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Infrastructure and Composing: The *When* of New-Media Writing

New-media writing exerts pressure in ways that writing instruction typically has not. In this article, we map the infrastructural dynamics that support—or disrupt—new-media writing instruction, drawing from a multimedia writing course taught at our institution. An infrastructural framework provides a robust tool for writing teachers to navigate and negotiate the institutional complexities that shape new-media writing and offers composers a path through which to navigate the systems within and across which they work. Further, an infrastructural framework focused on the *when* of new-media composing creates space for reflection and change within institutional structures and networks.

Rebecca Leibing's digital composition "Sunoco" (Figure 1)—available as a QuickTime movie at the URL above—was created in the beginning weeks of a multimedia writing course; her composition is a digital movie composed from a rather traditional personal narrative essay about her first job at a gas station. Rebecca drew and colored a collection of still images, set them to a digital recording of her reading her paper, and contextualized the combination of images and voice with digital music clips. These media were then tracked to-

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gether, with the addition of transitions and image pans, using digital video software. To create this piece, she used equipment (software and hardware), technical support, instruction, and different media choices—framed by decisions about color, texture, appeal, and other variables—to fuse what have traditionally been discrete media. Rebecca's composition could be remarked upon as a product in itself—it is funny, smart, and well-written. Certainly, many in the field of composition and rhetoric would choose to focus the analytical lens on this product of new media and for good reasons. However, what is remarkable to us about Rebecca's piece is the story behind its composition, which is revealing of a moment in time, space, institutional relations, and seemingly insurmountable obstacles.

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Many researchers pay attention to the what and why of new media without paying attention to the *when* of new-media composing. For example, scholars have done important work that examines the blend of visual and verbal elements in the surfaces and structures of new-media compositions (e.g., Allen; Anson; Bernhardt, "Designing" and "Shape"; DeWitt; George; Handa; Hocks, "Feminist" and "Understanding"; Hocks and Kendrick; Kress "English" and



Fig. 1. From "Sunoco," by Rebecca Leibing, a digital composition available at <http://www.wide.msu.edu/cc>

“Visual”; Markel; Ruszkiewicz; Sirc; Ulmer; Wysocki and Johnson-Eilola).¹ All of these scholars have in common their focus on new-media writing products, an important topic to be sure. However, few offer frameworks for understanding the spaces for and practices of composing in contemporary, technology-mediated ways. To this growing conversation about new-media composing, we would like to add a focus on the institutional and political arrangements that—typically invisibly—allow these new-media products to emerge in the first place.

In this essay we focus on the institutional infrastructures and cultural contexts necessary to support teaching students to compose with new media.² These often invisible structures make possible and limit, shape and con-

We argue that infrastructures are absolutely necessary for writing teachers and their students to understand if we hope to enact the possibilities offered by new-media composing.

strain, influence and penetrate all acts of composing new media in writing classes. Although these structural aspects of teaching new media might easily be dismissed as mere inconvenience when they break down or rupture entirely, they are, in fact, deeply embedded in the acts of digital-media composing. We argue that infrastructures are absolutely necessary for writing teachers and their students to understand if we hope to enact the possibilities offered by new-media composing.

Writing within digital spaces occurs within a matrix of local and more global policies, standards, and practices. These variables often emerge as visible and at times invisible statements about what types of work are possible and valuable (encoded, often, in curricula, assessment guidelines, standards, and policies). Some of these issues need the attention of teachers and of program administrators, but we would be miseducating student writers if we didn't teach them that these issues—that which we can too easily dismiss as “constraints”—are indeed deeply embedded in the decision-making processes of writing. If students are to be effective and critical new-media composers, they should be equipped with ways in which they can consider and push at practices and standards in strategic ways.

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While the analytical lens that focuses on the *when* of new media keeps in focus the materiality of such media (e.g., the software, wires, and machines), it also brings to light the often invisible issues of policy, definition, and ideology. Indeed, the concept of infrastructure itself demands an integrative analysis of these visible and invisible issues; separations of these issues cannot persist if writing teachers are truly interested in making an impact in both how new

media develop and how pedagogies and theories of multimedia composing come into being. We know many people, including ourselves, who have been prevented from working in certain ways as teachers and writers because it was infrastructurally impossible in a given context. Not intellectually impossible. Not even strictly technologically impossible. Something deeper.

Here we adapt Susan Leigh Star and Karen Ruhleder's definition of infrastructure to help us make visible the story behind Rebecca's digital composition. This infrastructural framework allows us to account for any number of "breakdowns" (cognitive, rhetorical, procedural, technical, and so on), to establish the importance of communities of practice, and perhaps most important of all, to focus our attention on the presence and operations of standards and classifications, which lean heavily on all writing practices—and on new-media practices in particular. An infrastructural analysis of the spaces and practices of composing new media gets at some basic and powerful issues with respect to new-media composing: the ways in which new-media writing becomes defined, shaped, accepted, rejected, or some combination of all of these (and more); who gets to do new media; who gets to learn it, where, and how; and what values get attached to this work (and to its writers and audiences). In these ways, we will show that analyzing the when of new-media composing is as important as analyzing the what and why of new-media composing.

Writing in digital environments, writing with multiple sign systems

We are interested in ways of understanding the contexts of new-media writing because our own experiences suggest that writing with multiple sign systems within technology-mediated environments pushes on systems and established ways of working with a pressure that other ways of writing don't exert.³ Many of the writing teachers we work with indicate an interest in developing teaching practices that better attend to visual rhetorics and multimedia writing, but these teachers also voice the concern that such teaching is impossible because of the institutional resources currently available to them. This recognition of institutional and technological limitations suggests the need for analytical tools that might help us account for the contexts of new-media writing in ways that enable students and teachers to achieve what they can imagine in and for the composition classroom. But how best to account for the contexts of new-media composing?

