

JAC Volume 12 Issue 2**What Counts as Writing? An Argument from Engineers' Practice****Dorothy A. Winsor****Editor:**

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Imagine that you are a researcher who has decided to investigate writing in different disciplines including engineering. An engineering professor has agreed to allow you access to the writing his students do in class, and you are watching a group of them take a test. Their pencils are in constant motion, and you eagerly anticipate that you will have much material to work with. What disappointment you feel when you finally look over the examination papers and find that the students were using their pencils to enter multiple-choice letters or perhaps even to fill in circles on a computer grading sheet. Sadly, you conclude that answering one essay question at the end of the test was the only writing the engineering students did. The next day you travel to a manufacturing plant to interview an engineer about the writing that goes on there. The pile of papers on her desk raises your hopes for a moment, but you are disappointed again as she shows them to you: a computer printout listing parts that have been rejected this week, a form on which a dock worker has checked off shipments as they were received, graphs comparing this month's productivity with last month's. You begin to wonder if perhaps your research project is ill-founded. Suppose, however, that you are having problems not because no writing is being done but because your own background prevents you from recognizing writing when it occurs. After all, when we writing researchers look at writing in other areas, we bring with us an idea of writing that reflects our own practice, our own discourse community. Perhaps we are ethnocentrically assuming that the only documents that should count as writing are those that most resemble the traditional English essay.

I would like to argue that the documents I have mentioned above are writing. My argument attempts to add to the kinds of documents seen as worth studying in the discipline loosely known as English. Over the last twenty years, we have moved from thinking that only literature is worth studying to including student writing, business writing, technical writing, and so on as part of our field of study. I think we have to extend our attention to documents which are even less literature-like. Calling these documents "writing" has consequences for our understanding of both writing and the various fields in which it occurs. As Lisa Ede and Andrea Lunsford point out, "We name in order to know, but that naming inevitably limits our knowing. . . . Definitions of writing, of course, reflect a set of ideological assumptions that we ignore only at our peril" (15). The ideological assumptions we ignore here have to do with how knowledge is created and how much control individuals have over their own knowing. Ideology leads both us and engineers to deny that writing has occurred in much engineering practice.

In this paper, I would like to examine some of that ideology. I think that there are at least three ideas that make us resist redefining the documents I have described as writing. First, we believe that when we write, we freely create meaning. Second, we believe that writing requires the direct presence of a human being. And third, we believe that writing necessarily involves words. In this paper, I am going to argue that none of these things is essential to writing. Clinging to these assumptions keeps us from even seeing that writing occurs in

certain areas and keeps us from understanding the nature of the writing we do acknowledge, including our own.

The Free Creation of Meaning

Traditionally, many people have believed that when we *really* write something, we think it up all on our own and do creative, original, individual work. To some degree, this is the myth of the self-made individual that James Catano critiques in "The Rhetoric of Masculinity: Origins, Institutions, and the Myth of the Self-Made Man." This myth says that if we are strong enough, we can have control over ourselves and our lives. It ignores such matters as cultural training and institutional determination. Catano argues that this myth affects our teaching of composition, notably in the devaluation of transactional or instrumental writing and the valorization of self-expressive writing whose content is taken to come from the true inner self of the writer. Catano points to Elbow, Macrorie and Coles as theorists whose work sometimes seems to espouse this myth. This belief in the individual as the sole originator of his or her thought and language makes us reject fill-in-the-blank test answers as writing because what the student records on paper is so highly constrained.

As we know, however, the meaning any of us can make when we write is always constrained to one degree or another. Freedom to create meaning is never absolute because we always operate in communities that shape what we can say in a comprehensible way. In *Invention as a Social Act*, Karen LeFevre discusses the relationship between social context and the origination of thought and language. LeFevre points out that thought does not happen in a vacuum. Any thought we might have is made easier or harder by the discourse community in which we operate. Thus, for instance, one of the reasons I can write this essay is that I've read LeFevre's book and articles and books by other scholars. They make it possible for me to think what I think, and their past work is also part of what makes it possible for readers of this essay to recognize and understand what I say. Moreover, thought is also shaped by language which is by definition social. The idea that language is a veil for thought or that thought is prior to language is probably false. Thus, to quote LeFevre, "Invention is *social* in that even while it occurs in an individual, it is heavily influenced by that individual's relationship to others through the social entity of language as well as through social structures, forms, purposes, and practices" (119-20). What I can think and therefore what I can write are always constrained by context.

