually stop growing, but it can continue to develop. The term "sustainable development" therefore makes sense for the economy, but only if it is understood as "development without growth." (p. 30)

The distinction between development and growth is equally useful for sustaining digital ecologies, which may, at certain institutions, receive pressure to grow merely for the sake of growth. Funding, no matter what its strings, is better than no funding at all, and the need for speedy grant writing may result in uninformed requests for more computers or newer software or bigger labs—without long-term, sustainable planning. Extending this distinction between growth and development to technology budgets means planning beyond the sake of growth for growth's sake—that is, thinking beyond simply increasing the number of computers available to students, faculty, and staff, and considering how the technology will be (or could be) used and how useful it might or might not be in the future. More computers without the staff to maintain them, or newer software without the training to use it, do nothing to sustain a digital ecology, and could, in fact, harm it. Computers merely added to an institution without pedagogical planning could end up serving only as glorified typewriters and might, as Christine Hult (1988) demonstrated, actually reinforce weaker writing practices. Hult's initial research revealed that without proper guidance, students would use word-processing software to correct individual words rather than using the technology to consider the overall communicative impact of their writing. Merely adding computers or increasing the number of students who use computers, in other words, contributes to growth, but does not address the development crucial to fostering digital ecologies.

Sustaining a digital ecology entails emphasizing development rather than growth. Further, true development is a gradual process that entails a rethinking of pedagogical objectives and processes that includes faculty, staff, and students. This development coincides with what William Massey and Andrea Wilger (1998) identified as the last level in faculty instructional technology adoption, an achievement that moves beyond an efficiency level, in which technology is used to enhance "personal productivity" (email, for example, to quicken communication) and "enrichment add-ins," in which faculty use technologies such as Web pages to enhance their existing teaching but do not significantly alter their teaching. This kind

of faculty development constitutes a paradigm shift, in which faculty rethink their teaching, combining the best of their former practices with the best technological advances in order to maximize student learning. These levels of faculty development necessarily overlap and leak into one another, and, at any given moment, different faculty engage technology at different levels. Sustaining digital ecologies will therefore include taking into account these differences as we work toward a paradigm shift that prioritizes development over growth. Prioritizing development in the long run means a return to and renewed focus on the complex practices impacting literacy as we parse limit and its many codes.

Development Requires Limiting Growth

Ecologists argue that limits must be placed on economic growth so that natural resources may be preserved and/or shared more equitably across nations and even generations. A recognition of limits is therefore key to understanding how a shared resource can be developed or sustained. At the surface, considerations of limit seem to be more about containing, holding back, and controlling; limit conjures images of scarcity and finitude rather than possibility. But if we consider how limit has been used successfully to protect environmental resources through the creation of wildlife preserves and national parks (both of which are ecological commons), we recognize that certain kinds of limited growth (i.e., contained development) may actually help to sustain the material components of digital ecologies. Conversely, unmasking the limits to our work—which include such constructions as those of race, gender, sexuality, and social class that associate affluent, heterosexual white males as keepers of the technological flame (see, for example, Cynthia Selfe, 1999) and exclude others—becomes a productive act when the unmasking performance is shared with those who have power to support technological literacy.

Given that limits are human artifacts, constructing and constructed by political and social contexts, they carry with them the same complexities and contradictions of any cultural element. For digital ecologists, these complexities and contradictions stem from the multifaceted nature of their work: Institutional digital ecologies consist of the virtual, the material, and even the psychological. As Lessig (2001) contended, “cyberspace is between [the world of ideas and the world of things]. It offers not quite the freedom of the world of ideas, though it offers much more of that freedom than the world of things” (p. 104). Similarly, digital ecologists must work with the world of ideas and the world of things; they must also work in the world of people. When the concerns of digital ecologists involve the physical components of their commons—such as software, rooms, computers, and even access to online teacher feedback— “limits” may be used productively to ensure the most democratic use and access possible. In this regard, the digital ecologist serves as a kind of steward. When the concerns of the digital ecologist turn to the ideational (who uses computers and why), the limits to thinking and access are productive to the extent that they are identified, unmasked, and then used in their own unmaking. For digital ecologists, limit is a multifaceted concept to be embraced judiciously, dismantled entirely, and engaged thoughtfully, depending on the context.

In the next section, I map one of the key ecological arguments in support of limits: Garrett Hardin’s (1968) “Tragedy of the Commons,” and then explore Lessig’s (2001) application of the commons construct to cyberspace, where limits, in the ecological sense, actually diminish the cyberspace commons. Finally, I demonstrate how limits within the cyber commons of an institution (rather than in cyberspace in general) can be productive as well as destructive, and that digital ecologists need to recognize that complexity in developing and sustaining the digital commons of their institutions. In the table, I provide some of the key terms that will be used throughout the chapter.

Table 1. An extension of Lessig's (2001) innovation commons to the work of the digital ecologist.

