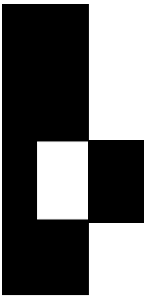

Letter from the Editors

Sharon Quiroz
Michael Pemberton

This issue of *LLAD* is focused on materials and resources for instructors teaching writing intensive courses. The first article, "Students' Reasoning and Rhetorical Knowledge in First-Year Chemistry" by Driskill, Lewis, Stearns and Volz is co-authored by a writing specialist and three chemists. It combines research methods from composition/rhetoric with the very specific demands of the chemistry course. This article is followed by a useful companion piece, a bibliography for chemisty teachers, compiled by Bill Klein and Betsy Aller.

Lee Ann Kastman and Susan L. Booker offer a bibliographical review of WAC articles that should prove very useful to anyone teaching in an agriculture program, and they go beyond a mere listing of references to consider more broadly the dominant approaches and guiding interests of those who publish in that area.

Pascal de Capraris, a geologist, gives us the benefit of the years he has spent improving lectures so that students can follow them. This would be a fine article to use in a WAC seminar, especially in a new program.

In a forum we've called "Controversy Across the Curriculum," four writers take up once again the tensions between WAC and composition as they are played out in the ongoing debate between first-year seminars and introductory composition courses. Lex Runciman's essay "Ending Composition as we Knew It," makes the argument for first-year seminars, while David Chapman in "WAC and the First-Year Writing Course" makes the argument for introductory composition. Nadine Weidman's "Gender Issues in Biology: An Approach to Teaching Writing," is a description of an excellent first-year seminar, not originally intended to be polemic as the other two were, while Beth Daniell confronts the issues on both sides, in "F-Y Comp, F-Y Seminars, and WAC: A Response." The trouble is that there are good reasons for the disagreements and Daniel readily admits she has no easier answers than anyone else. The authors were invited to reply to Daniel's reading of their three essays. Only Weidman, under-

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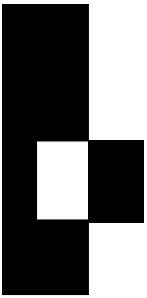
standably, felt the need to supplement her descriptive piece with an argument.

The debate is followed by a related piece: Linda Bergmann's review of Joseph Petraglia's fine collection, *Reconceiving Writing, Rethinking Writing Instruction*.

There are a few things we would like to call your attention to as you read. For one, please note the call for papers on page 95 regarding our special issue on "Communicating Across the Engineering Curriculum," guest edited by Steven Youra at Cornell University. Please consider submitting a proposal for this upcoming issue or passing the call on to a colleague who is working on a piece that might be appropriate. Also, we are constantly on the lookout for program descriptions of ongoing (or developing) WAC programs, so if you have such a description on hand—or are willing to write one—please send it to us.



Students' Reasoning and Rhetorical Knowledge in First-Year Chemistry

Linda Driskill, Karen Lewis, Jennie Stearns and Tracy Volz
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Abstract

A case-based introductory chemistry course at Rice University tests students' reasoning with essay questions. A protocol analysis project investigated the relation between successful and unsuccessful students' reasoning about chemistry and their rhetorical knowledge. We observed that (1) students' writing processes were affected by several constraints (time, accessibility of information in memory, need to repress dissonance, design of the exam, knowledge of test answer genres, and predisposition to enact test-taking roles learned in high school), and that (2) writers' rhetorical knowledge influenced their ability to reason and discuss chemistry. Theories of analogical reasoning helped explain differences in students' reasoning and performance. A complex model that includes components representing genre and role was created for explaining the composing processes needed in writing answers to ill-defined problems. Recommendations for new uses of writing in introductory chemistry were developed, based on the differences observed in successful and unsuccessful writers' processes.

New emphasis on theory and reasoning

At the third national Writing Across the Curriculum Conference (1997), keynote speakers warned of several trends rapidly sweeping higher education and emphasized universities' need to prepare students to accept change and solve complex, non-routine problems. So quickly are the challenges in the workplace evolving that futurists expect sixty percent of the jobs available in 2007 will be ones not yet invented today. Many introductory chemistry courses shortchange students by teaching standard procedures for routine problems. To meet the more complex challenges looming ahead, students should be learning how to define complicated problems, evaluate models for solving them, use genres, adopt roles,

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and communicate with others who may share responsibility for addressing problems. Emphasis on formulas and calculation, especially in scientific fields, has repressed discussion of problem solving's rhetorical dimension.

One non-traditional course, John Hutchinson's Chemistry 101 at Rice University, presents first-year chemistry as intellectual inquiry; the course's central feature is argument and explanation to others. His textbook explains, "The models, concepts, and theories we use to describe nature are accomplishments equal in creativity to any artistic, musical, or literary work. Unfortunately, textbooks in Chemistry traditionally present these models and concepts essentially as established facts, stripped of the clever experiments and logical analyses that give them their human essence" (Hutchinson, *Cases,* iv). Hutchinson's students experience the challenge of creating new knowledge as they participate in classroom dialogues concerning nine historical cases (method described in T. A. Holme). The cases recreate the uncertain situations faced by chemists of an earlier time and challenge the students to design experiments, propose theories, and test hypotheses that led to revolutionary insights.

The reasoning and writing required in Hutchinson's chemistry course, particularly in its examinations, differ significantly from the cognitive demands described in Coppola and Daniels' first year chemistry course (69, 81). Their students' writing primarily consists of comparison, summary, and definition. In contrast, Hutchinson's students write to test theories and respond to ambiguous situations. Hutchinson's approach has special value because it involves students in writing and problem analysis early in their college careers and sets up expectations for the kind of work students would perform in the future as chemists.

Students participate in group problem solving in class and have an opportunity to address theoretical issues individually on exams which both majors and non-science majors have been able to pass in the past. In addition to traditional chemistry problems, Hutchinson's exams contain multi-part essay questions of the following types:

Question Type 1. identifies a theory and asks students to present experimental evidence that would support the theory,

Question Type 2. provides experimental observations and asks students to explain the theoretical conclusions that can be drawn from them, or

Question Type 3. presents two seemingly contradictory observations and asks students to use a specified model to resolve the contradiction.

Students receive limited instructions about tests in advance. They are not taught about these three question types, but they are given explicit advice about audience. Hutchinson says, "I tell them . . . . You have

to assume that the reader is very smart; capable of understanding your answer, well informed, but you have to explain it" (Interview). A good answer, Hutchinson and his graders claim, is one that would make sense to a fellow student. Because students must cast their understanding in words rather than formulas and because the information must be expressed in logical propositions for a smart novice, the rhetorical aspects of problem solving are foregrounded. In effect, Hutchinson says, a student writer should become a teacher.

In the fall of 1995, a higher proportion of student writers who claimed to "know the material" were having trouble with the essay questions on the first two tests. Students sometimes confused *information* with *argument*. When students came to Hutchinson unsure why their answers had been marked wrong, he said, "The first complaints . . .were always in the nature of 'my answer's the same as hers, but I got counted wrong,'" (Interview). In other words, even after receiving their graded exams, students were having difficulty recognizing the differences between a memory dump and an answer that actually explains connections between facts. To understand the differences in writing processes that led to misunderstanding the requirements of examination writing, a research project, described in this paper, was created. The study led to recommendations for using writing to learn and solve problems characteristic of chemistry research that involves major discoveries.

Investigating the relation of reasoning to rhetorical knowledge in chemistry

A team from Chemistry and English compared the essay test writing strategies of successful and unsuccessful students, and more fundamentally, the relation between their reasoning about chemistry and their rhetorical knowledge. Protocol analysis, which has been used to study problem solving in other fields, especially mathematics, as well as writing processes, was chosen as a method (Flower and Hayes; Flower, *Construction*, 317-329). In protocol analysis, a writer speaks aloud as he or she solves a problem, and the remarks are tape recorded, transcribed, and analyzed along with the drafts. This process cannot capture all of the writer's cognitive processes, but it allows researchers to glimpse many significant actions not evidenced in the final text.

This method was used with nineteen students who were invited to take a practice test (Appendix) before the final one-hour exam of the semester. All of the students but one (who spoke English as a second language) talked freely while being recorded. In most sessions, an observer watched and prompted students if they fell silent for several seconds. Half of the remaining eighteen students (9 men; 9 women) had

received A's and half had received D's or F's on the two previous exams. Experienced Chemistry Department graduate students graded the practice exams, and the English Department team analyzed the transcribed recordings.

Elaborating earlier models of writing to explain examination writing

We elaborated the sociocognitive model that was developed by the national Center for the Study of Writing (CSW) between 1985 and 1990. CSW studies emphasized that social influences and prior experience play forceful roles in writers' or readers' task representations and constructions of purpose. However, the categories used for analyzing writing processes in these studies were not sufficient to capture differences between successful and unsuccessful writers' processes.

Nelson's CSW study spotlighted the persistence of students' prior experience and familiar writing strategies in task representation. She also described the discrepancies between the tasks instructors believed they were assigning and the tasks students represented to themselves. Behaviors and text features rewarded in a particular setting significantly affected students' interpretations of an assignment and shaped their approaches (Nelson 20). She concluded that teachers were too likely to expect novices to figure out field-specific ways of thinking and writing suited for sociology, engineering, and so on. Unless motivated, students could reduce assignments to a system of production shortcuts without engaging with the central issues of the course.

In another CSW project, Stein and Flower studied the task representations and strategies of college freshmen in "reading to write" tasks. The "reading to write" project analyzed cognitive processing into four categories: planning, monitoring, elaborating, and structuring. In "elaborating," Stein suggested, prior knowledge combines with source text propositions to create new ideas and critical perspectives. On the other hand, "structuring" involves "looking for instances of agreement and disagreement between propositions in source texts or between a proposition in the source text and the student's prior topic knowledge, looking for superordinate categories under which to subsume items in the source text, arranging text into high-level and low-level propositions, and discovering relations between ideas in the text that may not have been apparent on reading alone" (Stein 3).

Despite their relevance to task representation, these four broad categories of cognition were not specific enough to account for differences between successful and unsuccessful chemistry reasoning or writing. They left a good deal unexplained about the relation between memory searching, planning, and drafting. Most protocol studies have assumed

memory searching is an unproblematic activity. In test-taking, however, the role of memory searching becomes critical, and each of these four activities change a great deal from their manifestation in paper writing: planning drops to zero, structuring becomes a controlling factor as the question is reformulated as a "thesis" that guides drafting, and "elaborating" becomes recall of information plus some commentary. Monitoring is reduced to a minimum—even watching for typos and grammatical scanning may be abandoned. Even more, these categories did not account for larger issues of academic role, purpose, and genre. We wondered why, after students had attended 30 hours of class and taken two exams, most did not immediately notice when once again Professor Hutchinson gave them pairs of discrepant observations that were to be explained in terms of a particular theory or model.

Relevance of psychological theories of analogical reasoning to writing

We supplemented the categories of cognitive processing with codes based on psychological theories of analogical reasoning, social construction of knowledge (Bazerman), and genre (Berkenkotter and Huckin). As the following discussion will show, their primary value is to describe more adequately the processes of task representation and construction of purpose. They provided the basis for describing differences in memory search processes, comparisons, and logical reasoning. They also helped us to describe the roles students assumed in particular writing situations.

Three theories of analogical reasoning have become dominant—cognitive mapping theory, constraint theory (which involves the role of context and pragmatics) and case-based reasoning theory (Gentner and Holyoak; Holyoak and Thagard; Kolodner). The three theories share fundamental assumptions whose stability has been well established, according to Gentner and Holyoak (32). Each of the theories helps explain specific aspects of the complex reasoning and writing required in Hutchinson's tests. We will first explain the relevant aspects of each theory.

Holyoak and Thagard (35) illustrate the central processes of cognitive mapping in analogical reasoning with the behavior of little Aaron, aged 24 months. Like other toddlers most people have known, Aaron was in the habit of coming to his mother when he experienced some hurt so she could "kiss the boo-boo" and "make it better." Unexpectedly, as she was dressing him one day, Aaron's mother exclaimed that her hand hurt. Almost instantly Aaron responded, "I kiss it."

In this story little Aaron draws on such incidents, called "source analogs," to define significant features of a new situation, a "target analog." This process has three steps: (1) perception of similar features in the

source and target (a child and a mother in the example); (2) recognition of similarities in relationships or categories (an injured person and a family member); and (3) assignment of structural similarities in roles (one who presents an injury; one who administers the soothing kiss). The process of constructing the analogies is called mapping.

Holyoak and Thagard point out that little Aaron might have found corresponding features and relationships in the situation without choosing a new role for himself (he could have "mapped" or identified his mother in the source analog with his mother in the new situation). In that case, he could have said, "Mommy, you kiss your hand." However, he did not do this; he mapped the role of the injured person in the source analog onto his mother in the target situation and assigned the role of caregiver (his mother in the source) to himself.

Indexing and mapping to detect "role relationships"

What makes Aaron's performance possible? Case-based analogical reasoning theory would explain that Aaron's earlier experience had become "indexed" in his memory so that he could compare situations through mapping. When it comes to learning in school, students may have too few experiences to enable them to draw on their backgrounds in solving some problems; they lack a source analog to apply to the item in the test (Kolodner, 57-58). And their assigned reading may not be helpful because they did not "index" features for reference as they read and did not look ahead to anticipate how the reasoning or elements could be used in the future. A mass of unindexed reading doesn't help students much on a test: some try to memorize, as a whole, a long stretch of material but cannot search it. In addition, the questions asked in traditional tests train students to look for mere matching or one-to-one feature correspondence, the kind of question that would ask little Aaron to recognize "mother" in both situations.

Reasoning for a purpose and to achieve coherence

Constraint theory contends that how analogical reasoning proceeds depends on three powerful influences: the proportion of one-to-one feature correspondences that can be observed in the source and the target, the felt need for coherence between the source and the target, and the purpose of the reasoner in making the analogy (Holyoak and Thagard). Aaron's purpose and social context were stronger constraints than the need for congruence between categories. In exam situations, the time limit serves as a high pressure constraint. The greater a student feels the need for coherence, the more he or she is likely to ignore differences between

the source and target, differences Hutchinson wants students to explain. Furthermore, if a memory search yields meager results, any perceived correspondences may seem like a high proportion of correspondences worth writing down. Constraint theory helps explain how the role proposed in mapping theory can be so powerful, bringing to bear the individual's purpose and other contextual factors. It also helps explain why some analogical reasoning in test taking concludes prematurely.