On the other hand, LeFevre also says that invention is dialectical, "in that the inventing individual(s) and the socioculture are co-existing and mutually defining" (35). In other words, the discourse community I belong to shapes my thought and language, but then the way I think, speak, and write shapes the community in turn (Doheny-Farina). Culture shapes the individual, and the individual shapes culture with the amount of influence either has varying from situation to situation.

When we look at what a student does in short answer tests or at what a dock worker does making check marks on a form at work, what we see is a great deal of culture shaping individual invention and a minimal amount of individual input shaping the surrounding culture. It is probably no accident that some of the most constrained writing is done by students and fairly low-level employees. When students write test answers, particularly but not only if they are in short answer form, the only choice the students have is whether to acquiesce in the discourse community's way of knowing. They are not so much creating or communicating disciplinary knowledge as they are creating themselves as members of the community. Until they have written themselves as community members, they can't have much influence on the community. Novices must mark themselves as community members by knowing and saying the right things before they can make new contributions to the discourse community's conversation. Similarly, employees filling in forms do so in a context in which the organization has severely limited the kind of meaning it is interested in. The individual who wishes to remain an employee has to function within those limitations.

Writers, of course, do not always accept limitations unquestioningly. In his discussion of what he calls the "underlife" in a composition classroom, Robert Brooke describes first-year students resisting efforts to get them to write like academics, and he argues that such resistance can be construed as positive. Greer, Locker, and Bonfield have described a similar situation in a factory. They looked at such documents as an underground newspaper in which line workers criticized management and items critical of management posted on company bulletin boards. Documents such as these suggest that control over writing is not always ceded to a discipline or employer. Writers accept or resist constraint in different areas for reasons which are not always predictable and which have been little explored by research.

Questions of constraint become complicated when we look at the writing of engineers because in their work engineers actively value constraint. As part of their disciplinary ideal, engineers attempt to engage in what Bazerman calls "the active search for passive constraints" (223), or the deliberate attempt to allow the physical world to limit what they can say. Scientists may use culturally constructed knowledge systems, Bazerman says, but they aim at allowing nature to limit what they conclude within those systems: "Once you have established, for example, a procedure for identifying the hardness of rocks and have developed a taxonomy of rock types, which rocks are labelled as harder than which others is no longer a matter of cultural discretion" (312-13). Like scientists, engineers value constraint on writing as much as many humanists value authentic voice and originality of expression.

In addition to valuing constraint by physical reality, engineers also value being able to work within social constraints. Engineering differs from science in its inherently contingent nature. Science aims at knowledge that will be universally true; engineering aims at knowledge that will work given the limitations of the marketplace and technical artifacts as they already exist. How one company chooses to modify its diesel engine, for instance, will vary from how another chooses because the engines were different to start with and what works with one will not work with the other. Moreover, neither is aiming at the perfect engine since, even assuming such an engine were possible, it would be prohibitively expensive and would not be ready for sale until sometime in the next century. What all of this suggests is that freedom to create meaning in writing should be seen as a continuum rather than as a dichotomy. We all write with both freedom and constraint. People are responsible for their own actions, but they are not heroically free. Knowledge and action occur in social contexts which can neither be ignored nor unquestioningly served.

The Necessary Presence of Human Beings

The second assumption I would like to challenge is that writing requires the direct presence of human beings. The apparent absence of a human writer is, I think, what we object to in defining a computer printout or other documents produced by instruments as writing. In keeping with the ideology of technology and science, instruments such as spectrographs and gauges are often used to try to remove people from the research process and create the illusion that nature is recording itself (Knorr; Latour "Visualization"; Winsor "Engineering Writing"). But all machines are designed and created by human beings. Human beings design an instrument to record readings in a certain way or program a computer to produce a certain output. I therefore believe that the output is writing as much as what we generate by printing out a file on our word processors, despite the gap of time and space that occurs between the human action of designing or programming and the appearance of a document.