	Example	**Impact of Use**	**Type and Role of Limits**
Rivalrous commons	pasture	depletes resource	environmental protection laws; help sustain
Non-rivalrous commons	public domain novel	no impact	unneeded; resource has been placed outside of private property bounds
Innovation	Web	increases resource	privatization of computer code; depletes resource as fewer people have access to innovate and improve resources
Digital ecological commons	knowledge of digital technology	mixed: knowledge is enhanced through use, but material resources (equipment) is diminished	social and psychological limits need to be understood, engaged and then reduced or eliminated to increase access; resource use limits may be necessary to democratize access (example time limits on public computer use)

Limiting the Use of Pastoral Commons

Hardin's (1968) "Tragedy of the Commons" is perhaps one of the most well-known environmental arguments in support of placing limits on natural resources and biological commons. Hardin's central example of a commons is a shared pasture on which farmers graze their animals. Left to their own devices, Hardin argued, all farmers would attempt to graze as many animals as possible, thereby maximizing gain from the shared land. As Hardin asserted, however, a pasture can sustain only a finite number of grazing animals before it is depleted beyond recovery. This finite number constitutes a limit. Ocean fishing and coal mining provide similar examples of commons in which individuals compete and deplete through use. Economic growth—through an ever-increasing number of cattle grazed, fish harvested, or coal mined—is ultimately limited by the capacity of the ecosystem. But rather than grow economic use to the point of irreversible ecological collapse, humans can create social limits (i.e., laws) on the use of resources well before the natural limits are reached. In this way, we can sustain the commons. Because Hardin believed that humans possess an instinctive inclination toward maximizing self-interest, he argued that limits on the use of finite resources were imperative if the tragedy of collapse were to be avoided.

This notion of limit has reverberated throughout environmental discourse. *Limits to Growth* (Meadows, Meadows, Randers, & Behrens, 1792), for example, was commissioned by the Club of Rome, a group of international scientists who used computer modeling to predict Earth's maximum sustainable human population. More recently, discussions surrounding global warming (popularized, somewhat, by Davis Guggenheim's 2006 documentary, *An Inconvenient Truth*, about Al Gore's global warming lectures) have included arguments that support limiting greenhouse gas emissions. In both of these instances, the Earth and its atmosphere constitute a kind of commons at risk of being changed and/or altered to a point at

which it is no longer fit for human habitation.[3] For ecologists, this issue of limit has raised complex questions concerning the degree and specifics of limits—for instance, who should determine parameters and at what point limits should be imposed. Murray Bookchin (1989) explained that the ancient Greeks conceptualized limit as "the golden mean which meant 'nothing in excess'" (p. 178). Arguments posed at several Earth Summits have noted that the current industrialized nations of the world achieved their economic advantage through an unrestricted use of various resources, such as coal and oil, but nations whose economies are emerging are now expected to restrict their use of such resources for reasons of global environmental health.

The contested, complex nature of environmental limits has its parallels in the issues threading digital ecologies. Significantly, the relationship between limits on material resources and the culture of support outlined by Richard Selfe (2005) is as conflicted as the relationship between limit and environmental movements aimed at sustaining the earth. When the issues surrounding limits are considered in terms of the non-material, they become even more complex. To explore the role of limits in the non-material components of digital ecologies, it is helpful to see how they have been constructed for cyberspace.

GRAZING IN THE CYBERSPACE COMMONS: COMPLICATING LIMITS

As discussed, for environmentalists, shared resources typically include commons (e.g., (pasture, forests, natural resources), free and open to use by anyone. But the notion of commons, as Lessig (2001) pointed out, may be extended to include cultural artifacts such as public domain material and documents for which authors have released their absolute copyright and invited others to use and remix those documents. Lessig has refined the commons model by categorizing commons into two distinct groups: *rivalrous* and *non-rivalrous*. Hardin's pastoral commons, Lessig explained, is a rivalrous resource—a resource for which individuals compete, and a resource diminished with each use. By contrast, a non-rivalrous resource is something not diminished by use—a public domain text, for example. Any number of people may read, discuss, prepare derivatives of, and otherwise borrow from a public domain text without decreasing its availability to others. Because use does not deplete non-rivalrous commons, limits need not be placed on the amount or frequency of their use. Lessig has established the difficulty and even the danger of placing the same limits on rivalrous and non-rivalrous commons: "The system of control that we erect for rivalrous resources (land, cars, computers) *is not necessarily appropriate* for non-rivalrous resources (ideas, music, expression). Indeed, *the same system for both kinds of resources may do real harm*" (p. 95; emphasis Lessig's).

