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From Manuscript to Digital: Remediating the Geology Field Notebook

1. Introduction
Shoshana Zuboff’s (1988) book-length ethnography titled, In the Age of the Smart Machine: The Future of Work and Power, chronicles the stories of three very different industrial environments undergoing monumental change as they move from performing action-centered skills steeped in a rich, sensory reality, to a technological restructuring of their work that requires them to develop a new set of performance competencies – specifically, intellective skills. These intellective skills are necessary to navigate their way through an ever-changing system of data interfaces and other symbolic media, and connect those interfaces to a meaningful context – a context that will allow them to interpret what is happening in those rich, sensory realities they have exchanged for a myriad of screens at desktop terminals.

I was moved by her compelling description of human labor jettisoned into a new dimension, the crisis of meaning attending the development and use of each new information medium; I determined to follow her methodology and example; to seek out situations where, driven by relentless innovation, a workplace or an academic discipline finds itself at the brink of transformation where the traditional concept and distribution of knowledge is simultaneously enhanced and threatened; where novices, seasoned technicians and professionals are required to develop an entirely new set of competencies – competencies necessary to reconceptualize the practices they engage in as they construct new knowledge, new meaning, and indeed sometimes a new language for ever more complex and specific purposes.

Most recently I discovered such an opportunity while meeting over coffee at my university with a colleague from the “science” side of the College of Arts and Sciences. My field is considered to reside on the “arts” side of the College. It seemed, he reported, that a very few scholars in the field of geology education had, over the last few years, begun to look at how the traditional field notebook could be both transformed and improved by advancing it from manuscript to digital format. Such digital notebooks had been incorporated for testing and evaluation in field geology classes at the University of Michigan’s Camp Davis, near Jackson, Wyoming (a western mountain state in the US), and at the Department of Geology at Northern Arizona University (a southwestern state with a predominantly desert climate). Northern Arizona had been using Tablet PCs for five introductory geology courses as well as six field courses since 2002. Both institutions’ instructors evaluated and reported on their separate projects in two separate articles, finding that student and faculty reactions to the introduction of this technology in both classrooms and field classes were ‘generally positive’ (Manone: 2006) (Knoop: 2006).

These authors’ reported survey results and observations indicate that the skills and abilities required from geology students increased with the use of digital mapping techniques and digital field notes, while learning and teaching opportunities and processes for instructors were also significantly enriched and enhanced.

Upon reviewing these publications, however, I found that these researchers’ results appeared quite preliminary, and reported only generally on the results of the study’s qualitative data – sur-
veys which remain unpublished and therefore closed to other scholarly interpretation. I wanted to conduct a more rigorous qualitative investigation that would not only triangulate the results of student surveys, interviews, and my own analysis of their digital field notebook files, but would also publish the full content of my evaluation instruments and their specific results in tabular and graphical form.

2. Methodology

My field research began with a trip to Durango, Colorado in 2005 to observe Bowling Green State University geology students combining the disparate tools of Pocket PC’s and manuscript field notebooks in an undergraduate capstone field course. My goal was to observe the students’ use of two writing technologies in the field: (1) the traditional manuscript field notebook that practicing geologists regularly use to record data in the field, and (2) pocket PCs used to enhance the basic skills necessary for fieldwork and enable students to perform digital mapping. More importantly, I wanted to explore the feasibility of transforming the manuscript field notebook into what Geisler et al. (2001: 270) have identified as an IText – a blend of information technology and text with the power to alter “the very character of texts and the interactions of those who use them.”

My initial questions were: Could students produce a digital field notebook? What disciplinary discourse and genre conventions, pedagogical practices and preferences, technological literacies, and interpretive competencies would be impacted by the use of digital field notebooks in the geology curriculum? The field notebook is used to record the processes involved in field research … Geology is one area where field notebooks are used extensively to describe rock formations, topography, rock and mineral deposits, landscape features, and other items important to this research (Gurack/Hocks: 2009: 96,100).

According to Gurack/Hocks (2009: 102), the notebook is primarily a personal record-keeping document and writing space [that] also serves as documentation of …[researchers’] thinking and discoveries during the … observational process. Collaborative research groups share notebooks or review one another’s entries regularly, and they sometimes respond in writing to each other.