Although previous scholars have not adopted the specific language we have here (i.e., "infrastructure"), computers and writing researchers have long

paid attention to issues of digital writing environments. Teachers of writing in computer-mediated spaces have been attentive to the spaces in which they teach, and to the physical and digital spaces in which students work; for twenty years, composition scholars have published on possibilities and complications related to teaching in computer-mediated settings (for example, in technology classrooms: Bernhardt, “Designing” and “Shape”; Britton and Glynn; Dinan, Gagnon, and Taylor; Gruber; Haas; Kent-Drury; Moran, “Access” and “From”; Palmquist; Palmquist, Kiefer, Hartvigsen, and Godlew; Selfe, *Creating*, “Creating,” and “Technology”; with/in electronic spaces like e-mail, bulletin board systems, and MOOs/MUDs: Cooper; Cooper and Selfe; Grigar; Holdstein; Kinkead; LeCourt; Moran and Hawisher; Rouzie; Sanchez; Spooner and Yancey; Thompson; and via distance- and online-education spaces: Buckley; Harris and Wambeam; Webb Peterson and Savenye).

Compositionists have also attended to issues of agency and subjectivity in regard to digital media and online spaces. For instance, Stephen Knadler, Heidi McKee, Teresa Redd, Elaine Richardson, Todd Taylor, and others have addressed issues of race and difference in digital spaces, both from an instructor standpoint and from a student perspective. A strong thread of composition scholarship has explored issues of gender in digital space, attending to the male-centered context of computing and to possible feminist interventions in electronic spaces (e.g., Brady Aschauer; Hocks, “Feminist”; Pagnucci and Mauriello; Rickly; L. Sullivan; Takayoshi, “Building” and “Complicated”; Takayoshi, Huot, and Huot; Webb; Wolfe). Access—an issue that often manifests itself at intersections of gender, class, and race—has also been addressed as an issue crucial to computers and composition scholarship. Jeffrey Grabill and Alison Regan and John Zuern have targeted issues of access by exploring the movement of computer-mediated composition outside of the classroom and into communities. Lester Faigley, Joseph Janangelo, Charles Moran, and Cynthia Selfe have studied issues of access and traced access across cultural, social, and historical trends.

New technologies have raised questions not only about manifestations of race and gender in the “bodiless” realm of cyberspace and about the real issues of access to machines and networks, but new technologies have also raised speculation about emergent and electronic literacy practices (see, for example, Bolter; Burbules; Heba; Holdstein and Selfe; Joyce; Selfe, “Technology and Literacy”; Tuman). Closely related is scholarship analyzing how specific interfaces potentially shape writing practices and processes (e.g., Condon; Curtis; “Forum”; LeBlanc; McGee and Ericsson; Selfe and Selfe; P. Sullivan;

Vernon; Wysocki, “Impossibly” and “Monitoring”; Wysocki and Jasken); certainly, text messaging, blogs, and wikis are shaping research paths related to interfaces of/for writing. Framing all this work are examinations of institutional and political dynamics as they affect writing classrooms via, for example, policies, guidelines, and intellectual property laws (Gurak and Johnson-Eilola; Howard; Johnson-Eilola, “Living”; Kalmbach; Lang, Walker, and Dorwick; Porter, “Liberal” and *Rhetorical Ethics*; Porter, Sullivan, Blythe, Grabill, and Miles; CCCC Committee). These contributions are significant, and help situate composition scholars within emerging—and existing—issues of visual and digital rhetorics and possibilities for new-media production, or at least analysis. Specifically, these contributions help us to better understand the ways that composition researchers have made sense of past and current integrations of technology and writing.

Although the composition scholars mentioned above have noted the increasing prominence given to visual communication, online writing, and digital spaces, and although researchers are paying more attention to the blend of visual and verbal elements, few offer frameworks for understanding the spaces for and practices of composing new media. Issues such as the standards and policies of network use and the institutional locations of new-media curricula still remain invisible—and these issues

are integral to understanding and enabling new-media composing. Here we attempt to make visible these and some of the other dynamics of new-media writing. An infrastructural framework helps

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not only to reveal these dynamics and their consequences, but also to identify access points for discursive agency and change-making within institutions. As an analytical framework, then, an understanding of infrastructure makes strange the taken-for-granted, often invisible, institutional structures implicit in the teaching of new-media composing. In the remainder of the essay, we’ll outline this framework and apply it to the new-media writing class in which Rebecca’s piece was produced. We demonstrate the utility of an infrastructural framework for writing teachers who hope to uncover the deeply embedded institutional, cultural, and political issues involved in teaching new media.

Infrastructure as analytical tool

When teachers express frustration with their ability to teach new-media writing, they often point toward specific and often physical infrastructural im-

pediments—computers, software, and networks. An infrastructure of a computer lab certainly would include its server and network system, the machines and their monitors, and the wiring within the room. However, there is something more complex going on in any composing context—both in terms of what frustrates teachers and in terms of how we understand infrastructure itself. If we expand our notion of infrastructure, we would include the policies and standards that regulate the uses of the room. We would also include systems of support for the work that takes place in the room, and the budget and funding (and related decisions) for the material objects in the room. We would include structures for surveillance within the room and within the spaces to which the machines allow access (e.g., the security cameras found in many of the computer labs on our campus; the student tracking function in course-management software that allows teachers to see how often students have accessed a course site and what areas of the course site they have visited). We would consider the tasks and practices that occur within the room—how the material objects are used, to what end, and for what audiences. Our use of the term “infrastructure” reflects the work of Star and Ruhleder, who characterize infrastructure in the following way:

- *Embeddedness*. Infrastructure is “sunk” into, inside of, other structures, social arrangements and technologies;
- *Transparency*. Infrastructure is transparent to use, in the sense that it does not have to be reinvented each time or assembled for each task, but it invisibly supports those tasks;
- *Reach or scope*. This may be either spatial or temporal—infrastructure has reach beyond a single event or one-site practice;
- *Learned as part of membership*. The taken-for-grantedness of artifacts and organizational arrangements is a *sine qua non* of membership in a community of practice [. . .]. Strangers and outsiders encounter infrastructure as a target object to be learned about. New participants acquire a naturalized familiarity with its objects as they become members;
- *Links with conventions of practice*. Infrastructure both shapes and is shaped by the conventions of a community of practice; e.g., the ways that cycles of day-night work are affected by and affect electrical power rates and needs. Generations of typists have learned the QWERTY

keyboard; its limitations are inherited by the computer keyboard and thence by the design of today's computer furniture [. . .];

- *Embodiment of standards.* Modified by scope and often by conflicting conventions, infrastructure takes on transparency by plugging into other infrastructures and tools in a standardized fashion;
- *Built on an installed base.* Infrastructure does not grow *de novo*; it wrestles with the "inertia of the installed base" and inherits strengths and limitations from that base [. . .];
- *Becomes visible upon breakdown.* The normally invisible quality of working infrastructure becomes visible when it breaks; the server is down, the bridge washes out, there is a power blackout. Even when there are back-up mechanisms or procedures, their existence further highlights the now-visible infrastructure. (113)

If we think of the composing infrastructure on our own campus in these terms, we come up with the following list of infrastructural components:

- computer networks
- network configurations
- operating systems, computer programs, interfaces, and their interrelatedness
- network, server, and storage access rights and privileges
- courses and curricula
- the existence and availability of computer classrooms
- decision-making processes and procedures for who gets access to computer classrooms
- the design and arrangement of computer classrooms
- time periods of classes
- availability of faculty, students, and spaces outside of set and scheduled class times
- writing classifications and standards (e.g., what is writing; what is good writing)

- metaphors of computer programs; metaphors people use to describe programs; metaphors people use to describe their composing processes
- purposes and uses of new-media work
- audiences for new-media work, both inside and outside the university

This list is far from exhaustive, but provides a sense, at least, of the sorts of elements and issues an infrastructural framework can make visible. But there is much more to an infrastructure than what is material or technological. Our list includes standards and classifications—most powerfully what counts as writing, what is permissible in a writing class, and what makes for “good” writing. Infrastructure also entails decision-making processes and the values and power relationships enacted by those processes, and infrastructure is thoroughly penetrated by issues of culture and identity (in ways that space limits prevent us from exploring here). *All* writing activities are contextualized by certain infrastructures; our aim here is to argue for the importance of understanding the distinctive infrastructural dynamics that new-media composing creates as well as the ways that such composing is dependent on infrastructural dynamics that may not be configured to accommodate traditional writing activities.

As an analytical tool, Star and Ruhleder’s characteristics of infrastructure have significant scope and heuristic value. However, we don’t want the focus of this discussion merely to settle on issues of defining an infrastructure. The most useful question, as Star and Ruhleder assert, may not be *what* an infrastructure is but rather *when* it is. Working from a piece by Yrjö Engeström

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that asks “When is a tool?” Star and Ruhleder argue that “infrastructure is something that emerges for people in practice, connected to activities and structures” (112). In other words, a tool is not an artifact with “pre-given attributes frozen in time,” but rather is given meaning *as* a tool by specific users working on particular problems in specific situations (see also Feenberg; Johnson[Latour]); so too does the meaning and value of an infrastructure emerge. That is, an infrastructure

is more than material, is never static, and is always emerging. We want to suggest that writing programs will never adequately come to terms with how to understand and teach new-media composing unless we can come to a productive and activist understanding of infrastructure. For students, understand-

ing infrastructural constraints on new-media composing offers important grounding in the kinds of decisions that influence the possibilities, processes, and final deliverables of their digital writing. Such an understanding will allow students and professors to anticipate and participate in a number of institutional processes that shape infrastructure and so shape how we teach new-media composing.

In what follows, taking Ellen's multimedia writing class as a source of data, we use the notion of infrastructure as a heuristic for reading our local contexts. We focus on when new-media infrastructures emerge and what the dynamics of infrastructure mean for composing in those contexts. Thus, we demonstrate how writing instructors might apply this framework to their classroom and institutional contexts. The material we use here to situate our explanations of an infrastructural approach to writing was collected in a multimedia writing class taught at Michigan State University (MSU). Interested in studying new-media composing processes and the teaching of multimedia writing, Ellen collected student work and also saved the many correspondences to administrators and computing services specialists, the class notes generated on the Blackboard space used for the course, and archives of virtual chats that took place in class.⁴ These materials will be excerpted throughout to help us address the larger questions we ponder in this manuscript: What material, technical, discursive, institutional, and cultural conditions prohibit and enable writing with multiple media?⁵ How does an infrastructural approach offer a lens through which we can better interpret and understand the multiple conditions at play in our writing classrooms? How can an infrastructural interpretation support and enable new-media writing?

File management and standards: Thinking about products before processes

Ellen's multimedia writing class allows us to see the structures, technologies, and decisions that teachers and writers navigate. Questions at the forefront of writing with multiple media emerge as soon as the software launches and the interface expands, questions that force writers to consider the material and rhetorical realities in which they will compose and through which their final products will be produced and viewed. For example, before digital video software opens to an interface for composing, a window prompts composers for their project settings. As with writing, the composer must know something about what the final product will be *before* beginning the process. However, in the case of composing a multimedia video product, the writer must also know

what kinds of files will be needed and created to meet the demands of the final product—including types of files and media (e.g., chunks of text, images) and specific forms of files and media (e.g., a voice file saved as a .wav, images saved as .jpgs).