Lessig (2001) posited that the Internet, ideally, should lie outside the rivalrous/non-rivalrous commons dichotomy because cyberspace constitutes an "innovation commons" (p.23), which is neither rivalrous nor non-rivalrous, and is actually increased through use. By using the Internet, for example, programmers and Web authors often copy readily accessible HTML code and cascading style sheets without charge, and, through this process both learn how to build Web pages and compose Web pages. The lack of limits or controls on this code encourages authors to experiment, expand, and invent freely. Such movement "builds a commons. This commons in turn lowers the cost of innovation. New projects get to draw upon this common code; every project need not reinvent the wheel" (Lessig, p. 57). A similar effect

[3] The arguments surrounding to what extent the Earth will or will not be fit for all human habitation are far too complex for the confines and focus of this chapter, and admittedly will be impacted by the intersections of race, class, and gender as the Earth remains habitable for some people in some places and is uninhabitable by some people in others.

is experienced in the digital ecologies of educational institutions. The Conference on College Composition and Communication (2004) made clear in its "Position Statement on Teaching, Learning and Assessing Writing in Digital Environments" that "as composers use digital technology to create new genres, we can expect the variety of digital compositions to continue proliferating" (online). Innovation breeds innovation. Digital ecologists—whether introducing students to Internet search strategies or helping them to explore the facets of wiki composing—need as much freedom as possible to explore, invent, and create.

Conversely, limits to innovation diminish the innovation commons. Lessig (2001) conjectured that had Apple's AppleScript language (which allows code to be concealed) been the main language of the Web rather than HTML, the "knowledge commons" would have been smaller. Although farmers who graze their sheep on a common pasture will deplete it, Web designers who post pages and sites are building the Web through their use of it. Lessig's analysis of this innovation commons emphasizes the negative effects of controlling ownership: The more Internet technologies become property, the more the innovation commons is diminished; ownership thus tends to consolidate access. Limits in the form of intellectual property laws—unlike the limits of environmental regulation—deplete rather than preserve the innovation commons. Further, converting elements of cyberspace into private property, Lessig contended, excludes some groups. When fewer people have access to the tools to build within a commons, fewer people contribute to it. There is less diversity of opinion and idea, less opportunity for innovation and exchange. In the cyberspace universe, a limit becomes a kind of control that actually diminishes the commons and the digital ecologies sustained by those commons. (See Figure 1 below for a map of rivalrous, non-rivalrous, and innovations commons and their intersections with digital ecological spaces.)

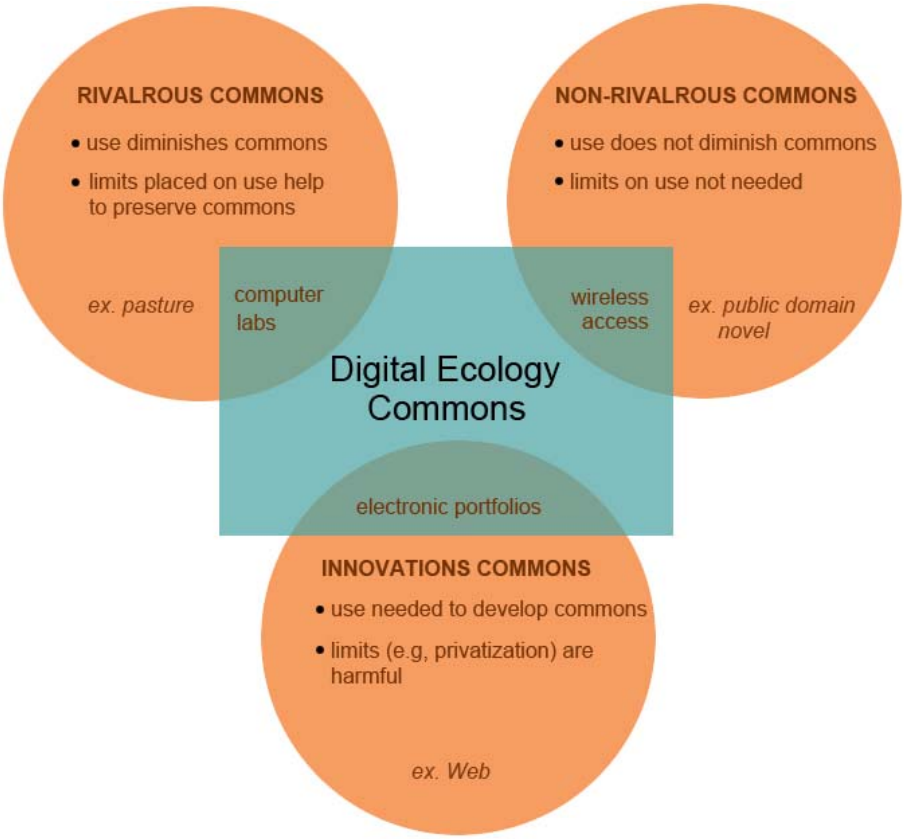

Figure 1. An extension of Lessig's (2001) innovations model to the digital ecology commons