Reasoning that adapts old knowledge to new situations

Case-based analogical reasoning theory explains how prototypic experiences or cases may be revised or reindexed and applied to novel problem-solving situations. In courses that teach case-based reasoning, Kolodner (62-64) explains, students address complex real-world problems by applying prior knowledge, however indexed. To prepare for applying knowledge, they need to have recognized multiple possible implications of concepts studied prior to actually taking a test. Otherwise, when an exam poses a new problem to which a learned case study might be relevant, students are not likely to realize—or even remember—which memorized concepts will help them solve this new problem.

In searching for feature correspondences and looking for sets of relationships during a case project, students can qualify, limit, or complicate their prior indexing. Hutchinson helps students index classroom cases by involving them in classroom dialogue; the exam writing causes reindexing and more robust learning. Students taking tests are asked to recall a previously indexed theory and relate it to appropriate theoretical evidence; to compare experimental observations to theoretical concepts in order to draw conclusions, or to resolve apparently contradictory observations by means of a specific theoretical model. In writing, students reindex and complicate their understanding of chemistry and achieve a higher level of cognitive flexibility, becoming able to adapt concepts to a variety of situations.

Analogical reasoning involved in chemistry exam writing

Analogical reasoning is likely to be involved when students

- read and interpret questions
- search memory on the basis of indexed terms
- select models or concepts related to key terms
- assign relationships (sometimes called roles) among items in a narrative of events
- reason about the relation between theory and observations
- assume social or disciplinary roles in writing

Students recognize feature correspondences as part of the cognitive process of reading test questions. For example, when students see key terms, such as "valence," networks of indexed terms are activated in their memories. Some questions may force students to relate specific words or phrases to an appropriate set of concepts (as when they are told to explain a specific observation in terms of "the nature of radiation"). When they recognize the correspondence, students say "Oh, now I get it" or "I see what he's asking me." However, in Hutchinson's questions a word may relate to more than one model or concept set. In the following excerpt, the instructor had intended the student to reject one particular model, the Lewis structure model, instructing the student: "Explain each of the following observations *in terms of the properties and energies of the occupied orbitals in the valence shell*" (Question 2, Appendix, emphasis added). However, in the following protocol excerpt the student disregards the instruction and relates the term "valence" to the Lewis structure model anyway, telling the tale of "what calcium 'really wants'" instead of relating it to atomic shell theory:

> . . . if potassium were to give up one of its electrons, it would attain a full outer shell. It would have an electron configuration of argon, and basically most atoms are trying to attain a full outer shell (Student 19).

Because "valence" occurs in both models, the student makes a common error. The student's sense of urgency in the test situation and the apparently adequate one-to-one correspondence between a term in the question ("valence") and a term indexed in memory apparently causes the student to settle for the first correspondence he recognizes instead of looking for other correspondences based on the instructions. Hutchinson commented that this particular error occurs frequently.

The writer's role also drives the reasoning and writing processes by affecting task representation. Bazerman contends that the classroom is a set of scenes for writing, each with its expected student roles and genres. Hutchinson's tests demand that students play a role quite different from the one most students had known in high school. Although he had told his students to imagine themselves *teaching* other students with their answers, most chemistry students did not escape the role of the one being interrogated: "So what are they asking me to say? (rereads the question) OK. That's kind of vague. I think I'm just going to start writing, because if I show him I know something, it's better than showing him I know nothing." This woman remains in the student role of one being told to speak and proceeds in ways she thinks will be rewarded, just as the students Nelson studied did (22). And indeed, the student's perceptions coincide with the graders' own accounts of how they allocate points (Interview with graders). Both settling for identifying one-to-one feature

correspondences and settling for a familiar student role led test writers to produce less satisfactory answers, to do what would earn some points but less than a maximum score.

Changing writing roles is not easy. Student 4 commented: "It's kind of shocking to come here and see a different format for taking tests. In high school, basically all you needed to [do] was memorize, try to understand a little bit of the background, two or three essay questions, and the rest was multiple choice or fill in the blank. . . . But here, when you study, it's totally different." Student 1 had abandoned his high school approach: "I took the first test, and I decided I was doing something wrong. I needed to step up to a higher level there, because I wasn't internalizing the information. I was basically just trying to spit it back, and it didn't work . . . ." Memorizing the case itself also was inadequate, Student 1 said, ". . . because I know they have questions on the test that don't directly apply to the cases in the book sometimes. You are just supposed to infer this from that over there." Student 1 is informally describing the mapping that must go on from the source to the target analog.

As Student 1 notes, analogical reasoning in Hutchinson's chemistry tests demands that students juggle several constraints: time, varying levels of indexed concepts and information in memory, and the pragmatic issues of graders' practices. Hutchinson's first question type identifies a theory and asks students to present experimental evidence that would support it (such as Question 1b in the Appendix). The student must be able to recall indexed examples or types of appropriate evidence. Hutchinson's Type 2 questions, such as 1a (see Appendix), provide a key term: "Explain briefly how we can account for these observations in terms of the nature of *radiation*." The student must have indexed the term "radiation" to related definitions and concepts and must be able to map that knowledge onto the details or observations about the photoelectric effect (See question 1a in the Appendix). Some questions could possibly require several analogic reasoning steps.

The mapping function required in question 1a ("explain in terms of *radiation* . . . ") does not really position the student in the teacher's role as Hutchinson intends. Although Coppola and Daniels (77) like Hutchinson say they want the student to teach others with their answers, "becoming the teacher" is a complex role change. The test question does not give the student the freedom to choose the source analog needed to occupy the teaching role. Most adult roles, not just teaching roles, usually include the authority to choose one's own source or target analogs.

"Teaching" for the purpose of our analysis means presenting information or arranging for students to encounter the information in a way that leads to indexing. When students become "teachers," they demonstrate the definition and logical significance of material while using a genre

the field considers appropriate. They also demonstrate their ability to connect concepts with indexed terms, manipulating source and target analogs. And most challenging of all, they must select the appropriate starting points for their audiences—other students. Many students seem to disregard the instruction to teach, possibly because they are so overwhelmingly conscious of their own role as the ones being interrogated.

Students in the chemistry course did not recognize the "teaching" role implied or genres of answers they should produce. Because Hutchinson does not explicitly go over the three "types" of questions that regularly appear on his chemistry tests in class, students don't recognize them as writing genres. Miller describes a genre as "typified rhetorical actions based in recurrent situations" (159); Bazerman elaborates genre as "a social construct that regularizes communication and relations" (62). According to Patrick Dias, his students' lack of genre knowledge in Education caused them to fall back on "formulaic imitation" and to experience uncertainty (195).

Because few chemistry students seemed to recognize the genres of either the questions or the answers, most did not use them in analyzing questions or planning answers. As first-year students, the chemistry writers attempted to map their high school schemata, roles, and habitual task representations (as source analogs) onto new college situations, as others have observed students doing elsewhere (Rosebery et al.; Bartholomae). In high school the students had been encouraged to rely on teachers' instructions and conform, rather than to learn how to reindex old knowledge and create new knowledge.

In his introduction to *Composing Social Identity in Written Language*, Rubin (9) emphasizes how instructors oversimplify the challenges students face and how, in comparison to oral discourse, written identity in college involves different conventions, organizational patterns, syntax, vocabulary, and other factors. For example, scientists often embed their logical propositions within independent clauses that emphasize communal performance: "**We see** A . . . . **We take** B to be C. . . . **So it is obvious** that Z." The chemistry students tried to imitate this distinctive pronoun use and syntax from the written cases and the classroom in the production of their written identity; they did not, however, usually understand the logical structure these pronouns and logical connectives were intended to introduce and they sometimes did not produce logical conclusions, as will be shown later.

Case-based theory, as an addition to mapping theory and constraint theory, was useful in uncovering problems in indexing, mapping, and reindexing material, as shown in the following section, because the test questions required students to apply concepts. Furthermore case-based learning is essential for problem solving and taking on adult roles. When

combined with ideas about task representation and construction of purpose, the fundamentals of case-based reasoning, mapping theory, and constraint theory can help us understand several strengths and weaknesses in the writers' processes we observed.

Differences between successful and unsuccessful writing processes

After analyzing protocols and students' written exams, we concluded that an ideal student's test-taking processes would include analyzing test questions, efficiently searching memories, planning answers before writing, revising answers based on self-evaluation, and reasoning. Furthermore, an ideal student would accept the responsibility to organize answers logically and clearly for a fellow student; that is he or she would adopt a "teaching" role. Few students matched little Aaron's shift to the appropriate role. These processes occurred more frequently, however, when students wrote their answers in full paragraphs. Because the constraints of time, unreconciled concepts, and poorly indexed memory affected the writing and reasoning processes of students who received the highest scores, none of them fully reached this ideal.

A model answer (though not ideal) is Student 18's response to question 1a (see Appendix) in which the student adopts the appropriate "teaching" role, conducts an effective memory search, and reasons deductively (plain text indicates speech; italics indicates writing):

> Because it takes some certain minimum frequency to eject electrons, and this ejection can't be accomplished by just raising the intensity, it must be that radiation isn't a continuous stream; rather it's quantized into little packets of radiation. And since the energy of the ejected electron increases with frequency, frequency must be the measure of the energy in each packet.
>
> *In other words, once frequency and thus energy of each packet ("photon") is high enough, it supplies enough energy to remove the electron from the metal. Any frequency above the threshold frequency supplies an excess of energy to each electron, measured by each electron's kinetic energy*.

Students who write successful answers are able to select the most appropriate or useful elements from the cluster of meanings associated with a particular term. The students recognize which definition, example, or model applies in a given set of circumstances, and can decide when to eliminate less useful concepts. In the example above, Student 18 immediately rules out the possibility that intensity is the factor critical to explaining the photoelectric effect and correctly focuses instead on frequency.

A good answer, which would be useful in teaching someone, not only defines terms carefully, but also demonstrates an understanding of the relationship between experimental observations and theories. An answer based on deductive reasoning presents important premises and deductions in a logical, sequential order, is well organized, and contains cues that signal logical relationships between ideas. Notice above how Student 18's response to question 1a presents a logical progression from the given observations to conclusions. He includes transitions and rhetorical cues like "because," "it must be that," and "since" to express the relationship between his reasons and conclusions.

Successful exam writers also recognize when a word is used with different implications in various models or theories (as "valence" or "electron" is, for instance, in Lewis models and in atomic shell theory). Recognizing when an explanation is not adequate is vital in paradigm-changing and solving problems that no longer can be addressed by traditional practices of "normal science." For students to experience the challenge of historical discoveries (or to address ill defined problems in the future), they must also experience the frustration of vocabularies and concepts that do not accomplish their purposes.

Student 14, a good but frustrated student, illustrates the practice of determining what tasks a question requires: "I guess I don't quite understand—(reads) "in terms of the nature of radiation," I'm assuming that's in terms of—they want us to talk about the particular nature of light." This student can also handle seeming dissonances between presented facts and memorized facts by looking for dissonances and writing about them according to the genre conventions of exam writing. Student 14's almost-perfect response to question 2a (see Appendix), for example, treats the question as a "compare and contrast" question, as her use of transitions such as "when," "however," and "in this case" suggest (plain text indicates speech; italics indicates writing):

> *We must first understand that valence is applied when atoms combine with another molecule. Affinity, however, refers to the energy released when an electron is added to an atom. This atom does not combine with others in this case. We see the oxygen atom alone is a stable atom with no net charge. We also note that its valence shell can accommodate two more electrons. When taking on an extra first electron, oxygen will release a bit of energy, which is resulting in a positive electron affinity value. However, the affinity for a second electron is negative, because we already have a negative ion, O-. Therefore, there is no reason why it would want to be more charged. The valence of an oxygen atom, however, is two in this case, because valence refers to the*

> *sharing of electrons. When electrons are shared, they do not take on the full negative charge as if oxygen were—as when whole electrons are simply added to a lone O. Therefore both spaces left in the valence shell of an O- can be filled.*

Here, Student 14 answers the question by comparing and contrasting two hypothetical situations, that of an oxygen atom taking on a first electron and that of one taking on a second, a logical and rhetorical strategy appropriate to the question type. However, the answer is only near-perfect because the student falls back into the metaphoric discourse of Lewis structure models (in which atoms "want" or do not want events to happen) instead of explaining the influence of effective nuclear charge on electron affinity.

Successful exam writers demonstrated an awareness of when they were not correctly approaching a question. For example, after reading question 1a, Student 21 responded:

> *Since, when they increase the frequency of light above the threshold, the only resultant change in outcome*—that's a little bit redundant, but whatever — *is that the kinetic energy of the electron increases. We can then conclude that an increase in frequency increases the energy of light.*
>
> Now, I just realized that I haven't exactly answered the question. What he asked me to do was to explain how we can account for these observations in terms of already knowing the nature of radiation. He didn't ask me to deduce the nature of radiation from the fact that we make these observations.

Although we have not included Student 21's planning phase above, this student planned his answer carefully, and more importantly, he paid attention to what the question actually asked, as his realization that he hasn't "exactly answered the question" indicates. This recognition could, of course, be imagined as a teacher's concern for responding to a student's question, but nothing else in the student's protocol indicated that he was doing anything but complying with the exact terms of the instructor's question to him.

Not responding to their own perceptions of dissonance separated unsuccessful test-takers from successful ones. Question 2a asked them to explain, "in terms of the properties and energies of the occupied orbitals in the valence shell of the given atom," why it is true that "the electron affinity of oxygen for a single electron is positive" despite its being negative for a second electron. Student 1 read this question and simply said, "Why would it be negative for the second electron?" and immediately moved on to 2b. Granted, this is too brief a comment to indicate precisely what the student was thinking; however, this response—"Why would it be?"—*was* the question. That the student made no effort to explore his

own paraphrasing of the question suggests that he was unable to differentiate between the question's fundamental problem and his own uncertainty.