Would migration of the genre from manuscript to digital format enhance these functions? Would the common social motivation within the discourse community of geology and the exigencies addressed by the field notebook genre be better served? From the standpoint of access, particularly during collaboration and review, it would seem so. Would any resistance to the notion of migrating the genre from a physical, palpable artifact to a virtual, digital format manifest itself in interesting ways? Would students (and faculty) be open to creating a richer sensory document via the capabilities of embedded digital photos, maps, voice recorded notes, and video? In moving from manuscript to digital format, geology students would have the opportunity to represent action-based skills in ways that provided more sensory detail, thus reducing the funnel-like cognitive effect of exclusive alpha-numeric text as they opened up their notebooks to the use of color in their drawings, inserted maps, embedded digital photographs and other forms of multimedia. Would they see the value of blogging their digital field notebooks as a further, amplified form of collaboration? Or would they resist? Would these possibilities, if actualized, result in that “blend of information technology and text” with the power to alter “the very character of texts and the interactions of those who use them?” Moreover, it seemed that digital field notebooks might, as Zuboff had discovered in her study, require that novices, seasoned technicians and professionals develop a new set of competencies – competencies necessary to reconceptualize the practices they engage in as they construct new knowledge and meaning within the discipline and practice of geology

In all my research, I have consistently made use of multiple methodologies, weaving them in what I hope are creative and useful ways to provide a richer description of my observations, descriptions, results, interpretations and conclusions. In this study, my primary methodology has been ethnography. As Doheny-Farina notes (1993), qualitative, ethnographic studies of writing
have helped inform the teaching of writing for a variety of nonacademic settings, including scientific writing. Like Doheny-Farina (1993), I agree that researcher claims made about the field are always rhetorical in nature, and so the exposure of the personal positions that guide us in our ethnographic work is an ethical requirement – one upon which our strongest authority rests. Ethnographers not only cannot, but should not attempt to stand above or outside the subjects of their research (Ellis: 1996). However, at the same time we acknowledge our particular perspectives and practices as researchers, we must avoid privileging those perspectives and practices over others. Newer ethnographic studies not only admit, but foreground the view that researchers are not invisible; they leave traces of their convictions in the texts they construct and by refusing to mask or marginalize their presence in those texts, they accept and are personally accountable for the impact of their presence. Philosophically, new ethnographers are pragmatic; their focus is not on questions about truth or how to get at the truth, but rather on how their experiences and reports can be used. They hope that their work can assist others in understanding what new directions to take (Van Manaan: 1988).

In accordance with these ethical prescriptions, I avoided the distanced observer stance in this research and attempted to become actively engaged with participants in the geology field course; I carried with me into those relationships the conviction that geology field notebooks, which have been constructed in manuscript form for at least 1,500 years (Sigurdsson: 1999: 73), will, like so many traditional genres, eventually be remediated by information technology. These small, bright yellow and orange paper notebooks written by hand on waterproof pages will, in the not-so-distant future, be replaced by digital field notebooks that include color drawings, print text, sound files, photos and video, composed in the field on tablet PCs and shared with a variety of academic and non-academic collaborators via email and the WWW.

Figure 1. Manuscript Field Notebooks

As a second methodology, my study makes also makes use of North American genre theory. In North America, contemporary genre theorists study texts as products of recurring social actions. The purpose or action that is accomplished by a genre’s use, together with the interactions of its users is the unit of analysis; these users are also understood to be acting as members of particular systems of activity (Miller 1984). Thus the researcher must also examine the role writing plays in those activity systems, especially where it mediates work in powerful ways, such as the work of knowledge making (Russell 1997).
Unfortunately, much genre research frequently “lends itself to a mode of reporting that reproduces the dominant discourse of its research site, and spends relatively little energy analyzing the modes and possibilities for dissent, resistance, and revision,” (Herndl 1993: 349). However, I have deliberately looked to uncover those very modes and possibilities for dissent, resistance, and revision within the activity systems and discourse community of geology. The concept of a discourse community itself can present an unrealistically rosy view of togetherness, support and identification, obscuring “the [group] dynamics of restriction and regulation, the [tacit] means whereby a community enforces its [particular] discourse conventions and its methods of producing knowledge” (Pare 1993: 111). Such regulation influences not only the composition, interpretation and use of community texts, but more profoundly, the thinking of community members.