DIGITAL ECOLOGIES IN HIGHER EDUCATION: THE CONTRADICTORY NATURE OF LIMITS

The innovation commons that Lessig (2001) described poses a particularly complex challenge to higher education, where some limits diminish digital ecologies, but other limits help to preserve and expand them. Unlike the internet, other digital ecologies often serve as the nexus of rivalrous and non-rivalrous commons. Most digital ecologists recognize the rivalrous nature of their work, in which unproductive limits include shortages of funding to replace outdated equipment or renovate classrooms or purchase software licensing agreements. At the same time, most embrace the non-rivalrous, seemingly limitless attributes of digital ecologies: the exploration, experimentation, and innovation made possible by their exchange and use. I wish to suggest however, that limits at times may be productively recognized in three ways:

- First, through establishing them when it is necessary to maintain the deepest possible use of resources (as when, for example, an instructor may limit enrollment in an online class to ensure that the students receive as much individualized instruction as possible).
- Second, through identifying social limits that result in fewer women and or students of color engaging with technology; these limits need to be identified and called into question as direct contradictions of an institution's mission, rather than being seen as indicators of "natural" inclination or impediments only to technical facility.[4]
- Third, identifying and engaging with groups who might pose individual limits to the commons because of their reluctance to adopt digital technologies is paramount. Engaging those who actively resist adopting technologies—playing what Peter Elbow referred to as the "doubting game" and what Wayne Booth termed "the rhetoric of assent," will entail actively listening—not with the intent of "winning" the technology argument but with the intent of understanding and, ideally, moving to a position acceptable to both.

This next section examines how constructing some limits (such as access to computer labs) helps to preserve digital ecologies, while identifying, unmasking, and engaging seemingly unproductive limits may be the best way to make use of them.

[4] The field of composition and rhetoric at its core, is a democratic field founded on principles of equality and access. Work undertaken to develop the field, by extension, adheres to the same principles. By contrast, limits placed for the purpose of consolidating power and limiting education to any select and/or privileged group, are at their core anti-democratic. The challenge, of course, lies in identifying hidden limits—if one is surrounded by individuals who have ready access to technology, it is easy to forget the variability in both depth and breadth of access to software, hardware, and the knowledge to use the two effectively.

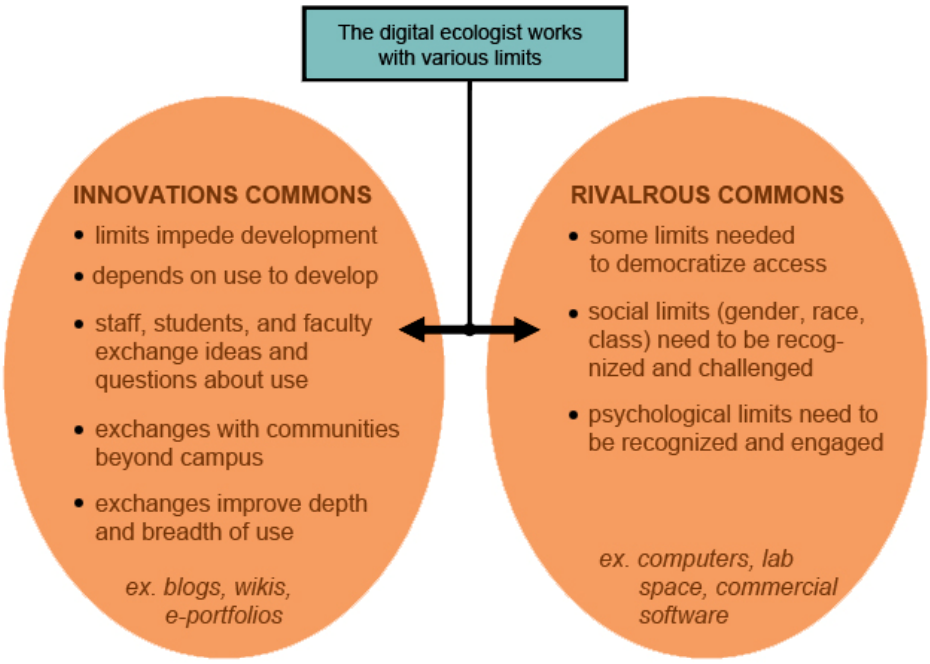

Figure 2. The digital ecologist works in two commons

The Potential Benefits of Material Limits for Rivalrous Resources

The systems of regulation that we devise for rivalrous resources, such as rules controlling access to computer labs or policies related to borrowing laptops, may impede the production of non-rivalrous resources, but also may be necessary to ensure access to the commons. At times, limits are needed to protect the corporeal elements of the cyber commons. Institutions with limited computer resources may find it necessary to limit the amount of time students can spend on a computer or may limit the types of activities students can engage in so that as many students as possible can access those facilities. It may also be necessary to construct limits proscribing the type of commons usage. Computer labs may restrict students from using chatrooms or accessing email on designated research computers. In these instances, the regulation of a computer lab functions very differently than the privatization of software. Although intellectual property—like software—restricts use to only those who can afford it and results in fewer people using it, limits on the amount of time or the ways in which public computers can be used are intended to maximize the number of users gaining access to a resource. For digital ecologists, limits on material resources democratize rather than privatize the digital commons.