Student 2 had similar difficulties coming to terms with this question:

> (planning). . . Maybe it has something to do with the fact that—hmm—this is odd. Electron affinity means it wants to attract another electron. Well, it already has 2P, and it's going to make another pi and the last one—I don't see why there wouldn't be an affinity for it. For a single electron, it's positive, but for a second electron, it's negative. I know—that's kind of strange. I'm going to explain the second one, because I can do it.
>
> *(writes) The valence of oxygen is two because there are two spaces in the 2P bonding orbital.*
>
> (planning) Affinity means want. It doesn't require any extra energy to put those electrons into—okay, let's talk about this. Oxygen is usually a double molecule, so usually it only wants—well, if it had seven electrons, it could still bond to something else. At the same time, I don't understand why it wouldn't want eight. I could see the fact that electrons repulse each other. When you put something into its 2P orbital, you kind of have problems, because there are more electrons there, and it creates a lot of repulsion. But—I don't know.

Student 2 wrote only the single italicized sentence as an answer. He came closer to a correct answer *after* writing this one line with his recognition that repulsion is involved, but, for whatever reason, he quit writing. Instead, he played it safe by answering the part he definitely knew, an error that suggests that, like Student 1, he did not distinguish between the question and his own uncertainty—the question asked him to resolve an apparent tension between two facts, and just commenting on one of those facts was to disregard the question. A desire for coherence seems to have caused him to abandon the attempt to explain the question's dissonances.

In addition to experiencing intense need for coherence and time pressures, the students had the most trouble with information retrieval, according to our protocol analysis. Most students tried to use the vocabulary of formal logic and the conventions that they associated with scientific discourse (for example, "we know that"), as Student 2 did when answering question 1b:

> Okay, well, *we know that* you can predict the frequencies. *What do I know*? *I know that* only specific frequencies are emitted because you only have certain energy levels, ...

Student 6 likewise used the structure of formal logic as a memory probe when answering question 2c:

> . . . *In the period, as we have more electrons* . . . electrons . . . the atoms . . . no, when there's more electrons, *they are attracted,* attracted *more to* them, to *the nuclei, decreasing the energy.* Therefore, what? Yeah. *Therefore, the radii decreases also.* . . .

Student 6's response illustrates how students started writing not just without planning, but without necessarily knowing where their logic would lead them.

Using formal logic as a heuristic helped students recall the facts on which a correct deduction depended; however, difficulties occurred when students used the same stock phrases both as heuristics during prewriting and as transitions in their finished answers. Most students' exam writing lacked a distinct prewriting phase; they generated and shaped their answers simultaneously. Consequently, the transitions that should have made their logic clear seemed instead to have been thrown in inexplicably.

Student 19's first spoken response to the Question 1a (Appendix), for example, has the form of a deduction, but clearly the second half of her sentence does not logically follow from the first: "First of all, radiation is a type of wave, so frequency, wavelength, and amplitude are all properties of waves." This student was not making logical connections; rather, she was only retrieving what she had stored in memory.

Appropriate connections were more likely to be established when students wrote their answers in full paragraphs. Although most students wrote their answers in the form of paragraphs, some sketched only brief list-like answers that resembled class notes more than the type of writing we are accustomed to seeing on essay exams. When we asked Hutchinson whether he felt such differences generally corresponded to the quality or correctness of an answer, he responded that he does not prescribe to his students the form in which they should write their answers but tells them only that as long as an answer presents the necessary information in a logical order, it receives full credit. Despite his sense that such formal matters were not among the criteria for evaluating answers, when we looked at actual exams, we discovered that the highly scored answers were, without exception, among those written in the form of complete paragraphs. Students 1, 3, and 4 wrote list-like answers consistently throughout the test and did poorly.

This observation indicates, admittedly, perhaps nothing more than that students uncomfortable with the material the test covers are simply unable to write coherent paragraphs; nevertheless it is possible that the act of writing complete sentences and paragraphs encourages students to reproduce not merely the facts their textbooks supply, but to look for the

logical connections between the facts they recall, and more importantly, to plan their answers at least partly before actually writing. When Student 1 encountered the first test, he fell back on a familiar strategy: "The first test was hard, since I didn't even know how to answer the questions. I tried to answer them like essay questions, but I realized it was better to answer them as an outline, just as I summarized the case studies. . . ." In this instance, the student had reduced the task representation to a simpler instruction, one he had followed in test preparation. This student's inferences about how to present his answers were, in fact, wrong.

Conclusion

As Winsor's longitudinal study of four engineering students demonstrated, students in science courses seldom are taught about the rhetorical side of their discipline. Their courses focus on calculation, formulae, and physical properties, not the way that issues are formulated in language. The oddity of essay questions on a chemistry exam reveals just how much the rhetorical dimension of chemistry—not just engineering—is usually repressed. Successful and unsuccessful chemistry writers differed in their awareness of the genres of questions, ability to search memory, judgment in relating key terms to appropriate models or concepts, understanding of logic, use of planning, application of rhetorical knowledge, and adoption of appropriate roles.

We conclude that students' test taking schemata generally suited traditional tests requiring recall rather than the knowledge creation Hutchinson asks for. In the typical test-taking scheme, the four cognitive processes of composing (planning, elaborating, structuring, and monitoring) are drastically modified. Continuing to use this typical test-taking scheme undermined students' efforts to deal with Hutchinson's exams. Simple recall is an inadequate substitute for analogical reasoning on exams which, as Student 1 commented earlier, ask questions that "don't directly apply to the cases in the book." The three question types on Hutchinson's exams ask for the kinds of exploratory and constructive processes usually associated with heuristics for planning papers and the elaborative processes better explained with concepts from analogical reasoning theories. The traditional test-taking scheme is consistent with the students' awareness of their roles as people being interrogated. To assume that simply telling students to "become instructors" will cause such a transformation is naive. In general, chemistry instructors (whether Coppola and Daniels (77) or our own faculty) seem not to recognize the complex nature of "becoming a teacher" in discourse.

Concepts of indexing, mapping, and role assignment from psychological theories of analogical reasoning can help identify students' diffi-

culties and instructors' opportunities to improve student learning. These concepts extend models of cognitive processes used in earlier studies of "reading to write" in ways that help identify students' problems and differences in processes.

Recommendations

Improve indexing through in-class writing, journals, and the World Wide Web

How can students be helped both to retrieve the facts they have learned from reading case studies and to recognize their applicability to new contexts? In successful case-based courses, Kolodner finds that "built into the curriculum is the reflection needed to promote analysis and encoding of students' experiences in ways that will make them useful and accessible in the future at opportune times" (58). We believe, therefore, that it is essential that students be given more opportunities for such reflection and be required to write outlines of cases. We recommend (1) helping students index their understanding of cases through outlining, journals, in-class writing, and on-line discussions, (2) making test writing a course topic by calling attention to question types and providing annotated examples of good and bad answers, and (3) revising the wording of questions to provide strategic cues.

In their pretest interviews, many of the students reported favorably on the benefits of having followed Hutchinson's advice to write outlines and answers to sample questions. Student 2, for instance, claimed that he wrote out answers to all of the study questions because "It seems to me that when I write things down, as opposed to hearing about them or seeing them, I remember them ten times better." Student 14 agreed, "I think there were times where I thought about them [the sample tests] more and just didn't write as much as I usually do, and I find myself doing not as well on the exams in general, in this and other classes."

The tests invite students to recognize the relevance of covered material to new contexts, but as Kolodner argues, students will seldom recognize such connections if they have not already spent time "reflecting on what they have learned and when they might find those lessons relevant in the future" (58). Students could improve their indexing through in-class writing, perhaps summarizing the logical steps in the case problem they had just solved in class discussion, or at the end of class students could write for a few minutes about what they have just learned. They could also practice in class the kind of writing required on exams; for example, they could describe the experimental evidence that supports a known theory or try to develop a theory using the evidence just discussed in class. Such practice would help students make those sorts of

connections when taking exams. Also beneficial would be responding to the case studies in a journal or doing more speculative forms of writing.

Currently, Hutchinson assigns his students to optional study groups led by graduate assistants; many choose not to attend these group meetings. Those students who failed to attend study groups missed the experience of collaboration Schleifer notes as customary in the sciences: activities in which the roles of master and apprentice are exchanged as scientists develop disciplinary expertise (446-447). These study groups might become even more productive if students and their teaching assistants discussed problems together in person, in on-line discussions, or in chat rooms on the World Wide Web. Instead of simply reading old tests posted on a web site, students might respond to such tests in writing if they knew that a teaching assistant or even a fellow student would send back corrections and comments. The more students write about chemistry before being tested on their ability to do so, the less difficulty they should have in test situations.

Editing sample answers, practicing logical connections and taking mock tests

It is possible that the act of writing complete sentences and paragraphs encourages students to reproduce not merely the facts their textbooks supply, but to look for the logical connections between the facts they recall, and more importantly, to plan their answers at least partly before actually writing. Because the more polished a student's writing is, the higher the score answers receive, students should be required to write their answers in paragraphs and the course should give them opportunities to develop their ability to do so. Such opportunities might include learning how to analyze questions, studying bad answers as well as good ones, editing incomplete answers, and taking mock exams in "real test" environments.

Students must learn to recognize the different types of examination questions and answers. Making question analysis demonstrations a topic in class lectures might enable students to understand the subtleties of exam questions. Such demonstrations might include how to identify key words and phrases ("explain in terms of" is one of Hutchinson's favorites) as well as differences in argument structure. Students could be given a list of facts needed in a sample answer and asked to revise these snippets into polished answers with strong logical connections. Such practice will help students index features of good answers and useful writing tactics.

Additionally, students would likely perform better on exams if they were given class time to take a mock exam before taking each regular one—or at least before the first one. Failure in a practice situation can be

more productive than penalizing students with a low first exam grade. Failure can promote learning, since, as Kolodner points out, "Failure at applying an old case in a new situation . . . might result in reinterpreting (reindexing) old situations or discovering new kind of interpretations (indexes)" (61). But to learn from their failures in this way, students need to spend time reinterpreting the case studies. It seems reasonable to assume students are more likely to reflect on their failures while they are still studying than after they have been disappointed by a grade that counts. Few students write new answers to graded exams—more often, they just vow to do better next time. Hutchinson relies on the first exam to provide students with their first negative experience (Interview). This practice might be counterproductive; students who initially try writing the practice answers and outlines might cease doing so, deciding that these study methods are not effective.

Question wording

Finally, instructors should experiment with different ways of wording questions. For instance, Question 1a tells students to "explain briefly how we can account for these observations in terms of the nature of radiation." The doubled instruction to explain how we explain might confuse students. Simplifying this command to "Explain these observations in terms of the nature of radiation" might clarify that students are to explain the observations themselves. Similarly, because some students mistake the apparent contradictions in the pairs of observations' (Question 2 a-d) for their own lack of understanding, they should be warned explicitly—at least on the first exam—that they need to resolve apparent contradictions. Since question types are repeated, the tests might also include general directions relating to particular question types.

If implemented, these various recommendations would give a greater prominence to the rhetorical dimension of chemistry. They would also help students become more aware of their learning processes and their roles in test situations, an awareness that would be valuable in many other courses. In the long run, students would be better able to apply their problem solving skills to reasoning about chemistry and about other topics in the 21st century's turbulent environment.

Appendix: Practice Test for Chemistry 101 Questions 1 and 2

1. (a) The photoelectric effect refers to the observed ejection of electrons from the surface of a metal exposed to radiation. It is found that (i) no electrons are ejected unless the light has a frequency as least as

great as a certain minimum "threshold" frequency; and (ii) the kinetic energy of the ejected electrons increases proportionally with the frequency of the light above the threshold frequency. Explain briefly how we can account for these observations in terms of the nature of radiation.

(b) The spectrum of radiation emitted by hot hydrogen atoms consists of radiation with specific frequencies n given by the Rydberg formula:

$$\nu = R\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$$

where n and m are integers with m > n. Give a brief argument for the existence of quantum energy levels for the electron in a hydrogen atom based on the Rydberg formula combined with your explanation of the photoelectric effect.

2. Explain each of the following observations in terms of the properties and energies of the occupied orbitals in the valence shell of the given atom. (There are two observations in each part; explain both of them.)

(a) The electron affinity of oxygen for a single electron is positive, but for a second electron is negative. Nevertheless, the valence of an oxygen atom is two.

(b) The ionization energy of a potassium atom is less than that of a calcium atom, whereas the ionization energy of a potassium ion, K^+, is larger than the ionization energy of a calcium ion, Ca^+.

(c) Within a group, the atomic radii always increase with increasing atomic number, but within a period, the atomic radii always decrease with increasing atomic number.

(d) An inert gas atom has a low electron affinity but is strongly electronegative. NOTE: Begin your answer by defining in chemical terms what we mean by electronegativity.

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Writing Across the Curriculum in College Chemistry: A Practical Bibliography

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Writing Across the Curriculum (WAC) has been a force in education for more than 25 years. Yet WAC in chemistry might seem still something of a mystery, especially for the chemist new to teaching or to the language studies teacher unfamiliar with conventions of thinking and writing in chemistry. Fortunately, teachers in higher education who wish to explore the uses of writing in chemistry have a wealth of material to draw from in the literature. Our review of that material is intended to address the needs of those teachers who want to get started using writing in their chemistry classrooms. Thus, the focus will be primarily on practical matters. We begin by pointing to studies that suggest why WAC can be useful, then turn to reports of successful approaches to using writing at all levels of the chemistry curriculum. Additional resources are listed at the end of this article.

Why Writing Is Useful in the Classroom

Writing Across the Curriculum, as a pedagogical strategy, has attracted teachers because it offers a way of teaching subject-area knowledge at the same time it facilitates the development of thinking and writing skills (Britton, et al. 1975). Writing in subject areas also encourages students to learn communication and other social interaction skills, which educators and industry professionals believe are critical to succeeding in the workplace (Stark, et al. 1986). However, to take full advantage of WAC theory and practices, faculty and administrators must look to writing as more than an end product, a curricular goal in itself. Instead, they must also see writing as the *means* to the end, as a way students can learn by exploring ideas and making connections between them (Madigan, Writing 1987). Some faculty, intent on incorporating writing into their classroom, focus so heavily on the end products of writing that their effort might be

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better described as "grammar across the curriculum." While grammar and basic writing mechanics are crucial to a chemist's education, focusing solely on these superficial matters ignores the greater benefits that WAC can bring to the classroom.