In this study, I regard both traditional and digital field notebooks as cultural artifacts: “Calling a genre a cultural artifact is an invitation to see it much as an anthropologist sees a material artifact from an ancient civilization, as a product that has particular functions, that fits into a system of functions and other artifacts,” (Miller 1994: 69). Cultures, including those created and maintained by scientific disciplines such as geology, can be characterized and analyzed using their genre sets as tools of analysis. “The genre set represents a system of actions and interactions that have specific social locations and function, as well as repeated or recurrent value....” (Miller 1994: 70). What I am most interested in by employing this method is pursuing the questions posed by Freedman and Medway (1994) in their book, *Genre and the New Rhetoric*:

> How do some genres (in this case, the traditional manuscript field notebook) come to be valorized? In whose interest is such valorization? What kinds of social organization are put in place or kept in place by such valorization? Who is excluded? What representations of the world are entailed? (1994: 11).

Finally, I include as a third methodology, Activity Theory, which considers how the relationship between humans and the objects of their environment are mediated by the tools they use. Field notebooks, as tools of scientific observation, shape both the internal mental processes of their users as well as the external reality they study. According to activity theory, tools “usually reflect the experiences of other people who have tried to solve similar problems at an earlier time and invented the tool to make solving those problems more efficient. These experiences are accumulated in the structural properties of tools as well as in the knowledge of how the tool should be used. Tools and the user relationships they mediate are created and transformed during the development of the activity itself ... [and thus are] a means for the accumulation and transmission of social knowledge” (Ryder 2007). Admittedly, I have just begun to scratch the surface of how digital field notebooks have the potential to, and in some cases have already begun to mediate the relationship between geologists and the environments they explore, study, and report on to the scientific community, the commercial fossil fuel industry, and others.

It is my hope that this multiple-methodological approach to analyzing the transformation of the geology field notebook will serve to enlighten, rather than confuse the direction of future research in this area.

3. **Results and Discussion**

The following sections present raw data from my research with two groups of students at two different times and sites.

3.1. **San Juan Mountains, Durango, Colorado, 2005**

The field notebook, ancient genre that it is, has become a highly conventionalized and often romanticized artifact in the work of a scientist; as one of my colleagues in the field of biology put it emphatically, “My field notes are my connection to Darwin!” (Author’s Field Notes: 2005) Genre theorist Peter Medway (2002) notes that personal (and I would add, professional) identity formation is shaped by discourse community rules and practices such as taking field notes; moreover, such personal identity formation motivates the writer to participate in the construction and main-
tenance of a shared communal identity in responding to the genre’s recognizable exigencies – recording, reflecting upon, and sharing observations in the field.

My first research trip to the San Juan Mountains in 2005 was exploratory in nature, consisting of a series of day-long observations logged on a digital voice recorder, numerous digital photographs, and several informal interviews with students and faculty during hikes in the mountains. My observations revealed that students were often personally attached to their manuscript notebooks, and did indeed use them to reflect in a contemplative and personal way on the results of their observations. They were given a list of what to include in their field notebooks, and cautioned against making any erasures, as in at least one case, a field notebook became a legal document used as evidence in a court of law. They were told that changes to manuscript field notes should not occur in the text of the notes; any changes are only reflected in the right-up of the final report. No conclusions should be drawn in the field based on recorded data, nor should conclusions be entered in the notebook itself. Analyses and conclusions are reflected only in the right-up of the final report, which is a separate document. When I asked one student if she thought this might not work to shape her conclusions in a different way than if she were to engage in more data interpretation while in the field, she replied that the data doesn’t change upon analysis, no matter when that analysis occurs. “What you see is what you see,” (Author’s Field Notes: 2005).

Students made use of the notebooks in unexpected ways as well; for example, as flat planes for performing dip and strike exercises to determine the stability of rock faces; I noticed one student using his magnifying glass as a bookmark for the notebook, and also using the notebook as a safekeeping place for the magnifying glass. Some students even used their notebooks as braces for shifting their weight against the rocks while climbing. Typically they carry 3 or 4 things at one time while climbing – the field notebook, a pen, the magnifying glass they need to look at the rock sample more closely, and a rock hammer. One student carrying two field notebooks indicated that he had large handwriting and was almost out of room in his first field notebook. Another carried a duplicate notebook as backup in case he lost one of them. Often they stop to write in the notebooks during recording activities that involve climbing, so it’s quite an impressive balancing act.