The writer, in the case of fairly robust video software like Adobe Premiere, must also have a sense of how the software is installed and runs on the computer and on the networks within which the user composes. Questions the composer must address include: What should the final product look like on screen (e.g., size of viewers' monitors and viewing windows)? What level of sound quality is expected (e.g., mono, stereo, 8 or 16 bits)? How is this product to be delivered (e.g., VHS, CD, online)? How much memory is available and where in the classroom? How much memory is available on the audience's computers? How will the audience members access this project? These questions—and this is but a very short list of the initial considerations a composer of new media must address—work at both the material and the rhetorical level in ways quite different than traditional writing classrooms might (that is, those that rely primarily on text and paper). Addressing these questions before composing even begins not only affects the writing processes of students, but also deeply affects the set-up and delivery of instruction.

In the case of Ellen's multimedia writing class, answers to these questions began with the file-management system on our campus. File-management issues arose before students even entered the class on the first day, and brought to the forefront institutional limitations that influenced the type, quality, and extent of learning that could take place in the class. The general structure of instructional computing on campus works somewhat like this: The campus computing protocol is to load all software from a main server when a user logs on to a campus computer; the rationale for this is related mainly to security and virus-protection measures. Thus little software is installed on and loaded from the local drives of computers—each time students launch a software application, they do so from a remote server. Writing with multiple media and writing within robust multimedia applications like Premiere or Macromedia Director violates this common network structure in various ways. First, because digital video software does not work well when virtual memory is engaged—and virtual memory is always engaged at MSU because individual users do not have the access required to change the control panel settings on the computers—the software will crash. Also, when a student logs off of a machine—or if a machine happens to crash and then reboot while the student

is working—all of the student's preview files are lost because the files are stored in a folder on the local disk, which is erased from the computer each time a user logs off or the machine restarts. Although the student is relying upon a remotely networked software application, the work students create is actually stored locally (and thus wiped out—deleted—upon restart).

Long before the semester began, Ellen realized that this network structure would influence the work for her class. She thus requested a meeting with the staff member who acts as liaison between instructors and the centralized campus computing facilities. During the meeting, Ellen described her needs for the class and the types of projects students would be composing during the semester (three in all, becoming sequentially more complex, with a final product of a digital portfolio on CD). She described the kinds of files associated with student projects: the project file (command file); the tracked files (e.g., images, voiceovers, music); the preview files (compressed motion and audio files created when the command file is executed and stored locally); and the final project, typically a 200- to 300-megabyte .mov file. The immediate response of the liaison upon hearing these file types, sizes, and needs was that students absolutely could not write to the local drive of campus machines. She followed up this statement by noting that Ellen would simply have to require fewer assignments and have students produce smaller, nonvideo, projects. She made suggestions that included students working with still rather than motion images. When Ellen balked at having a computer specialist demand certain teaching methods of her, the liaison argued that MSU computing policy clearly states that students cannot write to the local hard drives because there would be no security—anyone could erase their work. It was at this point in the conversation that Ellen realized that the issue wasn't a memory problem at all, but a *policy* problem. The equipment was available for use, but the computers were to be kept clean and safe from the apparently untrustworthy students. At the end of the meeting, Ellen was told that students would absolutely have to save their work to the campus server, that under no circumstances would students be able to save their work to the local computers, and that Ellen would be lucky to get an additional gigabyte of storage space for student projects.

In Ellen's class, the standards for file management established by the university and standards for system operation within the software itself were at

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odds. The university's standard operating procedure prohibited allowing students to save to local hard disks, but the software standards demanded that files be saved to local hard disks to facilitate the retrieval and compression process among the project file, dependent files, and preview files.

We approach standards from two directions: First, standards can be thought of as the typical approaches that people take as they perform a task; there are "standard" or conventional ways of accessing a network, launching software, and saving files. Second, standards can be thought of as Bowker and Star do: as procedures for how do to things (234). Although these two definitions might seem much the same, and although they do orbit around each other, they are, in fact, quite different. For example, a procedure might dictate an acceptable or appropriate use (e.g., via an "acceptable-use policy" that regulates a particular network); however, the conventions of practice that emerge among users as they work within the system might differ from and even work against established procedures. Users, in this case writers, invent standards as much as they follow them. Clearly, networks—technological and otherwise—are complex systems of interconnected human beings and machines, and because of the complexity of networks, normally transparent issues (e.g., file management, the operation of programs, and so on) become visible when different standards of operation compete.

On our campus, acting through/with/against standards means attending to the local standards of the centralized computer system and its multiple paths of decision-making power and practices, and paying attention to the larger network standards of state-based bodies (i.e., Michnet, the statewide network service upon which MSU's networks are built) and national organizations (the CCCC Position Statement on Teaching, Learning, and Assessing Writing in Digital Environments). Too often, because of institutional and disciplinary trends, writing teachers are absent from the histories and development of standards. On campuses where technology budgets are limited, writing is still often seen as a low-technology subject, and writing classes as low-technology spaces. Although few administrators would argue with the fact that most composing takes place on computers, writing courses and the concerns of writing teachers may not be seen as high-priority items during discussions of standards and policies, and during other decision-making processes. Standards—scripted as policies or regulations—often emerge from technology committees and information-system offices. Participating in and perhaps rescripting standards to support new-media writing is an ongoing process.

Encountering and rupturing policies

We will return to this conversation on standards and its infrastructural implications, but first we want to continue to follow the file management pathway—in reality a conflict between local network and more general software standards—to trace how these pathways overdetermine composing practices.