For help in understanding the relationship between writing and learning and the relevance of WAC methods to subject-area teaching, many turn to Emig's (1977) "Writing as a Mode of Learning," which connects research from philosophy, psychology, education, and other fields, to writing and the field of composition. Emig contends that writing is a uniquely different means of composing ideas and expressing oneself, and this uniqueness makes it especially useful to the learning process. Writing actually forces students to analyze and synthesize information in ways that are meaningful to them. Moreover, it helps them become active learners: when they use writing to express the concepts they acquire from their textbooks, classrooms, and labs, they become involved in an active process of sense-making. Teachers who would like to explore the theoretical underpinnings of WAC further could turn to two early works, Britton (1972) and Freisinger and Petersen (1981), among many others. Rosenthal (1987) and Beall and Trimbur (1993) provide practical insights that focus WAC theory on the particular interests of chemistry and chemical education.

Rigorous, methodological research on writing-to-learn is available. An early study, Britton, et al. (1975), examined over 2000 student writings from different subject areas and found that students learn when they write about subjects in a range of different ways, such as through private expressions (personal journals) and more public transactions (informational notes to the teacher). This finding has encouraged some WAC teachers to look to a genre approach to writing-to-learn. The use of personal journals as described in *The Journal Book* (Fulwiler 1987) and the use of poetic writing in psychology described by Gorman, Gorman, and Young (1986) are two such examples.

Writing-to-learn pedagogy has had broad support in chemistry over the years. The American Chemical Society endorsed the importance of writing and its connection to learning by stressing writing-to-learn methods at its Sixth Annual Conference on Chemical Education in March, 1992. That conference determined that chemistry teachers could use writing to track student thinking patterns, to improve student understanding of chemical concepts, to increase communication between students and professors and thereby improve opportunities for learning, and to use writing as a way to emphasize experiential learning and deemphasize didactic lecturing (Beall and Trimbur 1993). And using writing throughout the chemistry curriculum provides students much-needed opportunities

to practice writing with a variety of purposes, audiences, and formats. These goals can be accomplished in a variety of ways.

Ways to Implement WAC

Many accounts of chemistry teachers using WAC methods in their classrooms, for a variety of purposes, can be found in the literature. Their experiences offer insights that demonstrate a strong sense of practicality and the field's deep commitment to learning. The following strategies were selected on the basis of their ease of use and/or effectiveness in teaching chemical concepts; some strategies require more time and effort than others.

General and First Year Chemistry

The American Chemical Society Division of Chemical Education formed a task force in 1992 to study ways to reform the general chemistry curriculum. The Task Force defined five major issues (Rickard 1992):

- rekindling and sustaining student learning;
- teaching science as it is practiced;
- avoiding an impression that chemistry is too abstract and theoretical;
- developing more cooperative, interactive modes of learning; and
- linking chemical concepts to current events and social issues.

The literature suggests that WAC methods can help achieve many of these goals.

The University of South Florida, for instance, added to its general chemistry course a weekly one-hour participation section in which students were engaged in hands-on activities that involved problem-solving, writing, and critical thinking. Worrell (1992) describes one of these activities that improves students' ability to understand mass-to-mole and mole-to-mass calculations. In the activity, students in small groups perform an experiment and write up their observations; then after making their calculations, they describe in writing an experiment that confirms their calculations. According to Worrell, the strategy increased student enthusiasm and improved their personal satisfaction and sense of accomplishment.

In another instance, Stanislawski (1990) asked students in the first term of his first year chemistry course to write about components in the analytical process, such as data collection, recognizing relationships, and drawing inferences. In the second term, students used the analytical process to write critical evaluations of selections from the chemical litera-

ture. In the third term, students used the same methods to examine an issue of their own choosing. Stanislawski found that most students willingly accepted the writing assignments, and that most students found the writing to be a useful way to develop and demonstrate critical thinking skills.

Beall (1994) used short, ungraded in-class writing to help him identify students' preconceptions about chemistry and track their understanding of the concepts taught. During lectures, students took five minutes to respond in writing to questions related to material covered by the lecture. These responses were not graded, although several papers were selected and shown to class at the next class meeting. Beall found this to be a powerful way to identify students' misconceptions about lecture materials so he could remedy them quickly. Showing the papers during the next class helped him identify troublesome areas in the material, and highlight good writing as well.

Upper Division Chemistry

Writing-to-learn methods are particularly useful in upper division chemistry courses where students are often asked to synthesize and integrate more specialized information. Rosenthal (1987), for instance, used lab reports in her physical chemistry class to help students develop such medium-level cognitive skills as classification, summary, and comparison and contrast, which are necessary to performing the higher-level thinking involved in analysis and argument. She points out that students need practice at the medium cognitive level if they are to be competent at drawing conclusions from data by the time they graduate. And because lab reports are already part of the upper division laboratory course, teachers can provide practice in both medium- and higher-level cognitive skills without adding new components to the curriculum.

In his organic chemistry survey course, Wilson (1994) promoted problem-solving skills and critical thinking by requiring students to explain in writing the problems they solved during their labs. These one-page papers, which accounted for 20% of students' final grades, not only helped students learn the material, they also provided a clear indication of student misconceptions and weaknesses. Although initially concerned about the extra workload in grading papers, Wilson found he could move through them quickly by evaluating them primarily for the accuracy of their chemistry answers, commenting only if necessary on writing mechanics.

In his organic chemistry class, Powell (1986) asked his students to write often. Several times a semester they wrote abstracts of journal articles that expanded on lecture topics and placed them in the context of

real-world issues. These one-page papers required outside reading, planning, and writing, and promoted skills in analysis and synthesis, as well as reading and writing skills. Papers were ungraded, but students exchanged papers and commented on each other's work. This helped them develop critical sensitivities to differences in style, choice of language, and choice of content.

In addition, Powell asked students to keep a lecture notebook — a journal of lecture notes — where students learned to summarize and synthesize technical information in their own words. Students then revised and rewrote these notes at home with materials taken from the text and outside readings. Powell reviewed the notebooks periodically for content and to determine if students were acquiring the discourse conventions appropriate for their educational level. The notebooks enabled Powell to emphasize the importance of keeping regularly written records of scientific thoughts and ideas. It also enabled students to process the material through a personal, expressive mode of discourse.

Students in Powell's class also kept lab notebooks to record the experimental methods and materials, the proceedings, and their observations, of their lab experiments. The lab notebooks enabled Powell to teach professional discourse conventions of chemistry. Moreover, they gave him a chance to introduce the requirements for and procedures of recording technical information and data and of generating laboratory reports from a database.

All of these writing activities might seem overly ambitious, but Powell feels that the effort is justified because making written records are "an essential activity of the chemical sciences" (p. 415). Still, he was able to minimize some of the work by having students review each other's writing and by making periodic notebook reviews optional.

To be successful, Olmstead (1984) points out, students must be able to explain scientific material clearly to a variety of audiences, for a variety of purposes. Helping students learn to communicate well, then, should be a goal for all chemistry teachers. In his advanced laboratory course at California State, Fullerton, Olmstead used students' experiments as the subjects of various writing assignments, such as detailed procedure and discussion reports, abstracts, research proposals, journal articles, popular science reports, and more, to help students gain experience using different discourse conventions in the chemical fields.

Writing can be used to address other learning difficulties. Lavoie and Backus (1990) define these as "impedances to learning" and categorize them as either (1) content related, (2) process related, related to either (3) individual personal and cultural differences, or to (4) individual developmental differences. Lavoie and Backus explain these impedances within the context of learning styles. They present a chart connecting learning

difficulties and writing assignments aimed at reducing these difficulties. Chemistry teachers who are unsure of what kinds of writing to use in their class might find help here.

The literature explains other strategies in detail. Strauss and Fulwiler (1987) encouraged students to put their questions and concerns in writing, and then drop them in a question box before they left class. The strategy did not detract from class time or involve much instructor time or effort, but the suggestions provided useful data for shaping future class meetings, and enabled closer contact between students and instructor. McHale (1994) encouraged students to grasp the relevance of chemistry at the same time they learned chemical concepts and improved writing skills by assigning 4-5 page, graded term papers about current events that involved basic chemical principles. VanOrden (1985) describes how the ungraded short writings she assigned encouraged critical thinking and taught chemical concepts, and Malachowski (1988) explains how ungraded journal writing improved the depth of student involvement and understanding of chemical concepts.

Two curricular experiments that have proved successful deserve special mention here. Swan (1995) describes an environmental chemistry course at Princeton team-taught by writing and chemistry instructors that enables science and non-science majors to fulfill their general education requirements in writing or science, respectively, through a writing-intensive option or a science lab option. The results of this cross-curricular experiment suggest that the difficulties in teaching and learning science derive from scientific rhetoric and pedagogy, and not from any intrinsic characteristic of science. Swan found that the traditional presentational structure of chemistry in classroom instruction and in science writing, which moves from general principles to specific details and focuses on the chemistry, the object of study, actually hampered student learning and communication for both science and non-science majors. The general principle, which was new information for both sets of students, did not provide a context for making meaning of the details that followed.

The problem of helping students learn to make and express meaning was one that Coppola and Daniels (1996), and others at the University of Michigan, attempted to address in their restructuring of the undergraduate chemistry curriculum. They realized that the traditional curriculum minimized the historical, philosophical, sociological, linguistic, and moral considerations of chemistry and did not help students develop effective communication or collaboration skills that would help them express themselves to construct meanings and solve problems. In revising the curriculum, written and oral communication and collaborative learning became central to lab courses that were recast to capture the essence of the research experience — the design, implementation, and evaluation of an

experiment with an uncertain outcome. Critical to the success of their approach was the assumption that understanding is constructed socially, not in isolation, through language. The courses situated lab problems within contexts students could easily understand, and then encouraged practice with techniques and group collaboration to help students develop both technical and social skills. In one iteration of this approach, the "collaborative identification of substances" assignment, students were given an unknown substance, were instructed on identification techniques, and then were asked to find the two other students in class who had the same substance. Within the context of this task, students easily understood the processes and techniques of learning and implementing procedures to identify the substances and recording their results on paper. In addition, to complete the task, students had to talk to each other, express what they had learned, and compare their findings to locate the other students with identical substances.

Overcoming Constraints of Writing in the Chemistry Classroom

One of the major objections to using writing in the chemistry classroom is that it takes time and attention away from covering content (Labianca and Reeves 1985). But if we acknowledge the importance of writing in the curriculum, we can begin seeing writing as integral to the process of doing and learning chemistry, rather than as a tangential activity. Further, as the literature supports, writing enhances the learning of content rather than distracting from it.

Writing needn't be overwhelmingly time-consuming. Ungraded assignments, peer reviews, and short notes to the teacher and to other students, all reduce the time and effort required by the teacher to evaluate writing. And all can be used to emphasize content and provide practice in writing. The key is to make every writing assignment serve the purpose of teaching and learning content.

Another common objection is that chemistry teachers lack adequate training required to teach and evaluate writing. Although it might be true that chemistry teachers cannot teach writing as an English teacher might, chemistry teachers are in fact the experts and the best judges of what constitutes good writing in chemistry, and there is no reason why chemistry teachers need to accept poor writing from their students. Additional expertise can be found in English, Rhetoric, or Composition departments, and in Writing Centers, among other places. Collaborating with faculty both in chemistry and across campus is helpful in discovering strategies for teaching and grading writing.

Resources for Students (and Faculty) Writing in Chemistry

A number of resources are available to help both students and teachers learn more about the conventions of communicating scientific material. Perhaps one of the best resources on formal discourse conventions in chemistry is *The ACS Style Guide,* published by the American Chemical Society (Dodd 1986). Students find the *Guide* useful in learning about the science paper, the citation system endorsed by the ACS, and the methods for handling a range of details from tables and charts to punctuation. Other sources focus specifically on particular kinds of writing, such as writing lab notebooks (Kanare 1985), abstracts (Foos 1987), and proposals (Weissmann 1990).

Two fine resources for grammar and composition conventions are Day's *Scientific English: a Guide for Scientists and Other Professionals* (1992) and *How to Write and Publish a Scientific Paper* (1988). As a former journal editor, and former president of the Society for Scholarly Publishing, Day has a great deal of insight into scientific writing conventions. *Scientific English* covers the mechanics of grammar and principles of style most important to science writing. *How to Write and Publish a Scientific Paper* describes the science paper and abstract in commonsense detail. A number of other helpful resources are included at the end of this article.

Final Thoughts

Although substantial literature exists that links writing to successful learning in chemistry, more research is needed. Careful descriptions of the characteristics of the discourse conventions used by chemists, especially as they are practiced in industry, are lacking. These descriptions could be used to inform more relevant teaching as well as lead to further developments of Writing Across the Curriculum's body of knowledge. In addition, experiences with writing in team situations in chemistry, especially in capstone courses, would further enhance our knowledge of WAC in chemistry.

The literature reviewed here provides extensive evidence of the success with which chemistry teachers can bring writing into their classes. Because WAC methods offer such fertile opportunities for creative teaching and learning, each individual classroom can be a site for new successes and developments.

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Writing Across the Disciplines in Agriculture

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An important assumption of writing-across-the-curriculum movements is that language, learning, and teaching are closely connected (Russell 41), and this assumption has been acted upon across several disciplines (Abbott, Bartelt, Fishman, and Honda). However, as Susan McLeod reports, incorporating WAC is not as simple as assigning term papers: "WAC programs are not additive, but transformative—they aim not at adding more papers and tests of writing ability, but at changing the way both teachers and students use writing in the curriculum" (McLeod 3). WAC clearly involves innovative integrations of writing and language to enact a "transformation."

This innovation is becoming evident in WAC programs in agriculture. Although many universities have implemented WAC in agriculture curricula, and tremendous variety in WAC results (Blank; Wechsler; Wiebold, Buehler, and Scott; Firman; Fletcher and Branen; Smith, Charnley and McCall; Zinn, Faustman, and Riesen), a single theme emerges from literature about WAC in agriculture: writing is strongly encouraged not only as a valuable learning activity but also as an activity that prepares students for the workplace.