I had promised the geology professors that I would interfere as little as possible with students’ work in the field, so I often spoke with them during lunch and other breaks throughout the day. In addition to questions about their traditional field notebooks, I asked them to consider what affordances and constraints they felt digital notebooks might present for their work. Most initially balked, citing the possibility of damaging valuable equipment (although they were already using sophisticated technology for mapping purposes), or losing their notes as a result of technical malfunction. Part of the usefulness of the traditional manuscript notebooks from the students’ point of view is that they make it easy to evaluate what students are doing – “We need the field notebooks because we have to turn them in and they get graded,” (Author’s Field Notes: 2005) – something they couldn’t seem to conceptualize would be possible with digital field notebooks. I questioned professors as well on occasion and was given a similar response on the same subject of notebook evaluation: “Well, I usually sit in one of the vehicles with a stack of field notebooks next to me on the seat. As I grade each one, I toss it into the back seat. I couldn’t do that with a digital field notebook,” (Author’s Field Notes: 2005). The possibility of file sharing rather than having to handle the digital device itself seemed to escape him. Some students indicated that they would be able to use voice recording equipment effectively in the field (as I did) for taking measurements that were recorded in the field notebooks, and when I questioned them about the possibility of using drawing programs available on their pocket PCs for sketching in the field, they seemed to accept the idea, but not eagerly, and they did not attempt to use them to draw.

Overall, my preliminary findings on this first trip indicated that the growing use of digital technologies to represent information in the geosciences presented a timely opportunity to explore the possible benefits of producing digital field notes, and to observe the transformation of this manuscript genre through the lens of genre theory. Equally tantalizing was the opportunity to consider
the ways that digital field notes might work to transform the communicative interaction of geologists. I had encountered a good deal of resistance to change by both faculty and students, yet I determined to find an opportunity to study others who were already using digital field notebooks.

### 3.2. Jackson Hole, Wyoming 2007

Following are the results of my second trip out west, this time to Jackson Hole Wyoming and surrounds with a different group of geology students from the University of Michigan who actually did use specially designed Geopads to compose digital field notebooks. Geopads are tablet PCs loaded with Microsoft OneNote software, along with GPS mapping tools and a variety of other programs, including email capability. They can be strapped to the upper body in a sling-like, canvas support system that allows for both note-taking and safe hiking and climbing in rugged locations.

**Figure 2. First-day Use of Geopads**

Compared to traditional field notebooks regularly used by geology students, and apart from providing the striking advantages I mentioned earlier, digital field notebooks also possess certain inherent shared characteristics with traditional manuscript field notebooks. For example, as set forth in North American genre theory, both fulfill users’ common social motivation to perform a task required in an institutionalized situation, and answer their need for personal identification with the members of a professional community. Within the geology discourse community, both construct raw data for several future forms of communication within that community, within the wider scientific audience, and at some point within the communication channel, even with the general public. And both exhibit some characteristics of what Peter Medway (2002) has called a ‘fuzzy genre’: striking diversity in physical format, internal organization, the amount of use, the amount, type and style of drawings, relationship of drawing and text, and patterns of textual and linguistic organization. Students are instructed in both cases to keep their notes and drawings organized and legible, yet I found no formal or replicable pattern of organization to appear in either of the two types of field notes.

On this second trip, as with the first, my data collection consisted of a series of day-long observations of students using their Geopads, taking numerous digital photographs, and several informal interviews with students and faculty during hikes in the mountains of Grand Teton and Yellowstone National Parks. However, I had much closer contact with these students, as we spent 24
hours a day together for 8 days. On the second day of our travels, Professor Niemi of the University of Michigan Geology Department distributed the Geopads and harnesses for the first time to students while we were breaking camp and loading up the travel vans.