Familiarity tends to make us forget that writing is always accomplished with a tool of some sort and that the tool affects the nature of the writing. Elizabeth Eisenstein has shown, for instance, that the advent of movable type encouraged organizing a document in alphabetical order; that printing encouraged the inclusion in texts of lengthy lists of numbers which had been difficult to reproduce reliably in manuscripts; and that when the printing press made possible a series of ever improved editions of classical texts rather than ever more corrupted hand copies, the concept of originality changed from seeking truer pictures of original texts

to going beyond fixed texts in new directions (89, 461, 192).

As the reciprocal shaping between us and culture affects our writing, so too does the reciprocal shaping between us and our machines. Bruno Latour discusses both of these reciprocities in an interesting article called "Mixing Humans and Nonhumans Together: The Sociology of a Door Closer." In this article, Latour writes about the elbow-like device at the top of a door that automatically closes it. His point is that we shape a mechanism to extend human capacities and perform a task people would otherwise have to do themselves. Thus, we replace a doorman with a machine and shape the machine to function more or less as a human would. But once the machine is in place, it in turn shapes our behavior, so that we come through the door at a certain speed, for instance, and don't try to pull the door shut behind us.

In the way Latour writes his article, he makes a further point about the way humanly shaped institutions, like humanly shaped machines, reverberate upon their creators. The article appeared in *Social Problems*, an American journal, and Latour is, of course, French. When the journal's editors first considered publishing Latour's article, they apparently asked him to alter some of his French examples because they believed that such changes would give his article more appeal for an American audience. Latour made the changes and resubmitted his article under the name Jim Johnson of the Ohio State School of Mines. A footnote is now the only way a reader knows the true author. In the persona of Jim Johnson, Latour talks about his two-hundred-year-old house in Columbus and about attending a conference at Walla Walla University where the cold winds blow and an automatic door closer is an especially useful device. To some degree, Latour is undoubtedly amusing himself, and one has to give the editors credit for being good sports and publishing Jim Johnson's work. But Latour also uses the opportunity to make a point: an author is shaped by the means of writing that are open. These means, be they journals or laboratory instruments, both limit and facilitate writing.

In keeping with the heroically free ideology Catano critiques, we tend to want to distance ourselves from our writing tools and institutions, to see ourselves and our machines as completely divorced, and to have strong emotional reactions to any claims which see people and machines as intimately related. This reaction is so strong that it sometimes recalls the fervor with which nineteenth-century people resisted Darwin's claim that they were intimately related to animals. The fact that a machine mediates between us and a document, however, does not mean that writing hasn't happened.

Extending our idea of writing to include some of these machine-produced documents can have interesting consequences. For instance, engineers probably would not refer to a computer printout of a diesel engine's performance as writing; they would call it "data." And they would call the activity that produced it "data acquisition." Note how these terms imply that the engineer did not actively shape what appeared, but rather waited passively for preexisting reality to appear. In a sense, the engineer has accepted the idea of writing as free creation which I discussed earlier. The documents that machines produce are not defined as writing because they are seen as entirely produced by context. But the engineer actually worked very hard to make these written traces appear in this form. Using the term "writing" to cover this activity suggests the humanly created part of its nature.

The Necessity for Words

Finally, the third of the three assumptions I want to question is that writing necessarily involves words. This assumption is obviously connected to the second point above since many instrument traces occur in forms other than words. It influences our reaction to graphs and multiple choice letters, for instance. I think the insistence on the presence of words comes from the deeply ingrained idea that writing is recorded speech. We know, of course, that writing and speaking are two different language forms. Written sentence structure and

vocabulary, for instance, are identifiably different from their spoken counterparts. A transcribed tape of a conversation needs a great deal of editing to be read as normal writing. But beyond that, as many researchers have demonstrated, writing, unlike speech, makes ideas permanently visible so they can be stabilized and reexamined. Walter Ong says, for instance, that "until writing, most kinds of thoughts we are used to thinking today simply could not be thought" (2). Likewise, Richard Young and Patricia Sullivan say that unless we write, "there are mental acts we cannot perform, thoughts we cannot think, inquiries we cannot engage in" (225). Writing is thus intimately connected to thinking.