In this essay, we review literature that describes a work-related theme in agriculture WAC programs as seen primarily from teachers' vantage points. (Our review addresses literature in journals of two distinct sorts: journals dedicated to wide-ranging topics on agricultural education—*NACTA Journal*, for example—and discipline-specific journals—in forestry or agronomy, for instance—that cover technical and pedagogical topics.) We first very briefly trace the workplace-driven rationale for implementing WAC in agriculture; second, we review WAC assignment topics and teaching strategies that agriculture faculty have incorporated to assist students' preparation for the workplace. We conclude by identifying innovations in WAC in agriculture, such as electronic and oral communication, that address the increasing need for proficient communication in the workplace. We argue that although these new WAC developments may be innovative to agriculture—and perhaps transformative since WAC

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strategies in agriculture take teachers and students in new directions in the classroom—the tools they are using have been around for some time in composition and have been successfully put to use in other disciplines as well. In short, the literature we review here suggests that agriculture has recognized the usefulness of WAC and is beginning to put WAC principles into practice for workplace-oriented courses.

Why Use WAC?: A Workplace-Driven Rationale for Implementing WAC

While several reasons to use WAC programs in agriculture are identified in the literature, a central and even driving reason to incorporate WAC programs is the inability of recent graduates to communicate effectively on the job (Cobia 22). In response, faculty in agriculture, like faculty in many other disciplines, have become keenly aware of this shortcoming and demonstrate in the literature we reviewed efforts to remedy it (Fletcher and Branen 18; Wiebold and Duncan 27; Zinn, Faustman and Riesen 14; Berghage and Lownds 124; Boufford 249; Daniels and Reed 27; Wiebold, Buehler, and Scott 51; Flowers and Reaves 9). Rather than blaming English departments (traditionally the home of instruction in communication) for shortcomings in students' proficiencies in writing and communication, many programs in agriculture are benefiting from incorporating communication into their discipline-specific courses.

Not only do agriculture faculty support WAC as an important learning activity (Gleichsner 34; Daniels and Reed 28; Flowers and Reaves 9), but they have begun to see immediate applications of WAC—to increase students' competitiveness in the workplace. As a result, faculty are motivated to use WAC not only for academic purposes but also for professional purposes (Berghage and Lownds 124; Smith, Charnley, and McCall 34). The connections that agriculture courses are making to workplace communication beyond the classroom may be the strongest examples of transformative characteristics of WAC programs that McLeod describes.

How Can WAC Be Initiated in Agriculture? WAC Assignment Topics and Teaching Strategies

Suggestions for incorporating writing into agriculture classes include designing assignments appropriate to workplace communication and developing teaching strategies that encourage collaborative written and oral communication. These assignments and strategies are familiar in WAC literature and, in fact, may be borrowed from composition pedagogy informed by social theories of learning (e.g., the use of peer review and collaboration in the classroom). These assignments and strategies offer

students and teachers in agriculture a beginning step toward transforming classroom practices; missing, however, is a discussion in this literature of how and why WAC principles are valuable to the specific disciplines within agriculture.

Assignment topics. Because traditional assignments such as term papers, microthemes (Parrish, Brumback, and Squires 28; Berghage and Lownds 125), or abstracts (Parrish, Brumback, and Squires 28) may not allow students to practice communication appropriate to professional fields, faculty are seeking new, innovative assignments to incorporate writing in their classes (Boufford 249).

Through involvement in WAC programs, agriculture faculty learn to design assignments that address professional purposes, audiences, and contexts that their students will encounter in their future jobs (Wechsler 114; Fletcher and Branen 18; Fuccillo 29; Wehner 456). Narrowing purposes and audiences to focus on workplace contexts is a strong innovation in WAC in agriculture that has produced unique, interesting assignments, as well as general enthusiasm among faculty and students. Because agriculture includes numerous and distinct fields of study—from agricultural systems technology to microbiology to entomology—purposes and audiences for professional communication within these fields vary widely and allow for many communication opportunities. For example, agriculture professionals may engage in the following communication tasks: equipment safety rules to co-workers in ag systems technology, a feasibility report to an agronomy client, or animal ecology research results to an audience of non-native speakers. Consequently, assignments may include written instructions, reports, or news articles written to non-specialized audiences (Fuccillo 29; Wehner 457).

Another assignment typical in the workplace that addresses a professional purpose and audience is a newsletter. Robert Boufford assigned newsletters in his sophomore-level horticulture class as an "applied writing activity" (249). Often this application requires students to communicate their technical expertise to a non-specialized audience. Boufford requires students to write two articles and publish a newsletter related to turfgrass management—a communication activity that he believes graduates are likely to encounter in the workplace (249). Not only does this assignment allow students to write for a specific purpose and audience, but it also allows them to use computers in the process, an increasingly important workplace communication tool (249). Newsletters and other assignments with defined audiences encourage students to see the uses of writing in their discipline beyond the classroom. While these assignments may not be new to WAC professionals in other disciplines, they are new to agriculture.

Teaching strategies. McLeod's vision of transformative writing programs calls for change in the way students and teachers view writing in the classroom. Commonly discussed teaching strategies that strengthen communication in the classroom and prepare students for future workplace situations include collaboration in the form of peer review (Sims 105) and teamwork (Wiebold and Duncan 29; Fletcher and Branen 18; Westgren and Litzenberg 363). Again, these are not unfamiliar practices in WAC classrooms. But what is particular to WAC programs in agriculture is a consistent focus on workplace applications.

Peer review, a strategy in which students in a group review the written work of others within their group, has been found to increase student involvement in their own writing as well as in the writing of others (Sims 105; Berghage and Lownds 126; Westgren and Litzenberg 363). Like the use of peer review in WAC programs outside of agriculture, the strategy encourages students to see their peers as part of a writing community and creates a sense of audience that an individual professor cannot replicate. This newly developed writing community allows students to teach each other (Fletcher and Branen 20) by actively engaging in several stages of the writing process (Sims 105). In addition, WAC in agriculture makes use of peer review to model both workplace writing communities and the review processes graduates often face in their future jobs (Sims 105).

Teamwork is another collaborative strategy that can be incorporated into writing assignments (Burnett; Westgren and Litzenberg 362; Fletcher and Branen 18). Team-based work has been used in capstone courses where students practice problem-solving and research skills in groups that simulate some aspects of workplace groups (Westgren and Litzenberg 362; Fletcher and Branen 18). For example, WAC faculty at the University of Idaho suggest the usefulness of such experiential courses by discussing strategies for structuring the course, posing reasonable expectations for student reactions, and reporting on student outcomes. "Certainly students can learn from teacher-directed strategies such as lecture and demonstrations," Fletcher and Branen write. "But to meet the many needs of today's active learners, cooperative, student-initiated and student-directed learning is fitting" (22).

Peer review and team-based courses and assignments can help prepare students to learn to work with others—a valuable ability in their future professions (Blank 34; Brumback, Squires, and Parrish 33; Fletcher and Branen 18). Westgren and Litzenberg believe that the process of randomly assigning students to collaborative teams "attempts to simulate the group dynamics that employees may face in cross-departmental, task-oriented work in the workplace" (363). These authors also see students developing crucial skills in leadership and understanding more effectively how to allocate tasks as a result of their teamwork (363). In addition,

collaborative assignments can allow students to produce richer, more complex documents, such as handbooks and manuals that are appropriate for professional use (Wiebold and Duncan 28).

Innovations in WAC in Agriculture: Electronic and Oral Communication

WAC in agriculture currently focuses on preparing students for the writing they will do in the workplace but seldom discusses areas other than writing that are important to professional communication, such as visual communication, international communication, ethics in communication, interpersonal professional interaction, and document and information design. For WAC programs in agriculture to sustain their momentum toward transformative practice, more attention will have to be paid to these areas mentioned only peripherally in the literature reviewed here. Perhaps in the future WAC in agriculture will seek support from professional communication in addition to composition. However, literature about WAC in agriculture does move beyond writing in two important areas: electronic communication and oral communication.

Electronic communication. Literature reports a strong awareness and emphasis on emerging computer technology and that technology's role in WAC and agriculture programs. Computers have become essential writing tools and are fast becoming essential information sources as well (Boufford 249; Gleichsner 35).

Just as emerging technologies require students to become familiar with new ways of writing and collaborating, these technologies pose special requirements for faculty in agriculture who incorporate communication in their disciplines. Including electronic communication in agriculture curricula requires instructors to "enhance student awareness and abilities in the new technologies, creating a classroom environment that is supportive, non-threatening, and based upon an experiential approach to learning new material" (Herr and Parsons 9). One example of this innovation is using the Internet to teach interactive communication skills through media such as electronic mail and Internet access applications such as Gopher. Using technology in this way has the potential to empower students and create discourse communities both within and beyond the classroom (Herr and Parsons 9)—communities they will likely encounter in their future jobs.

Oral communication. Oral communication, like written communication, is a necessary skill and is expected among professionals in agriculture. Some agriculture programs focus on the development of oral communication skills to prepare their students for this professional expectation. While not necessarily recent innovations, oral presentations are com-

monly assigned to achieve this goal (Parker 34; Zinn, Faustman, and Riesen 14). To help students further develop skills, presentations may be videotaped to enable self-evaluation (Cox and Martin 26). Other potential oral communication assignments include listening skills, organizational interpersonal communication, and applied persuasion (Cronin and Glenn 358).

Conclusion

The literature we have reviewed focuses on programs that prepare students for the workplace. While this workplace focus is not innovative, it has allowed agriculture teachers and students to explore writing and communication in new ways. And, that new application may, indeed, be transformative.

Agriculture instructors are increasing the amount of writing in their classrooms and are using collaborative strategies to more closely resemble workplace contexts. Further, those strategies are influenced by technological tools. Each of these strategies in communication instruction prepares students for future demands of the workplace and changes the ways teachers assist in that preparation.

Because the literature we have reviewed suggests a strong emphasis on communication as it applies to the workplace, WAC programs in agriculture may soon expand their emphasis from composition to professional or technical communication. Although WAC literature in agriculture does not acknowledge the various distinctions of professional communication, the focus on workplace communication in agriculture curricula seems to be pointing this direction and perhaps may include these distinctions in the future.

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Controversy Across the Curriculum

Ending Composition as We Knew It

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Often enough those of us involved in the writing-across-the-curriculum (WAC) effort have looked past first year composition, focusing instead on curricular reform and faculty development aimed at promoting writing in courses beyond composition. Often these efforts have begun with our involvement in institutional discussions of graduation requirements and general education. At my institution, I have been part of such discussions, representing the humanities division on a campus-wide committee charged to review and reconsider our general education program, including the place of composition (which we have required for years) and the possible proposal of writing-intensive courses (which heretofore we had not required). As a group, we spent over a year and a half listening, discussing, arguing, and, finally, proposing. And during this extended discussion, I frequently was asked about composition, not so much as a teacher of it, but rather as a de-facto expert/apologist for its aims and its function in the general education curriculum.

Among many questions, our committee has wrestled with these: what is first year composition, what are its legitimate purposes, and who should teach it? Our discussions gave me a window on a series of assumptions about this course, assumptions I now realize are firmly grounded in curricular history. Those same discussions have also surfaced a variety of what I consider misunderstandings—and, occasionally, outright hostilities—towards composition teachers who some believe are simply doing a poor job. Joseph Harris in his book *A Teaching Subject: Composition Since 1966*, quotes a biologist at his institution, and it is sentiment I have heard from some of my colleagues too: "The thing is that most of us think that too many students can't write worth a damn, and we wish you'd just do something about it" (85). Our general education committee has done something about it. With faculty assembly approval, we have eliminated composition as a general education requirement. In its place, we have instituted a required first year Inquiry Seminar, taught by any teacher on any topic that lends itself to inquiry, provided the course adopts certain pedagogical practices and encourages in students a self-conscious aware-

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ness of the intellectual habits of mind associated with those practices. These courses carry an IQS designation rather than the designation of any one department, and at my institution they are now the only curricular exceptions to regular department-based courses. The Inquiry Seminar guidelines approved by the faculty assembly will seem familiar to WAC advocates:

INQUIRY SEMINAR GUIDELINES

—clear intellectual focus
—frequent student discussion; class participation and speaking (informally and formally) are figured as a part of the course grade
—use of a common grammar/punctuation handbook for teaching and reference purposes
—use of informal writing to help students explore course content and articulate questions (roughly 20 pages)
—at minimum four formal writing projects using the writing process, including provision for feedback and revision (roughly 25 pages of finished writing)
—at least one project requiring library/on-line research, hence discussion of research strategies
—discussion of ways writing situations differ according to the writer's audience and intent

To many of my colleagues outside the English department (and to some inside), eliminating composition seemed radical and, to a few, immediately irresponsible. After all, ending composition flies in the face of a century of curricular precedent, so as you might expect, I have repeatedly been asked to offer some rationale for such substantial change. I do so in a single—albeit painful—sentence: composition doesn't work. More fully: composition cannot possibly do the job that the rest of the institution asks and expects of it. Why not? Because, as I see it, the premises that first year composition was founded on in 1897 when Harvard deemed it the only course required of all students—those premises are too seriously flawed.

Composition in Historical Context

In the history of American higher education, composition began not as a single course but rather as a set of curricular practices. Prior to the Revolutionary War, virtually all American colleges were organized around some form of orthodox Christianity, with their primary purpose being the education of young men for the ministry (Brubacher and Rudy 8). This

purpose was naturally reflected in the long-established medieval curriculum centered on Greek and Roman literature and on the Bible. "In addition, such subjects as Aramaic, Syriac, Hebrew, ethics, politics, physics, mathematics, botany, and divinity were to be studied" (Brubacher and Rudy 14). Though the courses of study from institution to institution varied somewhat—for example, Yale's President Ezra Stiles required Hebrew study of all students until 1790—all courses of study emphasized the centrality of Greek and Latin languages and literatures. In short, the entire curriculum was language-intensive.

In addition, most institutions prior to the Civil War operated on the recitation system, a system built on the teacher's citing of a text and the students reciting of that same text (Brubacher and Rudy 82). At its worst, this reduced education to a tiresome, occasionally petty exercise of rote memory, but as David Russell points out, the recitation system was

> . . . at least structured to include many kinds of activities: oral reading, note-taking on spoken and written material, translation, paraphrase, historical and philosophical commentary. Students not only manipulated language (and languages), they did so in progressively more sophisticated ways throughout their schooling, leading to full-blown public speaking and debate (40).

In short, higher education up to roughly 1870 was a richly language-based enterprise. If it allowed students few or no electives (since all students took the same course of study), it also guaranteed frequent and progressively more demanding practice in language use, with no split between course content and what we would now term "writing" and "speaking."