Each of the computers had been given a human name, and was assigned to students for the duration of the trip. Naming the computers makes them more personal, I was told. Only one student continuously referred to her computer by name, Maxfield, and refused to use the harness, often carrying it against her body as one might carry an infant or a small child. Interestingly, she was the most reticent to use the Geopad for its intended purpose compared to other students, making it clear on many occasions that she preferred the traditional notebook.

After taking to the road, we stopped to orient students to the devices and had some difficulty due to inconsistencies in equipment software versions. Students opened the Visual GPS program and the ArcGIS program, which when integrated, allow students to tap with a stylus on sections of their maps and receive location information such as coordinates in pop-up windows. They can also enter information themselves to the maps in this manner. Next they were briefly oriented to the software they would be using to inscribe field notes — Microsoft OneNote. The insert menu for OneNote allows for embedding of video, audio, digital photos and other files, screen clips from the web or other mapping applications and files, and blogs to include commentary from other users, should they choose to post their field notes to the web. However, sadly, none of these features were used or encouraged to be used during field work; it was as if the old medium of the traditional field notebook were simply being poured into the new (Bolter/Grusin: 1999). Very little remediation seemed to be given any thought. One feature which did receive some attention from the instructor was text recognition, which converted students’ handwritten text to print, and in examining their digital notebook files I found that one or two students tried this occasionally, but then returned to their own handwriting for the remainder of the trip. Most felt the text converter was too labor intensive, and didn’t feel there was much value added. (Author’s Field Notes: 2005).

Other likes and dislikes students reported to me were:

1. Some disliked writing on the Geopad with the stylus because it was too slow.
2. Screens were difficult to see in the sun.
3. Holsters required adjusting when switching from writing to drawing.
4. Text conversion was difficult with the text predictor engaged as no science vocabulary had been added to the dictionary.
5. One student felt a loss of ownership of the notes. He explained, “When I write on the computer, it’s the computer that’s interpreting what I write.”
6. The Geopads were too big, too bulky, and the batteries didn’t last long enough.
7. Some students said they drew more with the Geopads, others less.
   a. Those who drew more cited the ability to use color, larger drawing space, no smudging, capability to shrink or expand drawings to make more room for text or to show more detail, and drawings (as well as text) could be moved around the screen.
   b. Those who drew less cited more difficulty shading drawings to indicate texture, less control “like drawing with a big crayon,” more difficulty connecting lines, less friction, and a time lag between pen motion and object appearance on the screen.
8. One student felt the digital medium would make better organization of data possible.

Dr. Neimi also raised what I consider to be a fascinating issue that demonstrates how digital field notes may have the capacity to transform how field work itself is spatially conceptualized by geologists. He explained that the mapping program presents several topographic layers of information to students at once in separate, simultaneously viewed windows; normally, each layer of in-
formation would be dealt with separately in sequence. He also noted that the field activities and note-taking exercises that accompany them involved in mapping are performed sequentially and thus produce a kind of gradually evolving narrative of experience and information accumulation which, according to received practice in the field, must be preserved in order to construct knowledge accurately. According to Dr. Neimi, digital mapping and note-taking may undermine this established process of knowledge construction, not only because of the non-sequential, simultaneous viewing capabilities the mapping program affords, but also because the editing capability of the OneNote software may tempt students to revise their notes while still in the field, and thus fail to preserve a sequentially acquired understanding of the terrain (Author’s Field Notes: 2005).

The screen captures from student’s digital field notebooks that follow provide some interesting data concerning their use. As I plan to publish a journal length article in the near future, I have chosen to withhold publication of my survey data which was graphically represented on handouts at the conference session, as pre-publication of data issues may arise with future publishers. Also, any future article publication will more particularly reveal the connections I make between my observations of the use of both traditional and digital field notebooks, and how they help us

• inform and transform the teaching of scientific writing
• analyze this emerging digital genre’s use as well as the interactions of its users
• understand the system of activity geologists engage in, and the role writing plays in powerfully mediating their knowledge making processes, and finally,
• help us analyze how field notebooks, as tools of scientific observation, shape both the internal mental processes of their users as well as the external reality they study.

Figure 3. Digital Field Notebook Screen Capture Strongly Resembling Traditional Version
Figure 4. Screen Capture Showing Use of Text Converter Feature

Figure 5. Screen Capture Showing Use of Color
4. References


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