Limits designed by digital ecologists to protect and democratize the use of computer resources, like environmental laws used to preserve natural resources, are key to sustainable

development. But other limits—such as small or non-existent budgets for hardware, software, staff, and training—restrain the development of the cyber commons. At first, it may appear that such limits are purely material (e.g., in the case of a shortage of funding). If, for example, a college had endless appropriate computer lab space, it would not need to place any limits on use. But underlying these seemingly material limits are decisions, decisions that are the products of psychological forces and social structures. As this next section explains, the innovation commons depends on use to build and sustain it.

The Drawbacks of Limits on Non-Rivalrous Resources

As Lessig (2001) noted, innovations commons depend on the free exchange of diverse ideas in order to grow, and such is the case with the digital ecologies of educational institutions. To build the innovation commons of their home institutions, digital ecologists must continually promote extensive and creative uses of their cyber commons. The more faculty who build digital work into their pedagogy—promoting multimodal composition, assigning blogs, teaching students to use wikis for collaborative writing, for instance—the more likely it is that other faculty will use and innovate with these technologies. But when digital ecologies go unused, the cyber commons is not merely unused and resting at steady state, it actually risks depletion. An extended example may help to illustrate this point.

Imagine that a college receives an external grant to support technological innovation and invests initially in laptops, software, and workshops to teach faculty and staff to incorporate the most recent technologies into their teaching. Through careful planning, the college makes internal grants available to faculty and staff willing to revise their pedagogies and share approaches within the community. The digital ecologists involved in administering the grant have the prescience to require that applicants document how they will evaluate and disseminate the results of their pedagogical innovations. As a result of this careful planning, the first wave of faculty and staff receiving the internal grants enthusiastically design and post Web pages about their efforts. They participate in conferences (e.g., EDUCAUSE, Computers and Writing), attend computing and teaching with technology symposia, and offer workshops to colleagues. They devote a summer to writing descriptions of their changed teaching practices for campus publications, and attend a summer institute devoted to teaching with technology. But all of this success, however commendable, does not guarantee that the digital ecology of the institution will be sustained. If the innovations commons has not been extended beyond the initial grant recipients or first wave of digital ecologists, it will, over time, deteriorate. The innovation commons depends on use to build it; those who do not use the commons actually deplete the digital ecology of their institution. The reasons behind such non-use may very well be at least partially rooted in the ways that digital ecologies are framed.

Impediments to Participation: Human Limits in the Digital Commons

Digital ecologists often confront seemingly technological limits that, at their roots, are actually quite human. Return, for a moment, to the hypothetical example of a college that receives a grant designed to promote technological education. Imagine that a staff member has lost interest in updating an online peer-tutoring schedule. After finding outdated information on the page, students stop looking there for information. The number of hits recorded for the page decreases, and eventually the staff members in charge of the page argue that there is no need for it because “no one uses it.” And, from one perspective, the staff members are absolutely correct. Just as innovation breeds innovation in the digital commons, stagnation breeds stagnation. In another pocket of the campus, feeling, like Jacques Ellul (1976), that “there can be no human autonomy in the face of technical autonomy” (p. 138), some faculty

see no reason to attend the technology workshops provided by their colleagues, and, deep down, fear the potential loss of control that technological change might bring to their curriculum. Both of these instances, in different ways, deplete the innovation commons of the grant-receiving college because each instance represents a kind of non-participation. By identifying, challenging, and sometimes even working with the social and psychological limitations of the innovations commons, digital ecologists work to build sustainability.

Grazing in the cyber commons, whether the grazing consists of rethinking student orientation to online research or teaching students to write collaboratively using a wiki, involves embracing innovation—walking, running, or even falling into the unknown. It means either trying something that one has never tried before or perhaps trying something that no one else has tried before. Ultimately, grazing in and thereby sustaining a cyber commons involves maximizing innovation, the degree of which depends on individual users. Individuals have different comfort levels with innovation, so it stands to reason that they have different comfort levels with digital ecologies and that the movement of innovation through an institution—and thus its ability to sustain a digital ecology—depends in part on each individual's orientation to innovation, which may present formidable limits.

Everett Rogers' (1995) theory of innovation diffusion offers a way of understanding one element of human limits confronting digital ecologists. According to Rogers, innovation diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). Such innovation, as Michele Jacobsen (1997) pointed out, depends on the degree of and the relation to time of that particular innovation: "Because individuals in a social system do not adopt an innovation at the same time, 'innovativeness' is the degree to which an individual is relatively earlier in adopting new ideas than other members of a system" (p. 3). The type of innovation also impacts its degree of diffusion; an innovation such as course-management software, for example, might be more readily adopted and diffused than the integration of student-authored Web pages. But it is important to note that innovation for the mere sake of innovation is not what sustains a digital commons: rather, communication is the sustaining factor. And, although Rogers' theory has been used to interpret practices ranging from the adoption of farm equipment to instructional technology, it is, at its core, a theory of communication—in particular, communication among various categories of adaptors: early adopters, early majority users, late majority users, and laggards.