For a variety of reasons, all this changed dramatically after the Civil War. The single-curriculum model was seen as restrictive and unresponsive to new developments in scholarship as well as new needs in American society, needs made especially evident with the 1862 passage of the Morrill Act establishing land-grant colleges. Clearly, the old curriculum and its language-rich practices were no longer the only model. As Iowa State Agricultural College President Welch said in 1871, "knowledge should be taught for its uses... culture is an incidental result" (Brubacher and Rudy 64). Institutions like Harvard also recognized the world had changed. In 1869, Harvard's newly inaugurated president Charles W. Eliot began a campaign championing what he termed "the elective system," an effort aimed at transforming Harvard's curriculum from a single prescribed track to one that offered students wide choice in what they would study (Rudolph 293). Eliot's move was entirely successful: Harvard dropped subject requirements for seniors in 1872, for juniors in 1879, and for sophomores in 1884. Freshmen requirements were substantially scaled back in

1885, and "by 1894 a Harvard freshman's only required courses were rhetoric and a modern language" (Rudolph 294). By 1897, the sole common requirement for Harvard graduation was a year of freshman rhetoric.

Thus a curriculum based heavily in classical languages—Latin, Greek, and Hebrew—gave way to a curriculum taught in English and meant not to perpetuate culture as consciously expressed in language, but rather to equip graduates with the knowledge required of them by a changing world. As the curriculum widened, the old recitation practices were abandoned, typically replaced by the lecture system that asked teachers to speak and students to listen and take notes. In this historical process, content split from its expression, and language activities gradually came to be seen as impediments to the efficient coverage of course content. The required first-year rhetoric course became the sole vestige of an old, admittedly out-dated, but also language-rich set of curricular practices. And ultimately, all responsibility for these practices—all responsibility for the written expression of any content—fell to this single course. Recall again the complaint of Harris's colleague: "The thing is that most of us think that too many students can't write worth a damn, *and we wish you'd just do something about it*" (emphasis added).

In the view of the institution as a whole, language practices became merely another content, in this case a content viewed as rudimentary, basic, and foundational. New disciplines developed (and continue to develop), yet for at least the first half of the 20th century, higher education presumed that a single writing course would provide sufficient foundation for language expression in any course in any context. The WAC movement as well as many advances in our understanding of the cognitive and social processes of writing all stem from a recognition that writing is not a single, rudimentary and foundational content. We know that one composition course is not sufficient. Yet many, many institutions continue to require composition without examining its aims or understanding its history.

Composition defined as a remedial, foundational course is at least as old as Yale's 1822 required remedial first-year course in English grammar, though by 1834 it had been dropped in favor of stiffer admission requirements (Brubacher and Rudy 13). In fact, discussion about whether or not to require composition as a course has always circled around the notion of admissions requirements and the need for remediation, thus consistently asserting the composition course as something preparatory to the real business of higher education. Citing William Payne's collection *English in American Universities* published in 1895, Robert Connors notes that the Harvard decision to require composition was not universal: by 1895, "Indiana, Nebraska, and Stanford had all abolished freshman composition in favor of strong entrance requirements" (49). Connors also

quotes Stanford professor Melville Anderson, who applauds the abolition of freshman English by saying: "Had this salutary innovation not been accomplished, all the literary courses would have been swept away by the rapidly growing inundation of Freshman themes, and all our strength and courage would have been dissipated in preparing our students to do respectable work at more happily equipped Universities" (49).

The 1994 catalog copy for my own liberal arts institution lists first year composition as the single effort needed to satisfy the "writing effectively" general education requirement. The implication is quite clear: first year composition is meant to equip students to do just that—write effectively.

It's the foundational fallacy that dooms this enterprise: a fallacy that asserts composition is, at its most reductive, merely a thorough knowledge of grammar and, at its most ambitious, a discrete set of writing skills, the presumption being that writing well is a matter of seamlessly transferrable mastery. From this view, context ought not to matter, audience shouldn't matter, nor should the writer's prior familiarity with content, or her interest or attitude, or even the amount of allotted time; good writing is good writing is good writing. The foundational fallacy's primary corollary takes all this a step further: it quite squarely rests primary responsibility for all writing instruction on composition teachers and no where else. We're supposed to take care of it. Joseph Harris's quote from his colleague has been mentioned earlier. Harris also quotes Richard Rorty as giving this more-or-less typical, thumbnail description of first-year composition: "I think the idea of freshman English, mostly, is just to get them to write complete sentences, get the commas in the right place, and stuff like that—the stuff we would like to think the high schools do, and, in fact, they don't" (85). Of course such a description merely perpetuates a very old model. It ignores more than three decades of studies and discussions that we now recognize as the discipline of composition; in shorthand, it ignores everything from Janet Emig's 1971 publication of *The Composing Processes of Twelfth Graders* to the present.

Asserting a New Model

What seems odd about all this to me now is the sense that for some time we all have known composition couldn't live up to its historical billing; we've known that we could not possibly do the writing teaching for all of our colleagues and all of their courses. We've known that the apparent split between "writing" and "content" is not merely false, it's counter-productive. Yet we have continued teaching composition or training others to teach it. Our students have continued to take it—what choice have they had? And so we've spent term after term greeting new

room-fulls of people who, for the most part, view composition just as the curriculum itself asserts. They too see composition in these same historical and reductive ways, as another content either unnecessary ("I already know this") or more of the same old torture ("I've seen this before and I'll never learn it").

I emphatically do not mean to suggest that first year composition was or is worthless. Typically it offers students small courses that let them form a genuine acquaintance with each other and with the course instructor. Genuine learning communities can thus result. And often enough it is a composition course that leads students to significant recognitions of complexity and nuance rather than more simplistic intellectual views. In many ways then, a composition course serves as an introduction to the intellectual life that defines higher education. Composition courses also have at their core a presumption that student thought is important and that its careful, accurate expression is worth a term's attention. Thus, while its curricular slot and function argue for composition as a content unconnected to any other, the course activities, readings, and practices have often worked hard to link good writing and good thinking, consistently affirming the argument that writing is "a mode of learning" (Emig 122).

In our committee discussions of the Inquiry Seminar, we have tried to preserve and highlight these useful, positive aspects of composition. The Inquiry Seminar is described as

> . . . an in-depth, collaborative investigation of a compelling subject. [It is a course that] explores and practices the relation between thinking and communication, both oral and written. [And] it embodies the goals of the entire Linfield Curriculum in developing critical thinking skills common to every discipline and vital to becoming an educated person. (Linfield 1996-1997 Faculty Assembly Agenda 33)

While we want to retain the positive aspects of composition, our goal here is also admittedly reformist: for students and for faculty alike, we hope to substitute a different set of assumptions about writing itself and a larger, common assumption of responsibility for "good writing." The comparisons below summarize the changes a first-year seminar program can assert. But this should be emphasized separately: instead of "college writing" taught only by English faculty, we now have seminars with such titles as "Justice," "Creativity," "Imagining Better Places," "Domestic Violence," and "Environmental Perspectives," taught by faculty from areas such as anthropology, music, nursing, art, business, speech, religion, education, political science, biology, sociology, philosophy, physics, English, and modern languages.

Proposition: Required first year composition reinforces various historically based assumptions; a program that abolishes first year composition challenges those assumptions and works to replace them.

COMPOSITION	INQUIRY SEMINAR
common view: writing is writing; content and context don't matter	writing happens in many contexts; writing well requires adaptation
common view: writing remains the responsibility of English department; if other teachers care about good writing, they're weird (a WAC program complicates this view)	writing is a responsibility shared by many teachers from many departments
faculty view: writing in the first year is mostly a matter of addressing error; students who have completed composition should now and forever write error-free prose; error is/ should be a matter for English faculty only ("the experts")	all writing is an integral aspect of learning and articulating course material; errors result from many factors and are one important element in a larger view of writing
faculty view: English teachers at all levels don't do a good job teaching writing because students keep having to take more of it, and "students still can't write"	writing facility can always be improved; writers continue to learn from many teachers
student view: a composition course is just more of the same—unnecessary for good writers, more drudgery for the rest	an inquiry seminar—what's that? (i.e. curiosity, challenge)
student view: the institution thinks we're unprepared for college ("we have to get past remedial stuff to get to the real thing")	the institution thinks we can do this
student view: the institution will tell us what to take and when	we have to make educational choices

As these comparisons suggest, a move to replace composition with a first year seminar is a move to assert wide responsibility for writing instruction and writing practice. This position is hardly new. Connors quotes Preston Slosson writing in 1913: "the real way to make sure that every Columbia graduate, whatever his other failings, can write whatever it may be necessary for him to write as briefly, logically, and effectively as possible, is not to compel him as a freshman to write stated themes on nothing-in-particular but to insist on constant training in expression in every college course (51)." And the emphasis on writing in every college course takes us directly to writing-across-the-curriculum, a movement and a curricular notion that came into being based on the recognition that a single first year course could not achieve its historical ambitions.

The WAC movement has consistently argued for a view of writing considerably at odds with the historical view of composition. A WAC view of writing asserts that every writing activity is situated and in some sense unique. WAC embraces writing as a large set of possible practices or processes. It argues in a variety of ways for the importance of audience and particular purpose. It affirms writing as a set of intellectual and emotional behaviors that, while they can be improved, cannot in their nature be mastered. It views errors as the result of many factors involving content, language knowledge, and writer motivation. And it argues for the considerable value of exploratory or informal writing as a fundamental tool for engaging course content and both extending and deepening one's understanding. In short, WAC has sought to replace a notion of writing mastery with a notion of considerable and varied writing practice. Given all of that, if we really believe that writing ought to extend across the curriculum, and if we already encourage the identification of writing intensive courses, then why not consider extending these same principles to the first year?

This is, I hasten to add, not an original idea. It has been enacted at various institutions already—at institutions like Pomona College, Dickinson College, Coe College, and Bucknell University to name a few. Cornell runs its first year seminar program with teaching assistants from departments across campus.

However strongly I am now persuaded of the merits of this proposal, I am equally strongly aware of its local, specific nature. I would not presume to advocate its adoption anywhere else, because I know a thousand local variables can come into play. Some of them are institutional: how much does an institution truly value undergraduate teaching and how is that valuation reflected in promotion and tenure guidelines? To what extent does a particular institution foster a sense of common community and shared responsibility? What sort of students attend the institution? How satisfied are faculty with the status quo? Other questions are

even more practical: what happens to an English department graduate program if composition goes away? And if English department faculty don't teach all those sections of composition, if that requirement is replaced, then who will staff this new requirement? If someone in, say, philosophy teaches a first year seminar, who will teach the philosophy course that otherwise would have been taught? Participating faculty immediately raise their own questions: how can we teach both ambitious course content and writing? And what about those faculty who feel intrigued but tentative or somewhat unprepared?

If these questions seem somehow familiar, it's probably because they are pretty much the same writing-across-the-curriculum questions that arise when an institution moves to adopt a WAC program. And the responses here can be quite similar too. We have some practice with these problems, and we do not have to reinvent the wheel. A first-year seminar program needs the same kind of institutional support and funding that any WAC program needs. It means faculty development workshops and the individual follow-up discussions that they inevitably provoke. It means a long-term and institution-wide commitment.

If nothing else, the proposal to eliminate composition can foster a genuine institution-wide reconsideration of what writing is and who is responsible for it. Faculty gathering in a series of workshops to discuss these issues have already begun counteracting the historical assumptions about composition as a course and writing as both process and product. This begins an institution-wide attention to what Lucille Parkinson McCarthy terms "the context-dependent" nature of all writing (153). A first-year seminar program rich in language activities suggests fertile links between writing and speaking. It suggests writing is a complicated linguistic and social activity central to human learning and understanding. And it suggests that the shared responsibility for good writing, as for good learning, extends to every department and every course.

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WAC and the First-Year Writing Course: Selling Ourselves Short

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The relationship between writing-across-the-curriculum programs and the first-year writing program has always been a delicate one. In some institutions, WAC is considered to be simply an extension of the freshman composition course. When Beaver College introduced WAC into their college curriculum in the late 70s, the freshman composition courses were modified to include at least one assignment drawn from a discipline other than English, such as biology or political science (Kinneavy 365). Writing-intensive courses in the major were expected to reinforce the skills developed in freshman composition. Furthermore, such courses would send a message to students that freshman composition was not simply a hurdle to pass on their way to the major.

In other places, however, the freshman composition course was seen as simply one element in the overall WAC program, or perhaps even an impediment to faculty acceptance of WAC. The debate over the relationship between WAC and the freshman program came to a head in 1988 when Catherine Pastore Blair declared that "the English department should have no special role in writing across the curriculum—no unique leadership role and no exclusive classes to teach—not even freshman composition" (383). In a companion article, Louise Z. Smith countered that English Departments were the ideal locus for the WAC program.

The debate has continued in various forms throughout the 1990s. Most WAC directors have received their graduate education in departments of English and have a faculty appointment in that discipline. In many cases, the WAC director is also the director of the freshman writing program or the campus writing center. Promoting the WAC program is seen, then, as a logical extension of the duties associated with the freshman composition program. In other cases, the WAC program is spearheaded by a faculty member outside of English who heads a WAC committee. Obviously, having a non-English faculty member leading the charge for the WAC program can ward off the accusations that the WAC program is a "power grab" by the English department.

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The question of who will lead the WAC program on campus is crucial because the success of the program often hinges on personal leadership. David Russell has chronicled the demise of several cross-disciplinary programs that failed due to a lack of institutional support. Cynthia Cornell and David J. Klooster have written how the success of the WAC program can sometimes depend on the goodwill of a single faculty member:

> Our ten year program has been sustained largely by the commitment of a single faculty leader outside the English department. When this leader retires in five years, he may well have no successor. (10-11)

Although some WAC requirements have been formalized (e.g., students must take a certain number of writing-intensive courses), faculty participation in the program is still largely voluntary. The WAC director has been in the position of recruiting a volunteer army for a literacy war. Given the competing demands on faculty time and energy, the importance of having charismatic and enthusiastic leadership for the program cannot be overstated.