Given writing's link to thought, how can we exclude from the category of writing such documents as the sketches engineers draw when they're trying to work out mechanisms in their own heads or communicate them to someone else? Studies repeatedly show that engineers use such non-verbal writing to do engineering. Edwin Layton says that a graphic means of conceiving of problems is characteristic of engineering and is one of the marks tending to distinguish it from science ("Mirror-Image" 574-75). In a 1990 presentation, Cheryl Geisler and Michelle Oulman examined the various kinds of symbol systems used by a group of student engineers working on a design project. They found four symbol systems in use: a verbal one using words; a mathematical one using numbers and equations; a visual one using drawings; and a mechanical one using physical models. Geisler and Oulman found that all of these systems were essential to the engineers in thinking and communicating about the project. The total number of symbols used increased over the length of the project, but as the project progressed verbal symbols decreased as a percent of the total and visual symbols increased. The engineers were still thinking through writing, but their writing needed to use a different vocabulary.

Similarly, scholars of design, which is central to engineering (Layton, "American"), have argued that designing something involves a kind of thinking best shown in non-verbal ways. For instance, Anita Cross says,

Drawing may be viewed as a descriptive code containing particular types of spatial concepts not contained in verbal language. The manipulation of graphic marks therefore involves a particular type of thinking, which may be inhibited by, and in conflict with rational verbal conceptualization. (18)

Harold Belofsky, who has studied what he calls the two "dialects" of engineering drawing, argues that the design process does not move in one direction only, from the designer's head to paper. Belofsky says that complex designs cannot be completely visualized in a designer's head:

Designs are therefore "worked out on the board" . . . and the various views must be worked out simultaneously. Hence, the designer works back and forth between views, in a somewhat disjointed sequence, narrowing many options in a process of successive refinements. (23)

Notice the recursiveness of this process and the way the document the engineer produces both expresses and clarifies his or her thoughts.

Moreover, Belofsky says that engineering drawing is not really pictorial because it does not try to represent an object as it would appear to the eye. Rather, engineering drawing is a highly codified symbol system (25). In *The Art of the Engineer*, Ken Baynes and Francis Pugh refer to engineering diagrams as "a visual form of communication incorporating signs and symbols that are as 'readable' as the words in a sentence" (15). Eugene Ferguson says, "More important to Renaissance engineers than scientific knowledge were the inventions in graphic arts that lent system and order to the materials of non-verbal thought" (830). Non-verbal elements in engineering writing may not be words but they are certainly language, and their visual representation can be seen as a kind of writing.

Consequences of Extending What Counts as Writing

What would happen if we thought about writing as I am suggesting we do? Such a redefinition would, I believe, change both the way we think about engineering and the way we think about writing. Let me give two examples of engineers' activity at work and the way our view of it might change if we thought of some of what engineers do as writing. A lot of the work an engineer does in a manufacturing facility is finding ways to record things better so they can be analyzed. For instance, one engineer described to me a project he was working on in the following way. He worked in an automobile manufacturing plant where the assembly line was asynchronous. That is, it did not move at a constant rate. Rather a pallet carrying a partially finished car moved to a station and stopped there while a job was performed. Then the pallet moved on to the next station. In an auto plant, any stoppage of the production process is extraordinarily expensive. Estimates of the cost of downtime are customarily performed in thousands of dollars per minute. Plants thus try to control downtime as much as possible. As the engineer's plant was run, when a station went down for some reason, its operator pushed a button which lit up a corresponding number on an overhead display known as a "bingo board." Thus notified, production engineers and maintenance people moved in to correct the problem. When the engineer began his project, then, downtime was recorded, was written, only on the bingo board.

The engineer's company, however, found this writing unsatisfactory for two reasons. First it didn't record small delays which occurred if a machine was running slowly, for instance, so that pallets had to wait to move into a station while the next station stood idle waiting for pallets to come through the bottleneck. Second, the bingo board system did not allow for permanent recording and subsequent coordination of data so that production engineers could identify breakdown patterns and perform preventive maintenance or make other changes to permanently correct problems. Rather, they were forced to reach on an event-by-event basis.