After a writer has addressed the questions we mentioned above related to the production and delivery of a composition, the writer translates the answers to these questions into project settings fixed within the software application being used to compose (see Figure 2 for an example from Premiere). The application is then launched, with a menu bar across the top; a project bin in the upper left; monitors next to the project bin; transition, navigator, and history tools on the right; and a timeline across the bottom of the screen (see Figure 3, again from Premiere). Although each window merits its own summary, the project bin and the timeline windows are perhaps most dependent on careful file management. These two components of the software are powerful meaning-making tools—the project bin is akin to a file cabinet from which the pieces of the project are drawn as needed; the timeline is akin to a com-

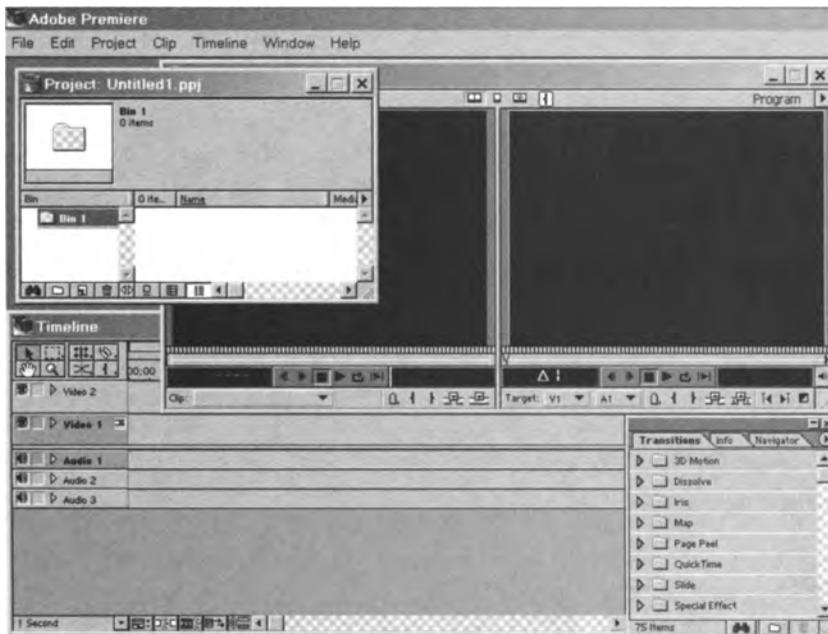


Fig. 2. Screen capture of Adobe Premiere interface

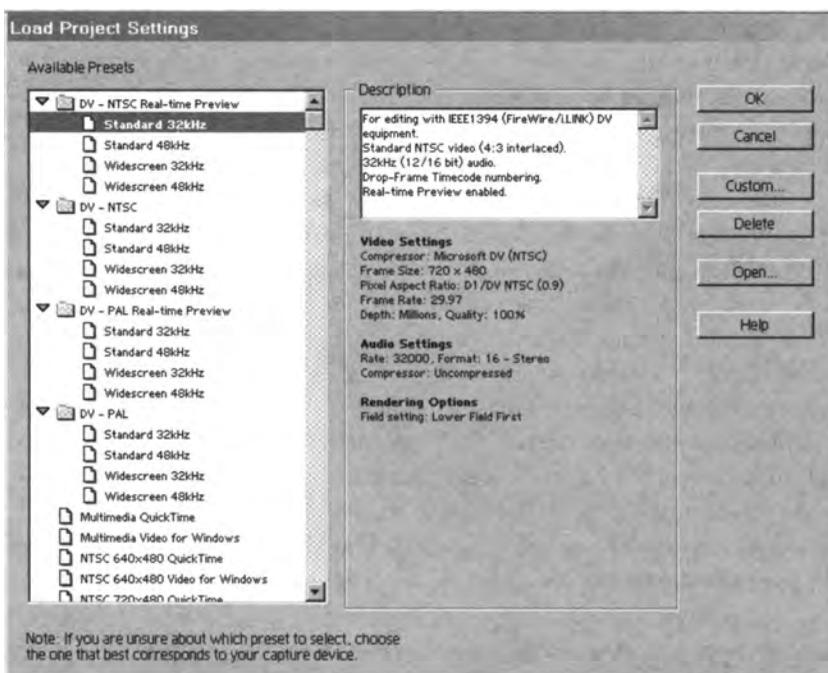


Fig.3. Screen capture of Adobe Premiere project settings interface

mand file (although its graphical interface hides the command language underneath) in which each file from the bin is tracked. The MSU computing policy—an assemblage of classifications, preferences, long-ago-established practices, and standards—hindered not only student access to this composing interface, but the writing they could do within it.

In her conversation with the computing services liaison, Ellen had been told to use specific network space for her class's work; one gig of memory was allocated to this space, for Ellen and for all of the students to share. Ellen's class notes from very early in the semester—January 15, 2002 (the second week of class)—are revealing of the complex routes necessary to access the shared space into which files could be saved:

Locating your server spaces. The icons on your Mac desktop include your own network space, as well as the "root" space for courses. We'll be using both of these spaces to save files this semester. I want you to visualize where you will be saving your files, so that you can better understand the "save as" windows:

1. Click twice on the root-space icon to open the folders there.
2. Go to MSU or MSU.edu (make sure that you consistently stick with one or the other, although I was told that they're essentially the same thing).
3. Go to Course, click twice to open,
4. Go to Eng, click twice to open,
5. Go to 391, click twice to open. Here we will have one gig of space into which we can save. Each of you will create a folder with your last name on it. We will then save all of our project and preview files here in your respective folders.

Although server space for all of the courses offered at the university can be found by following the process detailed above, the courses—hundreds of them offered each semester—do not exist in one space (as the visual folder metaphor suggests). Instead, the memory devoted to a given course is an articulation of parcels of memory distributed across many pieces of hardware across the campus. From a systems perspective, this is efficient. However, the use to which the one gig of space allotted to the multimedia writing class was put by students pushed not only on the technical structure itself, but also on the assumptions and established standards regulating the use of the technical structure.