As well as the issue of leadership, the question of funding can strain the relationship between the WAC program and the freshman composition program. In order to institutionalize the WAC program, the university must commit resources to pay for directors, secretarial support, workshop expenses, tutors, teaching assistants, writing fellows. At a few institutions the WAC program has become a big-ticket item, amounting to tens of thousands of dollars. Certainly, such costs can be justified as one of the few ways of directly improving the quality of instruction, but when resources are stretched thin, the funds being expended on WAC are likely to be jealously regarded by other academic units. Some freshman composition directors have found it ironic that the administration can devote large sums to the development of a WAC program while the freshman program is chronically understaffed, underfunded, and underappreciated.

At some institutions the establishment of the WAC program has resulted in the abolition of the traditional freshman composition course taught primarily, or even exclusively, by English department faculty. Such decisions are often made for theoretical as well as financial reasons. Administrators or faculty committees have sometimes eliminated or reduced required courses in composition at the freshman level in order to reinforce the notion that the responsibility for writing instruction belongs to the entire faculty. At some schools, the traditional composition course has been replaced with freshman seminars taught by faculty in various disciplines. The seminars are taught in the faculty member's area of expertise,

but the stated purpose of the course is to improve student writing. Consider, for instance, the freshman writing seminar at Cornell:

> The primary purpose of the Freshman Writing Seminar is to help students write good English expository prose . . . . Freshman Writing Seminars pursue this common aim through diverse offerings (more than 170 sections in more than 30 departments and programs). (*Publication of the John S. Knight Writing Program*, 1995-96)

The freshman writing seminars range from "Death and Dying in Anthropological Perspective" to "Disney's America." Although the faculty teach the course from a disciplinary perspective, the guidelines for the course are designed to ensure the centrality of writing in the course. At Cornell, teachers must require at least six, and no more than fourteen, formal writing assignments. At least two of these assignments must be seriously rewritten. They must spend "ample, regular classroom time" on the students' writing as well as scheduling at least two individual conferences. To ensure that writing remains the focus of the course, reading assignments are actually limited to a maximum of 75 pages per week.

Freshman seminars similar to the ones at Cornell have grown in popularity around the country, including the one Lex Runciman describes in a companion piece in this issue of JLLAD. I have already alluded to the budgetary logic of the freshman seminar approach. It also seems consistent with the general principles of WAC. If all teachers are qualified to teach writing in their disciplinary specializations, then why shouldn't they be teaching an introductory writing course? If anything, they should be more qualified, since freshman writing is presumably less complex and sophisticated than the writing of upper division students.

What I would like to argue here is that the qualifications required to teach a writing-intensive course and those required to teach the introductory writing course are not necessarily the same. Furthermore, I would like to indicate some of the potential problems for both faculty and students when the freshman writing course is handed over to those with little background in writing instruction. In making these arguments I will be drawing on my own experiences with programs of this nature at various institutions. The evidence is admittedly anecdotal. I will leave it to you to decide whether my experiences are singular or, as I suspect, more universal in nature.

The first question to be raised about the ability of those in other disciplines to teach the introductory writing course is: "Do they possess the necessary education to perform this task well?" I mean, by this, not only are they competent writers, but do they understand the theoretical

issues that undergird writing instruction. I have, for instance, received angry memos from faculty members who felt it was an imposition for them to participate in a WAC workshop. One of their first defenses was usually the long list of publications on their personal vitae. However, being a practicing writer does not guarantee success in the teaching of writing. In fact, the groundbreaking studies of Janet Emig, Linda Flower, and others have shown us how little awareness most writers have of their own composing processes. In many cases, academic writers are likely to fall back on advice that has little to do with their own writing experience. "Everything you need to know is in Strunk and White." "Be sure to have a clear thesis before you begin." "Never begin a sentence with a conjunction." And so on.

Like many graduate students in English, I had to do nearly as much unlearning as learning. The idea that writing was an epistemic activity was foreign to me. Writing was simply the expression of thoughts clearly conceived. The lack of correlation between grammatical knowledge and writing expertise was completely unacceptable to me. Surely, I hadn't completed all those school grammar exercises in vain. Time after time, in university committees charged with directing the writing program, I have argued that the purpose of a WAC program is much more than simply improving the grammatical correctness of student papers. But even if in one meeting the committee acknowledged the importance of writing as learning, the next meeting was likely to begin—tabula rasa—with a call for spelling exercises or sentence diagramming. Or, as one business professor succinctly put it to me: "You teach 'em how to write, and we'll teach 'em how to think."

This is not to say that all WAC programs are doomed to fail because the faculty are ineducable on composition theory and pedagogy. The success of such programs does hinge, however, on the willingness of the faculty to commit time and effort to understanding and applying these principles. The commitment to teach a writing-intensive course often requires a fairly minimal level of commitment: assign a few journals, divide the traditional research paper up into a sequence of assignments, provide some form of feedback during the writing process. However, all of these activities are connected to making the student a better chemist or speech pathologist or anthropologist or whatever that faculty member's personal passion happens to be. In every case, the writing is an instrumentality, not the focus of the course.

In the freshman writing class, the situation is quite different. Students are developing foundational skills in writing. Many of them are writing extended academic discourse for the first time. They may know little about using evidence to support a contention, about acceptable forms of argumentation, about the effects of organization and style on the

reader's response. Unlike the senior anthropology major who has read enough to understand intuitively the forms of discourse and rules of evidence acceptable in that discipline, the freshman student often struggles with basic genre distinctions, attempting to write reports as though they were manifestoes or essays or poems. Not infrequently, the professoriate may find the labor required to assist the freshman student beneath his or her dignity. Such was the response of an outstanding history scholar at my own university. I was team teaching an interdisciplinary humanities course with him when he showed up in my office one day with an armload of journals. I assumed that he had brought these over to show me how he had responded to the students in his group, but his real expectation was that—as the English faculty member on our team—I would be grading them. Although I dissuaded him of this notion, it was clear from his students' responses that he never read the journals or gave them anything more than a cursory, terminal comment.

And this leads me to my final point. Most faculty think of responding to student writing as mere drudgery to be endured. Of course, even the composition specialist may sigh at approaching a stack of student papers. But there is nothing more inherently tedious about responding to papers than there is about studying mold spores or comparing variant manuscripts or any of a thousand other activities that researchers are routinely required to perform. The difference is, of course, that the investigation is motivated by the hope of discovery. The botanist examines a thousand plants to learn how they respond to a particular soil treatment. For the composition specialist, the writing classroom is the greenhouse. How did students respond to this assignment? What models were used by students in organizing their papers? What can we learn about the way different genders interpret the assignment? What was the effect of collaborative work? What classroom activities contributed to significant revisions? As Mina Shaughnessy demonstrated so brilliantly, the papers most readily dismissed by others may generate the greatest insights by the dedicated researcher. And just the way that I cannot imagine a life dedicated to studying mold spores or wheat blight, I cannot expect all professors to have the same enthusiasm for composition research. It appears that in some of the WAC programs that have proved most successful—I am thinking particularly of Young and Fulwiler's work at Michigan Tech—the faculty became involved in significant research and publication on the nature of their own disciplinary discourse. Still, it seems unreasonable to ask everyone at the university to develop an interest in composition studies. That is a disciplinary imperialism that even the staunchest of WAC emperors would hesitate to pursue.

I trust my remarks will not be construed as a specific attack on any particular school or program. I suppose with enough dedication and

resources we could equip every faculty member to teach calculus or metaphysical poetry. But I do not think that replacing freshman composition with freshman seminars taught by faculty from departments across campus is a realistic option for most colleges in America. For the reasons I have outlined above, faculty have neither the preparation nor the inclination to provide the foundational course in writing for entering students.

Furthermore, I think that those who promote such schemes may actually undermine the legitimacy of the composition course. For some administrators, eliminating the freshman course is simply a convenient way of handling budget constraints. For some faculty, it is a way of putting a favorite hobby horse into the curriculum. For some writing program administrators, it may be a way of addressing the chronic shortage of faculty needed to staff the writing courses. But none of these reasons focuses on the needs of students and the key role the composition course plays in their future academic success.

Instead, the freshman seminar approach only reinforces the classic complaint leveled against those who teach rhetoric, that they have no real discipline, just, as Plato would have it, a bag of tricks used without any real knowledge. I do not think that writing-across-the-curriculum programs, per se, necessarily lead to this conclusion. After all, we ask students to read in all of their courses, but not everyone considers himself or herself an expert on reading. Similarly, we can promote writing across the curriculum without equating the rhetorical knowledge of those who teach writing-intensive courses with that of the composition faculty. But to place the courses dedicated to writing instruction into the hands of those who have, perhaps, given a day or so to thinking seriously about how to teach writing to others, is an act that sells short the expertise of those of us in this disciplinary community and which contributes to the tenuousness of a course which is already moored on the edge of the academic mainland.

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Gender Issues in Biology: An Approach to Teaching Writing

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In the spring of 1994, as I was finishing my dissertation in the department of Science and Technology Studies at Cornell University, I was given the opportunity to teach my own course: a freshman writing seminar on a subject of my own choosing. Eager to step to the helm after years of TAing, I leapt at the chance. But the experience of teaching writing from a non-traditional vantage point— by means of a field other than English— was much more rewarding that I could ever have imagined.

The course that I designed taught students to write by introducing them to a subset of science studies: gender issues in biology, historical and contemporary perspectives. I called the course "Women in Biology and Biology on Women." The terrain of science studies was unfamiliar to all of my young freshmen; the value of a humanistic perspective on science, the idea that science and culture are integrally related: all this was new to them. Many of them also came to the course resisting the gender focus and all too ready to announce, "I am not a feminist!" But in the end, every student— eleven women and two men— came away with a broadened sense of the meanings of feminism, a heightened awareness of gender issues in science and, most important, an ability to think critically, argue cogently and write clearly. Because so many universities are currently experimenting with teaching writing across the disciplines, I herewith offer a successful example of a course that fulfilled that ideal.

I was trained to teach writing in Cornell's John S. Knight Writing Program. The purpose of the Knight Program is to teach college freshmen to write clear, concise expository prose by introducing them to the subject matter of a particular discipline. The instructors, experts in their own disciplines, take a training course the semester before they teach, in which they design an assignment sequence and read extensively in theory of freshman composition. The freshman writing seminars are small (never more than 17 students), and are offered by instructors in more than 30 departments; the students end up taking two, one each semester of their freshman year. While the offerings are varied, the Program requires that the course leaders assign at least 30 pages of writing, allow opportunity

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for serious revision, spend classroom time on writing and hold individual conferences with students. While they are teaching their courses, the instructors also work closely with an experienced teacher of writing who meets with them weekly to discuss the progress of their freshman seminar and who observes several of their classes.

My course, "Women in Biology and Biology on Women," addressed two main themes. First, we looked at the ways in which biologists (both male and female) have thought about gender difference. What images of woman has biology constructed? How have feminist biologists tried to envision alternatives to these conventional ideas? What changes would they like to see in the practice of biology? In the second half of the course, we put the theoretical ideal of "feminist biology" to the test by turning to the work of women biologists, both historical and contemporary. Did they really work differently from their male counterparts? Rarely, it seems to me, does feminist criticism of science come in to direct contact with the history of women scientists. One of the points of the course was to give students experience with both genres.

My emphasis throughout the course was on the importance of constructing a strong argument to provide thematic coherence to an essay. An essay can make a variety of points, even ones that seem at first glance to be unrelated; but the writer must make the connections between them by establishing their relationship to a central argument. This requires learning how to become an organized thinker by gaining some critical detachment from the subject of the essay. At the same time, I encouraged students to write essays based on their own personal reactions to the course material (especially later on, as they became more confident writers). I wanted them to begin to see themselves as sources of paper topics, so that their own prose would matter to them, so that they would have some stake in it, and so that they would begin to believe in their own writing as a means of self-expression.

I assigned a series of short essays, 3-5 pages each, each one building on the skills they had learned in the previous one, and each one the culmination of a series of preliminary exercises. These exercises involved two different kinds of writing. In free or prolific writing, I asked the students to react personally and fully to the matter under discussion: sometimes I gave them a word or phrase to reflect upon; more often free writing was simply a way for them to set out in words whatever they were thinking. We did free writing in every class, for ten minutes at the beginning to serve as a basis for discussion, and for five minutes at the end, in order to allow everyone— not only those who had had the last word— to react to what had been said. I also asked them to free write at home several times a week, before they sat down to write a paper, after they had read something, or whenever they felt the need to. By emphasizing free writing, I

wished to foster in my students a dependence on writing as a means of thinking, to encourage them to see that they did not really know what they thought until they had set it down on paper. I wanted them to see the logical sequence that such writing imposes on thought, that first an idea must be expressed, and then examined from several different angles. I also wanted them to see that the clarity and forthrightness manifested in their free writing could become part of their more formal writing.

Our preliminary exercises also involved the writing of observations. I asked the students to read a passage, chapter or article and note how the text was constructed: the author's use of language, turns of phrase, turning points of the argument, rhetorical strategies. We often rewrote good prose in linebreaks to see how carefully it had been composed. I distinguished observations from criticism, and we discussed how their observations could become the germ of a paper topic. The observation-writing forced the students to do close readings of texts, but I also encouraged them to read through texts quickly to see if they could glean the main points. I asked them to compare their understanding of the text based on close reading with that based on the more superficial review. Were they learning to recognize the main points of an argument even if they were reading quickly? I wanted them to see that eventually the two types of reading could coincide, and that their reading of a text could become both quick and thorough. The text I used for many of these exercises was Ruth Hubbard's *The Politics of Women's Biology*.

I required at least two drafts of every essay, which I returned promptly with extensive commentary; students often revised beyond the requirement. I also had the students do peer revision. Together we developed a series of guidelines the students could use to comment on one another's papers: does the essay have a clear central argument? Does it address the assigned topic? Is there "empty" introductory material? What works particularly well? How can syntax or style be improved? After several exercises of this kind, students felt that their ability to organize an essay around a coherent theme was improving, but that their essays lacked style. We addressed this problem also through peer revision; each student chose a paragraph from another's essay that was stylistically least pleasing and gave suggestions for improvement. During rewriting, they took their awkward paragraphs apart and reconstructed them; then I asked them to reconsider their entire essay in light of the new paragraph.

The course concluded with two larger projects: an interview with a woman biologist, and a research paper of 8-10 pages on a woman of significance in the history of biology.

The purpose of the first essay was to examine the presentation of women scientists in the popular media. As a straightforward comparison and contrast of two *New York Times* articles, one about a male and the

other about a female biologist, the assignment allowed me to gauge my students' writing abilities. The students had to compare the images the articles constructed, make a point about their presentations, and marshall specific examples from the articles to support it.