The engineer's task was to develop a system that would detect where downtime was occurring and why. He developed a system of sensors that would feed information into a central computer which could display the data, thereby allowing coordinated analysis. I would argue that the sensor system allowed the engineer to write down what the assembly process was doing more completely and efficiently than the bingo board had done. The writing was highly constrained, was obviously mediated by a machine, and was frequently in the form of symbols other than words. But it was nonetheless writing. The engineer used writing—what Bazerman calls "visually transmitted symbolic activity"—to make the downtime visible, just as humanists might use writing to make an idea visible (23).

In another example of the unacknowledged presence of writing in engineering activity, a research engineer recently told me that some gatherings in his workplace are called "meetings" and some are called "presentations." Presentations always include visual aids such as transparencies, slides or handouts by means of which the speaker displays some sort of findings. In other words, presentations always involve writing. If there are no visuals, then the gathering is called a "meeting," and it is assumed that no findings have yet been arrived at and the group is going to discuss some situation. Moreover, because findings are seen as present only if there are visual aids, they are by definition written. In this context, the term "findings" tells us something about how engineers think of their own work, because it implies that the researcher has "found" something that already existed. But if findings are writing, then the researcher has actually actively constructed them in a way that engineers choose to ignore and that we writing scholars often do not notice. If we think in the terms I am suggesting, writing turns up as a pervasive activity in parts of engineering where it has previously been all but invisible. We can then more easily see the degree to which engineering is humanly created knowledge.

I do not mean to say, of course, that an engineer's writing is exactly like a first-year student's essay. Much of the writing engineers do does not fit our traditional narrow views, which

come from looking at writing characteristic of our own field and taking it as the standard. This narrow view has kept us from accurately assessing writing that differs from our own but that is not therefore necessarily inferior. For instance, as I have said, engineers value constraint. This ideal probably has consequences for the form their writing takes. One of these consequences might be that engineers use the passive voice more frequently than most writing teachers think desirable, producing sentences such as, "The third option was selected and installed." As we know, the passive voice slows down reading, lessens comprehension, and, as the example shows, may make assigning responsibility for actions difficult because it removes the actor from the scene. So why do engineers, who are great believers in efficiency, use it? One reason might be that removing the actor or knower is a rhetorical move by which an engineer removes himself or herself from sight and thus increases the believability of his or her findings. The writer is seen as constrained by reality and unimportant in shaping what results. The absence of an actor is a fiction characteristic of engineering and science and therefore is easier for us to see than our own fictions, such as free individual creation. Recognizing the fictions of others can, however, make us more conscious of our own.

Similarly, in a context very different from that which encourages the individualistic, speculative first-year essay, engineering writing is frequently a radically collaborative activity in which many people cooperate to create, shape, and edit (Winsor "An Engineer's Writing"; Paradis, Dobrin and Miller). This, too, has consequences for the form much of it takes. The engineering writing process is broken down into steps taken by different people but controlled by those in power. Management creates the literal forms that low-level workers fill in. It is incorrect to say that form is unimportant in this kind of writing. Form is always significant. In this case, it signifies a highly uneven power distribution. It allows management to focus the writer's attention only on the part of reality management deems significant. It attempts to standardize writing and therefore meaning so that they belong to the company as a whole rather than to the individual writer. This in one of the reasons that voice is often a problematic concept in technical writing.

We need to realize that our own writing is one pattern among many for creating and communicating knowledge. Different kinds of writing are specific to different fields. These fields, including our own, shape and are shaped by the particular kinds of writing they endorse. Examining the writing that differs so sharply from our own may, at first, make us nervous for fear we are meddling in areas in which we have no expertise to the possible neglect of areas in which we do. But unless we are willing to look at the documents that other fields value, we will be seeing the world in a highly restricted way. In their own characteristic writing processes and products, various fields make the world visible in distinctive ways and then argue that the world they see is transparently "real." Only when we have a clearer understanding of the various ways writing occurs, will we be able to communicate and understand one another and the world around us.

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