Once Ellen was made aware of and began to work through the policies and the technological systems in place—which *are* typically highly functional and efficient—and students began using the systems, the software, and the networks in new ways, they broke down. For example, some students were able to create their folders; five students, however, for reasons never explained or understood by the system administrators, were only able to save to their folders sporadically. Other students were not able to save their work at all on the server space. Further, according to the way in which the systems on campus are set up, once the project files were saved to the server space the actual composing could take place. But this didn't prove to be the case. In some sense, our narrative of what Ellen and her students experienced is a commonplace story of writing teachers and technological breakdown. The impression we wish to avoid, however, is that the case we are presenting is *yet another* story of writing teachers struggling with technology. Yes, this is a story of writing teachers struggling with technology, but that is but one thread of a much larger story.

The types of issues commonplace to new-media writing spaces aren't merely issues to be solved by teachers and administrators before classes begin. They are certainly that, but they are also issues that continue to have an impact on the composing practices of writers as a class begins and unfolds, *and*

The writers in Ellen's class had to make a number of "nonwriting" decisions related to audience and the technological and rhetorical needs of that audience (e.g., bandwidth, screen size, media form and function).

they are our discipline's attempts to negotiate, adopt, and script writing with multiple media into its practices. Note the various ways that the writers in Ellen's class had to make a number of "nonwriting" decisions related to audience and the technological and rhetorical needs of that audience (e.g., bandwidth, screen size, media form and function). All of these decisions entered them into different orders of discourse, different grammars and conventions of practice, and different areas of knowledge than would typically be entertained in a writing classroom. Note, too, that the discussions Ellen had with campus computing officials made visible the need for writers to negotiate what is—and what isn't—infrastructurally possible.

Networks dictate how and in what ways certain technological resources are available within any infrastructure; in our case, the networks within which Ellen and the students in her course were composing were split across computer classrooms and across buildings. How fast software downloaded from central servers, where students could save their files, and how quickly students could upload material for rendering and previewing often dictated the shape of composing, and the pace of the course itself. In fact, in work and conversations with central computing, it became clear that we understand networks themselves very differently than they do (not merely technically but socially and ideologically as well).

Networks—locally and universally—are core to new-media writing, enacting the old marketing cliché that the network *is* the computer. In fact, as more writing instruction moves to digital spaces and as the majority of students' writing activity takes place in online environments (e.g., instant messaging, blogging), the paths of the transparent streams of bits and bytes merit attention as part of the *when* of infrastructure. This *when* is acutely felt when students are seen as potential threats to the networks as opposed to users; it's felt when course content, file size, and location are prescribed by networking policies and physical structures that support these. Tracing and understanding network paths through wires, cards, ports, and servers and across the poli-

cies and standards that shape the design and use of such spaces is often necessary to understand complexities and to negotiate new-media writing.

Structures become visible upon breakdown: Locating points for institutional change

Let's return again to the process of composing new media to show one other way that the infrastructural framework helps reveal places to leverage institutional change: Digital video is composed using timelines. When complete, the timeline is essentially a command file that writes "code" based on the icons of the media tracked and on the project settings. The timeline compiles all the separate media files together into preview files typically housed within the software application's local folder on a computer. Preview files are memory-hungry audio and video files that represent a compilation of just a few seconds of the timeline. Preview files are typically created by keying ENTER after every few seconds of timeline tracked, so that composers can, in effect, replay what they've composed, seeing and hearing the rough cut in the monitor window. When compiled along the way, these files are then collected into one large movie project that itself becomes a file saved with the rest of the media files.

Three weeks into Ellen's multimedia writing course, students were expected to have tracked the basic media components of their project timelines. Students had written and revised their papers, collected the other media they were to integrate and choreograph with their texts, and learned the basics of tracking with the software. As they worked, students began running out of memory to store their files; their computers were crashing frequently due to "type 2" errors. Data transfer was stymied or disallowed completely for files over 10 megabytes—very tiny files in multimedia terms. When students tried to compile their projects, their computers froze, and sometimes crashed completely and wouldn't reboot. More often than not, the freezing and crashing corrupted command files, and hours of work were lost. Tensions in class—and after class, as the constraints of time were felt quite acutely when compiling times were long and class time was relatively short—were high. The class came to a complete stop when the first project was due. For whatever reason, Rebecca Leibing's project was the only one the class was able to preview. Like any other writing project, her work required some revision—in this instance, the music she embedded drowned out her voice in places and she needed more motion across the stills to better provide a sense of flow. Rebecca was able to revise her rough cut to create the project from which we've excerpted (see Figure 1). Two other students eventually completed their files as well, but the rest were not

able to complete their projects at all. Because the archive files were completely erased when the computers crashed, students lost their command files—and thus most of their work. Rebecca's project is interesting because it marks the when of infrastructural meltdown: *when* class came to a standstill, *when* her project was anomalously the only one produced, and *when* the typically invisible policy, cultural, and computer system structures became visible upon breakdown.

At this still-early point in the semester, the composing practices of Ellen's students had once again exceeded the technological space of the classroom. Ellen wrote a letter to the vice provost of libraries, computing, and technology (essentially the head of the centralized campus computing systems and the

Ellen wrote a letter to the vice provost of libraries, computing, and technology . . . making a case for additional server/network space for her class and her students' work.

information services director), making a case for additional server/network space for her class and her students' work. She argued for a specific upgrade (from one gig to two gigs), and noted that the class was at an impasse, and that students were prohibited

from writing and producing their digital compositions because of the memory limits of the campus network. Ellen implored the vice provost to bend current university policy and to consider allowing students to have continuous access to the hard drives in a folder saved even after a machine crashes and reboots or a student logs off. If students were able to save directly to a fixed local space, they would be able to save their tracking, project, preview, and final movie files. A key portion of the letter Ellen constructed conveyed her awareness of the fact that her course, new to the College of Arts and Letters and unique in the university, would soon no longer be unique—she emphasized the growing importance of writing in digital environments and writing with multiple media.