Rogers' (1995) taxonomy, like all taxonomies, is most beneficial if it is used to promote communication and understanding rather than static boundary construction or blame. For example, while the laggards (who appear to reject innovation entirely) could be viewed as a threat to a commons because they do not engage with it, they might also be viewed as valuable sources of information and understanding. The seeming limits to the sustenance posed by these individuals can be recast as opportunities to practice Wayne Booth and Peter Elbows' (2005) "rhetoric of assent"—opportunities to "find moments of genuine listening that do not naively surrender" (p. 386). Individuals have many reasons for rejecting technology, but until we listen to their objections we cannot know what those reasons are, nor can we appropriately address or negotiate them. Additionally, laggards can provide valuable insight into the reluctance of other users—perhaps they fear what a technical failure might do to a particular class lesson or they fear that posting student writing to the world through blogs would invite criticism of student work and consequently of their teaching. But until we listen to them, we cannot know.

Components of Participation in the Digital Commons

As Heidi Grunwald (2002) argued, Rogers' (1995) model of diffusion, though contested in some ways, has been commonly used as an explanatory construct in understanding—and, to a lesser extent, predicting—the extent to which faculty in higher education adopt instructional technologies. In addition to an individual's technological personality, the context of the technology itself will limit (or enhance) the digital commons. Rogers has identified five components of the technological context that impact the extent to which faculty adopt a particular technology: "relative advantage, compatibility, complexity, trialability and observability" (Grunwald, p. 22).

Relative Advantage

The relative advantage of instructional technology is the degree to which it is perceived as being an improvement over the pedagogy preceding it; *perceived* is crucial here. Some faculty have reacted against the promotion of cyberspace rather than against cyberspace itself. Andrew Ross (1994), for example, criticized an "Information Age boosterism" that seemingly offers no advantage whatsoever. Ross is representative of at least one form of resistance to digital ecologies when he asks,

> who really needs to be in the constant state of bounteous hypercommunication promised by all the ads? The blessed-out invitations to venture into cyberspace carry an undertow of retribution for those rash or obstinate enough to decline the Info Love Boat. Refuse this abundance and you will be perceived as obsolete: a citizen with no information access. (p. 273)

For Ross, commercial representations of cyberspace offer more peril than promise. At the same time, however, educational representations of technology may be more successful in explaining relative advantages. Course-management software, such as WebCT and Blackboard, for example, succeeds in contexts in which it is perceived as an improvement over previous practices. For some faculty, such improvements might be relegated to the software's ability to make course documents accessible to students—an improvement over hard-copy accessibility, which required students to carry materials with them (as opposed to being able to access them from any networked computer) and which made the replacement of lost materials more complicated for instructor and student alike. For faculty who had designed their own course Web pages, such software might not be an improvement, and might, for instance, provide them with fewer choices about the ways in which they make material available to their students.

Compatibility

The compatibility element of technology addresses the extent to which technology "is consistent with present values, past experiences or needs" (Grunwald, 2002, p. 22). Humanists who identify themselves with social justice issues may feel that technology has little, if anything, in common with their values as educators or with the overall mission of their institution. They may be unaware of the digital divide (Compaine, 2001; Norris, 2001) separating social classes and races, and that their technologically anchored pedagogy provides a means of narrowing the gap between those who are familiar with digital technologies (usually white and affluent) and those who are not (often people of color from lower-income households). However, humanists who rejects technology because of its incompatibility with their social justice values may actually be doing a disservice to the very

students whose access to power they wish to increase. In these instances, the role of the digital ecologist may be to identify and explain the social limits placed on technological access to the individual who rejects technology out of hand. It is conceivable that the limit to the digital commons in this instance—an assumed incompatibility with social justice values—might be challenged by explaining that implementing educational technologies help to break down certain social inequities. It might also be helpful to provide instances in which digital technologies are helping to perpetuate democratic values.

It is also possible that educational technologies will be rejected for being incompatible with a humanist mission if they are perceived to diminish human expression or individual choice. As Nardi and O'Day (1999) explained, the "rhetoric of inevitability" that characterizes so many technological discussions forms a limit to its adoption and an impairment of agency in how that adoption happens: "We are concerned about the ascendance of a rhetoric of inevitability that limits our thinking about how we should shape the use of technology in our society" (p. 17). The idea that computers and digital life have arrived and are here to stay is an intimidating one that can disempower those who most need to be brought into the commons. In an interesting twist, this rhetoric of inevitability can be considered in terms of the discourse of limitlessness—that is, the ubiquity of technological advance means that it has no limits. It is unstoppable. Although the "limitless" potential of technology is a positive value for some, for others, "limitlessness" conjures images of conquest and subjugation.