In response, the vice provost granted nine gigs of additional storage space. Soon afterwards (approximately six weeks into the class), two system managers visited the class to see firsthand the problems students were experiencing. They walked around the room reading error messages, watching students stall the system with file-transfer bottlenecks, and hearing from students about the problems they were experiencing. The students asked questions of the system managers that began to reveal how they were understanding the when of new media. For instance, when one student wondered why users had differential access to server space, she was told that this had to do with an outdated networking hub that bottlenecked when they tried to save. Another student asked how a type 2 error could occur when, upon checking the information on

the computer, it appeared to have ample memory capacity for the work. Finally, another student asked where the archives were located when they were creating these pieces. The entire class session the day the two system managers visited consisted of students making apparent their learning about what should have been transparent: the ways in which the system and policies for its use were incompatible with their needs as composers and incompatible with the software's requirements. To their credit, the system managers listened and worked to solve the problems; over the following weekend, they carried out some changes that made the environment more friendly and more usable.

The first change that took place soon after the visit included installing some software applications locally on the computers. As we mentioned earlier, university policy prohibited software from being stored locally, but in the case of the multimedia writing course it was imperative that software be locally accessible. With this installation, software freezes abated. Together Ellen and the students walked through the instructions from the system managers that explained how to copy software off the university's server and onto the local computers. In this case, we—Ellen as instructor, Jeff and Dànielle as program faculty, and students in the course—all gained insight as to how a system might be opened in ways that facilitate local use. Students were also allowed to read and write from their local computers, yet another manipulation of university computing policy. These two changes allowed students to compile their second projects with fewer bottlenecks, freezes, and crashes. In addition, the system administrators turned off virtual memory for all of the computers, so that the video software would work much more smoothly, with fewer type 2 errors. One of the system managers who had visited the class emphasized that Ellen needed to warn students that their folders were not secure—that they would be working on the “honor system” as they wrote to the hard disk.⁶ This itself was a significant shift in policy, albeit a temporary and local one. The campus computers were set up so that all student work was erased upon their logout, in part to protect against the spread of viruses, in part so that students could not access one another's files, and in part to protect against the local drives of computers quickly filling with work students stored and never erased. Allowing students to save permanently and locally required that the students adopt conventions regarding privacy and politeness that the campus policy previously restricted students from dealing with and actively participating in.

Allowing students to save permanently and locally required that the students adopt conventions regarding privacy and politeness that the campus policy previously restricted students from dealing with and actively participating in.

After these key changes, the technological spaces of the classroom and of student production worked much more smoothly. In the end, Adrienne Broch finished her second project (see Figure 4), as did all the other students. The course activities were truncated—because of the need to negotiate and renegotiate and then eventually change the systems in place and the policies governing those systems—so that students produced only two projects. Adrienne’s project was in response to a prompt that asked students to select a piece of creative writing and interpret it through a digital composition. Students were asked to show rather than tell their interpretation. Because of the enhanced performance of the software and the new file-management capabilities students had access to, Adrienne was able to take advantage of a variety of media, and a variety of effects.

In her piece, text files—at times multiply layered and scrolling across the screen—appear simultaneously as an image pan moves the view across the still in the opposite direction. Adrienne’s piece, “Der Panther,” is a gruesomely beautiful interpretation of a German poem in light of *The Dreaded Comparison*, a book that traces similarities between the ideologies implicit in animal cruelty and slavery. Her composition suggests the possibilities of new-media composing when the infrastructure enables them.

The *when* of infrastructure

Infrastructures can be transparent in that they do in some sense both preexist *and* work, and so even though infrastructures are always already the conditions in and through which we interact, compose, and think, we often *don’t* need to think about them. In a sense, however, infrastructure needs to be reinvented each time or assembled for each task. Again, the issue is not what an infrastructure is but *when* it is. When the tasks of composing—including the tasks of thinking, of imagining, of creating—are not consistent with existing standards, practices, and values, infrastructure breaks down, revealing the need



Fig. 4. From “Der Panther,” by Adrienne Broch; excerpt of digital composition available at <http://www.wide.msu.edu/ccc>.

to meet the demands of new meaning-making practices. The rupture points, as we've seen from this case, became teachable moments for both the students and Ellen. Both had to learn enough about the interrelations of networks, software, and file management to be able to simply complete assignments. In Ellen's case, a class that had never before been taught at this university introduced new conventions of practice and new forms of meaning making that stressed—in productive ways—the existing infrastructure. The spaces required and composing processes involved *created* a new infrastructure for multimedia writing. It is this time-space-place nexus—the *when* of infrastructure emergence/construction—that we will now explore a bit further.

An infrastructural analysis has helped us understand the composing and learning that took place in Ellen's class and imagine appropriate responses as we rethink courses, writing, and compositions. As Christine Borgman writes, all information infrastructures are “built upon an installed base of telecommunications lines, electrical power grids, and computing technology” (20), and certainly we can read the material aspects of infrastructure in the examples above. Infrastructures are also built upon available “information resources, organizational arrangements, and people's practices in using all these aspects” (20). We also see these elements unfold—and collide—in the writing enabled within Ellen's class. Johndan Johnson-Eilola notes that we live, are composed, and compose “at the nexus connecting an apparently infinite number of social and technological forces of varying weights, strengths, and directions” (“Negative” 17), and certainly the infrastructural dynamics described here create such a nexus.

Within this nexus, students are presented with infrastructural questions as soon as applications like Adobe Premiere are launched. The first few interfaces, shown earlier, demand an understanding of invisible institutional structures and policies, such as those related to permissions to save on networks, file management and architecture, and file size and compression. Before new-media composing can even begin, the software demands that students negotiate an understanding of the deliverables to be produced. These understandings must take into consideration the audiences' system and platform requirements for file formats, memory allocation, and hardware. These infrastructural concerns permeate most networked composing environments including the or-

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ganizations, workplaces, and institutions where students are likely to find employment. The *when* of new media, in other words, can and should be taught to students as part of and integral to new-media composing.