Historically, the rhetoric of limitlessness has played a significant role in expansion and domination narratives—think of the notion of a vast and seemingly limitless frontier and images of expansion and conquest (Slotkin, 1985). Quite possibly, the narratives surrounding cyber expansion evoke similarly negative images of domination and control—values incompatible with the democratic objectives of education. Digital ecologists need to address this very real concern as they seek to sustain the cyber commons. It is quite possible that some virulent resistance is borne out of a reaction against the threat of being left behind and of being excluded. Luddite/technophile dichotomies have been well-documented, but this polarization, particularly for those seeking to sustain digital ecologies, can lead only to the "culture of blame" that Richard Selfe (2005) enjoined us to avoid. Arguing, for example, that faculty should adopt a particular technology because technology is everywhere or because it can do "anything" may actually diminish faculty's capacity to conceive of how technology can be used to perpetuate democratic values.

Complexity

A third element identified by Rogers as impacting faculty use of technology involves its complexity. As Grunwald (2002) observed, complexity refers to "how difficult a technology is to use and understand" (p. 22). Digital ecologists can address this limit to the digital commons by reducing technological complexity for those who are uncomfortable with it. Wheaton College's Web Director, David Caldwell (2007), who has spent decades helping individuals overcome various limits, noted that "academics are not particularly adventurous types." At Wheaton College, Caldwell's solution was to recognize faculty's limited comfort level using technologies and then to wait for demand to "bubble up." The demand, in this case, was for the kinds of objectives achieved by course-management software: "We had faculty using distribution lists, threaded discussions and e-discussions with no consistency." Once the demand was clearer, Caldwell was able to advocate for Blackboard and Frontier, a software that provides a template for creating Web pages. Here the faculty's limited ability and comfort level with technology was not an obstacle to contributing to the commons, but was instead a point of entry into it. There was a kind of tradeoff in this instance between limited functionality and

accessibility, but in this instance the trade-off allowed for a greater diffusion of the technology. Faculty and staff had a springboard from which to innovate.[5]

Trialability and Observation

"Trialability," is another of Rogers' key concepts and refers to the fact that individuals are more likely to adopt technology when they are encouraged to test it. A limit to the extent to which faculty can test-run something is a limit to its adoption. A college that receives grant funding to support technology-enhanced teaching, for example, would do well to build ongoing workshops for experimentation. Rather than describing their successes and/or failures incorporating technology into their classrooms, the individual grant recipients might encourage colleagues to try out particular software in workshops. Such workshops permit the novice to experiment, slip, and even fall in a low-risk setting. The same experimentation and play that we encourage writing students to engage in should be used in sustaining the digital commons.

A fifth component of Rogers' innovation taxonomy pertains to the degree to which faculty can observe the technology at work. Faculty are more likely to adopt a technology if they can see the results of their work. Increasing such visibility includes practices such as encouraging faculty to request short reflective pieces from students about the technology; featuring work with technology in newsletters, announcements, and on Web sites[6]; and even using technological experimentation as a factor in tenure and promotion are all potential ways of making work visible.

Social Limits to the Digital Commons

Although Rogers' (1995) theory of innovation diffusion provides us with insight into how the digital commons may be limited through individual resistance to technological innovation, existing social structures may also provide limits that impede the commons. This next section argues that, in addition to working with and through individual limits, digital ecologists also need to address potential social limits to what they might achieve. These social limits also present opportunities for re-thinking, re-forming, and reengaging our educational mission and, in some cases, for remaking some tacit social divisions.

Henry Jenkins and David Thorburn (2004) have successfully drawn on the work of Raymond Williams to argue that electronic environments do not radically alter social contexts but instead emphasize existing tensions:

> the introduction of a new medium will engender debate about political culture but cannot by itself significantly alter the society in which it appears. Instead, the new medium generates an extended negotiation or contestation among

[5] Since then, Wheaton's digital ecologists, led by Scott Hamlin, have been able to design a pilot using Moodle, an open-source course-management software, for approximately eight faculty and their information technology liaisons. With backgrounds in a simpler technology (Blackboard) and knowledgeable support personnel, the pilot faculty are ready to work with a more complex technology.

[6] Organizations such as NERCOMP and Educause feature numerous activities for making this kind of work visible. Journals such as *Computers and Composition* and *Kairos: A Journal of Rhetoric, Technology, and Pedagogy* provide additional fora, as do electronic discussion groups like RhetNet-L and blogs such as Interversity.org.

> competing forces—some emergent, some well-established; some encouraging change, others resisting it; some publicly visible, others operating covertly (p. 5).