For teachers and administrators, the question of when an infrastructure for multimedia writing emerges has been answered (i.e., *now*) and will always be delayed (i.e., it continues to emerge). Ellen began her first interventions by breaking existing systems and drawing upon personal, rhetorical, and departmental tactics to save her class and to afford merit—technological and intellectual—to her students' work. We continue to work within emerging infrastructures by tailoring our curriculum, designing our requirements, and adopting different practices and assignments. We also continue this work by building new physical spaces (classrooms), arguing for new virtual spaces (new file-management practices), and pushing for changes in both policies and standards. Some infrastructural interventions require seemingly simple revisions to policies or machines that shape the use of a room, a lab, or a network—revisions that alter who can work there, and when, and produce what. We are attracted to these mundane interventions and will assert, despite the ways in which these assertions often bore our colleagues, that these interventions are powerful and important micropolitical acts of institutional critique, agency, and change (Porter, Sullivan, Blythe, Grabill, and Miles). Infrastructural issues have an impact, literally, on the space of the writing classroom and what happens there—and they do so in ways both visible and invisible.

What this brief discussion reveals to us is how situated new-media composing is—how infrastructures of composing both rupture and create possibilities. Rebecca's piece, being the only successful initial project in a classroom of fifteen students, points to the rupture of an infrastructure. Adrienne's piece suggests the possibilities of new-media writing when an infrastructure works: Her piece grew out of multiple revisions and deeper, fuller uses of the technology made available to her as a result of micropolitical changes in network policy and system use. Our own work with exploring and teaching new-media writing has revealed to us the cultural, political, and institutional contexts of composing—so much so that it is no longer possible for us to look at a product of new media without wondering what kinds of material and social realities made it possible. We also have become aware of the need to reach beyond the frameworks that we typically rely upon to understand composing processes and spaces of composing.

To understand the contexts that make possible and limit, shape and constrain, and facilitate and prevent new-media composing, new-media teachers

and students need to be able to account for the complex interrelationships of material, technical, discursive, institutional, and cultural systems. An infrastructural approach reveals the layers and patterns behind the products of new-media composing—patterns that directly affect contemporary writing, writing pedagogy, and writing classrooms. Our claim is that in order to teach and understand new media composing, some understanding of new-media infrastructure is necessary. Without such an understanding, writing teachers and students will fail to anticipate and actively participate in the emergence of such infrastructures, thereby limiting—rhetorically, technically, and institutionally—what is possible for our students to write and learn.

We argued earlier that our field has produced rich work that analyzes the currents of online writing, digital spaces, and media convergence. We also argued, however, that few scholars offer frameworks for understanding the spaces within which such compositions are produced. Here we see that the processes of new media are very much mediated by the dynamics of infrastructures and also that infrastructures might be best thought of as a “when” and not a “what.” An infrastructural framework, we hope, creates a tool for composers to navigate the systems within and across which they work, creates a moment for reflection and change within institutional structures and networks, and creates a framework for understanding writing that moves forward our understandings of how composing and compositions change shape within the complex dynamics of networks.

Notes

1. This work describes how “writing” has changed to weaving what we might call “traditional” (certainly older) media (like text, graphics, and audio) with and for computer interfaces. Characterizing new media as hybrid, for example, Mary E. Hocks and Michelle R. Kendrick (following the work of Bruno Latour) ask us to move beyond static binaries that separate visual/textual and image/word and to instead create spaces where we can focus on the “complex, interpenetrating relationships between words and images” (5), relationships that are not new but instead remediated with/in today’s technologies (see also Bolter and Grusin).

2. We might argue that new media aren’t necessarily new: images, motion, sound, video, and other media have existed for decades. What is new, however, are the spaces and interfaces in which and through which these media are woven. What is new is how writing is transformed into composing, requiring the ability to weave together what we might call “traditional” (certainly older) media (like text, graph-

ics, and audio) with and for computer interfaces. What is also new is the access to these media and technologies in our writing classrooms.

3. Consider a traditional writing classroom: Word-processing software is crucial, and a Web browser and Internet access are probably a must. Presentation software might also be used. Students produce primarily text-based documents, which are relatively small in size and can be easily stored, saved, and distributed; these documents are typically designed for print. Compare this classroom to a new-media writing classroom, where robust video-editing and multimedia-production software is in use, where Internet access is necessary to share and stream files, and where files themselves are gigantic—easily filling gigs of hard drives and network space. This is just a thin comparison, but a thick example of the ways in which new-media writing pushes on our established technological systems. From another direction: Consider, also, the assumptions made of writing instruction ten or fifteen years ago. We have each often heard the question, “Why do writing classrooms need computers?” The practices and needs of new-media writing explode this question in multiple directions.

4. Ellen distributed consent forms early in the semester. Most students signed them, thus granting her permission to include their compositions in her research and writing.

5. Although we have taught new-media classes here and at other universities where the courses have run according to plan, this class was chosen for use as a model here because it made visible to us the infrastructural dynamics upon which new-media composing relies. This course also allowed us, because of this visibility, to both critique and alter these infrastructural dynamics.

6. The students knew that they were able to open one another’s folders. We agreed to a policy of respecting the privacy of one another’s space and of only ever accessing this space with permission. In fact, this “security problem” became an important moment for the class. Students were creating a culture of technology in which they agreed upon practices for use and set a premium on respecting one another’s space and work. Students were creating a hospitable environment for learning, an environment that depended upon their shared respect for one another and a shared honoring of an agreement beneficial to everyone. Interestingly, they created this environment inside an infrastructure that doubted their abilities to do so: The computing policy of the classroom that demanded we use remote space as opposed to the local disk space was premised on a belief that students were not honorable—that they would in fact erase the contents of one another’s folders if given the chance to do so. What enabled new-media composing here was mutual trust, shared respect, agreement about access, and a culture of technology that ran contrary to the larger computing policy that continued to cripple the progress of the class.

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