With an educational digital commons, such tensions generally emerge over curriculum—what students should be learning and how. A composition instructor who receives grant money to infuse a writing course with technology may very well find herself confronting what Fred Kemp (2005) described as the "aesthetic anvil" of traditional English departments. Bringing digital technologies to her class may actually bring to the fore long-standing debates about the teaching of "English"— to what extent it should conserve and preserve all that is good and true about English literature, and to what extent it should progress, consider new forms, and interrogate new modes of communication. As she moves ahead with her efforts, the digital ecologist may do well to engage her colleagues in what they value in student learning—that is, what their collective goals for students should be. This particular limit to the digital commons—what Kemp argued is a centuries-old disciplinary resistance to innovation—may also provide a much-needed opportunity for discussion, dissensus, and debate.

In advocating for an environmentally sustainable pedagogy, Owens (2001) noted that "a sustainable society cannot be created without sustainability-conscious curricula" (p.27). To sustain a digital commons thoroughly, institutions of higher education need to change their curriculum—by altering general education requirements, by changing requirements for majors, and by reconceptualizing new majors. Without reform, curriculum constitutes a negative limit to the digital commons and an impediment to innovation. Digital ecologists should devote some of their efforts to working with colleagues to overcome individual limits or resistance to technology, but they cannot ignore the power of structural elements to their work.

THE COMPLEX INTERCONNECTEDNESS OF DIGITAL ECOLOGIES

Given the proliferation of an electronic consumer culture emphasizing acquisition and immediacy, it is tempting for educators to become caught in a mad, monolithic rush of expansion: more bandwidth, more computers, bigger facilities. But digital ecologies are based on a complex interconnectedness of computer networks, of personnel, of shared ideas, and of access to information. If we extend Lawrence Lessig's (2001) construction of the digital commons to digital ecologies that depend on innovation rather than competition for sustenance, we can consider the obstacles to such sustenance more fruitfully. Digital ecologists become keepers of their own innovation commons and in so doing are obligated to recognize the dual role limits play. When deployed in the interest of increasing accessibility and democratizing the digital commons, some limits (such as those allowing only certain kinds of use on public computers) maximize the educational opportunities available to students. Other limits, which restrict creativity and communication (such as blanketly prohibiting certain acts of composing and sharing on public computers)—which are usually grounded in issues of property and ownership—threaten the commons.

Still other limits, such as faculty resistance to adopting technologies, need to be broken down into constituent factors. All entries into the digital commons involve forays into innovation. Limits to innovation, then, are potential obstacles to the sustenance of the digital commons. Rogers' work—which identifies relative advantage, compatibility, complexity, trialability, and observability as key factors impacting faculty adoption of technology—provides key points of entry for digital ecologists wishing to develop dialogue in, around and about the digital commons.

In a postmodern arena characterized by surveillance and commodification, it is easy to see the potential dangers of limits—threats to freedom of speech, the exchange of information,

and the ability to experiment. When used to consolidate ownership and power, and thereby to prevent access to information and understanding, limits diminish a digital commons. Conversely, limits placed in the interest of stewardship—of maximizing access to the available technological resources—will protect the commons. Limits at the material level are based in resources: rooms, spaces, and even labor that has been commodified. Where resources are scarce, digital ecologists may indeed need to place limits to ensure that the broadest spectrum of individuals have the best possible access.

At the same time, a different kind of approach for ideational limits is warranted. The psychological propensities that lead some to embrace technology wholeheartedly while others reject it with equal passion need not be seen as obstacles. Rather, if we choose to group individuals along the innovation taxonomy developed by Rogers, it is quite possible that the limits become opportunities for dialogue and for genuine insight and understanding into why particular educational technologies will not work for some individuals. Listening to the most resistant individuals may provide ways for us to modify our practices and our positions to reach positions that are neither dogmatic nor skeptical but instead formed in the best possible space of critical thought.

In the case of socio-cultural limits that reduce access, digital ecologists may work best by naming and unmasking these limits, repeatedly demonstrating that supporting and sustaining the commons provides a way to address larger social inequities. By extension, failing to sustain the commons may mean that entry is left increasingly to those who already have the greatest and easiest access to power and privilege. The largest potential limit to digital commons everywhere lies in the risk of perpetuating social inequities. As cyberspace plays an ever-expanding role in who has access to information—and, ultimately, knowledge—those with the greatest and easiest entry to cyberspace will also be those with the greatest power. Their lives will at once be the most mutable, in the ways they are able to adopt cyber identities that tap into the most extensive storehouses of human understanding, and also the most enduring, in the ways they are able to write themselves into digitized memories and electronic history. Those without such access, those at the borders of cyberspace, may very well disappear. The digital ecologists who recognize such limits for their inequity and their constructedness already have access to the cyber commons even as they make it. They have the opportunity, then, to shape the commons in their own images: open, curious, diverse, and democratic. We can ask no more, nor can we commit the injustice of asking less.

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