In the next series of assignments leading up to the second essay, students read the writings of biologists who argued both for and against the existence of essential differences between women and men. They were also visited in class by William B. Provine, a professor of history and biology, who argued in favor of the existence of essential biological and psychological differences between the sexes, using excerpts from Darwin to buttress his arguments.

Before they had read anything, I asked the students to answer in free writing the question: are there essential differences between women and men, and if so, what are they? In their first essay assignment, they answered the same question in about three pages, unbiased by the works they had yet to read or by their classmates' opinions. I looked for and received personal reflection and the clear, focused prose that often accompanies it.

I then assigned them to read parts of *On Human Nature* by E. O. Wilson, the sociobiologist, and *Myths of Gender* by Anne Fausto-Sterling, the feminist biologist. We spent the next few class sessions discussing the pros and cons of essentialism; by the time Provine came to class they were well-versed in the issue and could engage him in meaningful dialogue and heated argument. In order to add further complexity to the issue, and to show them that debates can have more than two sides, we read some excerpts from Carolyn Merchant's *The Death of Nature* and from ecofeminist writers, who argue that essentialism need not be used to subordinate women but can be turned to feminist purposes. Finally, I asked my students to expand their essays to about five pages, combining their own opinions with what they had read and heard. While the essay form was a variation on the comparison/contrast theme with which they had already had experience, it also required them to sort out at least three different sets of views, to summarize others' arguments in a few sentences, and to find their own voice among them. By the time they had written at least two drafts of this five page paper, their essays were both passionate and clearly directed to a main point.

A central purpose of the course (and one of the results of this last exercise) was to make students less certain about what they thought they knew. At the beginning of the course, for example, they all agreed that the definition of "good science" was relatively unproblematic. A valid experimental method constituted good science, they said; science could be judged wholly by its internal characteristics. After the discussions about essentialism and sociobiology, however, the definition was no longer so

clear. Some of the students began to argue that science could not be separated from its social context; that it had to be judged with respect to its political content; that sociobiology, for example, could be criticized not solely on scientific grounds but on political grounds as well. I wanted the students to see that the complexity of the issue should not affect their ability to construct a clear argument about it.

Our next two projects came out of the issues raised by the essentialism discussions. I wanted the students to gain proficiency in arguing on both sides of an issue, in playing devil's advocate, as this would eventually help them to anticipate an opponent's arguments. In order to do this, we stayed with the issue of essentialism, but moved it to a different context. Instead of discussing the differences between women and men, we turned to the purported biological differences between homosexuals and heterosexuals. Regardless of what their opinions on this matter were, I assigned students to research one side of this controversy or the other; they met in small groups to discuss the issue and then we held a debate in class. In this case, the arguments for essential differences were coming in part from the gay community, while in the previous debate the essentialists had been largely anti-feminist. Students who had argued against essentialism in the earlier case, then, suddenly found themselves on the other side of the issue in the "gay gene" debate. This was a very successful exercise; without exception, the students participated actively in the debate. Afterwards I asked them to reflect on the experience; many of them noted that it helped them to formulate an argument in a logical order.

The issues of sociobiology, biological determinism and essentialism also engaged us in the third sequence of assignments. The purpose of this sequence was to help students understand the power of language, particularly of metaphor, to create meaning, even to construct reality. We read two essays, one a critique by the anthropologist Emily Martin of the metaphors used to describe the process of fertilization; the other by the feminist primatologist Sarah Blaffer Hrdy on the aggressive behavior of female primates. Martin criticized the conventional metaphors used to describe the meeting of sperm and egg, while Hrdy turned the metaphors of sociobiology on their head by using them to support a feminist agenda. Taking Martin's criticism seriously, I asked my students to write the story of the meeting of egg and sperm without using any metaphors at all. Is a metaphor-free language possible? How did the use of different metaphors change the story being told? This exercise made them notice metaphors that otherwise would have slipped by. We then broadened Martin's critique from reproductive biology to sociobiology. If it is not acceptable to endow cells with personhood, as Martin argued, is it right to call female primates "aggressive"? To say that chimpanzees "court"? That ducks "rape"? Is there some point at which human metaphors become appli-

cable to non-human entities? Their third essay was a comparison of the use and function of metaphor in the work of two feminist scientists.

The two final projects of the course were directed toward the second of its themes: does the ideal of feminist biology apply in practice? For the first project, the students conducted an interview with a woman biologist of their acquaintance (a professor, teaching assistant, friend or relative) in order to test out some of the ideas about feminist biology that we had discussed. Evelyn Fox Keller's biography of Barbara McClintock was our model for this assignment. Based on their interviews the students were to write an essay on the following themes: how were women in biology really treated? Did they feel that they worked differently from their male counterparts? I prepared them for this assignment by taking several class sessions to discuss interview technique and to help them formulate series of questions, and by staging three preliminary interviews, one on a volunteer from the class, and two on women biologists whom I invited in on two separate days. Before the students did their own interviews, I reviewed their questions in order to ensure that a coherent essay would result from them. After they had completed their interviews, the students prepared an outline of their proposed papers and gave a ten-minute presentation in class. Their final essays combined material from the interviews with their own opinions, organized around a central thesis. This essay also went through several drafts.

The final project was a research paper on a historical woman biologist. Here Margaret Rossiter's *Women Scientists in America* provided names of and introductions to some of these figures. The choice of subject was up to the student, but I required a brief outline of the subject's life and a list of sources to make sure enough material existed to sustain a ten-page paper. I also required students to use primary as well as secondary material, and not simply re-tell the subject's life in a heroic vein, but formulate an argument and use the subject's life and work to support that main point. Because in most cases their woman subjects were virtually unstudied, this assignment gave students a taste of original historical research. I also used this assignment to demonstrate how tone of voice in writing changes depending on the intended audience; I asked them to present their woman biologist to the readers of a campus newspaper and compare the style they used to that of their scholarly articles.

What follows is a list of books and articles I used in the course, along with some suggestions for different readings I might use if I were to teach the course again.

The books I required were:

Anne Fausto-Sterling, *Myths of Gender: Biological Theories about Women and Men, Second Edition* (Basic, 1985).
Ruth Hubbard, *The Politics of Women's Biology* (Rutgers, 1990).
Evelyn Fox Keller, *A Feeling for the Organism: The Life and Work of Barbara McClintock* (W.H. Freeman, 1983).
Margaret Rossiter, *Women Scientists in America: Struggles and Strategies to 1940* (Johns Hopkins, 1982).

The articles and excerpts from books that we read included:

Natalie Angier, "Drawing Big Lessons from Fly Embryology," *New York Times*, August 10, 1993.
Jane E. Brody, "Picking Up Mammals' Deep Notes," *New York Times*, Nov. 9, 1993.
Katherine Davies, "What is Ecofeminism?" *Women and Environments* 10 (1988): 4-6, and accompanying criticism, "What's Wrong with Ecofeminism?"
Anne Fausto-Sterling, "The Five Sexes," *The Sciences* (March/April 1993): 20-24.
Elizabeth Fee, "Is Feminism a Threat to Scientific Objectivity?" *International Journal of Women's Studies* 4 (1981): 378-92.
Sarah Blaffer Hrdy, "Empathy, Polyandry and the Myth of the Coy Female," in *Feminist Approaches to Science*, ed. Ruth Bleier (Pergamon, 1985).
James Kalat, *Biological Psychology, Fourth Edition* (Wadsworth, 1992). (Selections.)
Evelyn Fox Keller, *Reflections on Gender and Science* (Yale, 1985), esp. chapter 4, "Gender and Science."
Gina Kolata, "Brain Researcher Makes it Look Easy," *New York Times*, May 25, 1993.
Emily Martin, "The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles," *Signs* (1991).
"Sex and the Brain," *Discover Magazine* (March 1994): 64-71.
Edward O. Wilson, *On Human Nature* (Harvard, 1978), pp. 124-129.

If I were to teach the course again, I might use the following readings:

June Goodfield, *An Imagined World: A Story of Scientific Discovery* (Penguin, 1982).
Carol Gilligan, *In A Different Voice: Psychological Theory and Women's Development* (Harvard, 1982). (Selections).

Donna Haraway, "Situated Knowledges: the Science Question in Feminism and the Privilege of Partial Perspective," in *Simians, Cyborgs and Women* (Routledge, 1991).

Sandra Harding, *The Science Question in Feminism* (Cornell, 1986). (Selections).

F-Y Comp, F-Y Seminars, and WAC: A Response

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According to Bob Connors, only in good times do we propose abolishing first-year composition, and in those good times defenders of the course call for reform. In bad times, such as war or depression or civil unrest, we assume, Connors says, the first-year writing course to be a good and necessary thing. The debate in this issue of *LLAD* about where writing should be taught is then predictable. And we should, I suppose, be grateful for the absence of a national emergency.

In "WAC and the First-Year Writing Course" David Chapman poses the question often asked by people who want to do away with the first-year composition requirement: "If all teachers are qualified to teach writing in their disciplinary specializations, then why shouldn't they be teaching an introductory writing course?" The reply is of course that WAC programs do not assume that teachers are qualified to teach writing in their disciplinary specializations. Indeed WAC does not assume that most practitioners of a discipline can articulate the discourse conventions of that discipline, even while following those conventions in their own writing. Further, Chapman warns that we should not expect even the best writers among our colleagues in other disciplines to understand or be interested in the theoretical issues involved in writing. What WAC assumes (at least the way I've learned WAC from Art Young and the many workshop leaders who have visited Clemson over the last eight years) is that all teachers can use WAC techniques to improve their teaching.

But there is an important distinction between a writing course and a course that uses writing to help students learn a discipline. For example, I would not call the course at Cornell described by Nadine Weidman in "Gender Issues in Biology: An Approach to Teaching Writing" a writing course, but rather a course that uses writing. Nor would I call my own Introduction to Women's Studies a writing course; it is instead a course that employs journals, research papers, freewrites, and discussion to teach a body of knowledge. The primary focus in Weidman's course at Cornell, as in my women's studies course, is on the reading; the writing is to help students learn and understand the course texts.

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Nonetheless, as a writing teacher, I am delighted with the enthusiasm for writing and teaching that I see in "Gender Issues in Biology: An Approach to Teaching Writing." It is clear as well that this instructor knows the subject that she is teaching. And, with only 13 students, she appears to have been able to give each of these first-year students a great deal of attention. Enthusiasm for teaching, knowledge of the subject, and time to devote to each student: these are the components of excellent teaching in any area. It is important, however, to recognize that in this account the writing is being assigned, read, and commented on by a graduate student, not by regular faculty.

And regular faculty—by which term, I mean permanent, tenured or tenure-track faculty—is, or should be, the target of WAC programs. The purpose of writing across the curriculum is for faculty across the university to share the responsibility for improving the writing of undergraduates, for faculty to give their students opportunities to write well and often, not only in general education courses but also in courses in the major. The thinking is that if students see that faculty across the curriculum value writing enough to include time for it in their courses, then students too will value writing. At the very least, if regular faculty use writing in their courses, then students will not graduate having fulfilled their major requirements by means of multiple-choice and true-false tests. The premise is that practice *qua* practice helps people compose better, a point Isocrates made in the fourth century BCE. Certainly it is better to have students writing across the curriculum than not, but the question of who is assigning and reading that writing is an issue that should not be ignored in any analysis of undergraduate writing.

In "WAC and the First-Year Writing Course" Chapman makes other points that should be underscored. First, a minority of WAC teachers, including some in English, believe that writing, even writing to learn, means correctness. (Correctness is of course necessary to good writing but certainly not sufficient. And, of course, definitions of correctness vary wildly.) A colleague here at Clemson, for example, continues to ask at every WAC workshop how to grade spelling or punctuation. As believers in bottom-up theories of language and learning, these faculty members rarely change their minds. In other words, despite our faith in WAC as a way to help students leave the university as effective writers, not all WAC teachers will teach writing as WAC proponents typically mean that term; some will use WAC labels instead to ride particular hobby horses about the conventions of print and script and the prestige dialect.

Second, even if teachers are using various kinds of writing assignments to teach, say, engineering or architecture, responding to this written work takes time and energy. Attrition among WAC instructors is real. A family problem, a book contract, administrative duties, a grant pro-

posal—all these can mean that a superior WAC teacher loses the WAC in his or her syllabus. It is easier, after all, to teach without all the writing. When it works, WAC helps ensure that students can write in a variety of situations and for a variety of purposes. But let us not romanticize: WAC, whether entirely voluntary or institutionalized in writing-intensive courses, has its own set of very real problems and will not therefore bring the Millennium.

The first-year seminar Lex Runciman describes in "Ending Composition as We Knew It" answers my complaint about the Cornell model—that is, that it is taught by graduate students instead of regular faculty. Where it has been tried, the first-year seminar has proven successful in keeping first-year students enrolled. Small classes of 15-18 students with the best teachers on campus, who are also, not surprisingly, the best scholars, would surely involve first-year students in the best the university has to offer. Again, enthusiasm, expertise, small classes, lots of written and oral engagement—what's not to like? In the words of the old hymn, I am almost persuaded.

But this is not a viable, realistic alternative to the required first-year composition course, as Runciman implies when he says that Linfield's Inquiry Seminar is a "local" solution. One reason that such a course is not widely generalizable is that the freshman seminar is too expensive for most universities. Few deans or provosts are willing to pull the brightest stars in physics or industrial engineering or art history out of senior-level classes or graduate seminars to have them teach an f-y seminar. And few of these stars would be willing to do so on a long term basis. It's a lot cheaper to pay part-time or temporary faculty or graduate students to teach first-year students.

And it's even cheaper when these teachers are given more students per section than they should have. At my university, we save the salary of one instructor for every student we add to the cap of first-year comp. On smaller campuses, like Linfield, where teaching is the main task and where offering a quality baccalaureate education to the few is the mission, the f-y seminar may be do-able. But at large universities where undergraduate teaching comes in a distant third behind research and graduate teaching and where the achievement of a few superior students masks a factory structure (teaching the highest number of undergraduates for the lowest cost), the f-y seminar will rarely even make it to the agenda.

In "Ending Composition as We Know It" Runciman argues that composition doesn't work. He is right in that the typical one- or even two-semester requirement in the first year rarely succeeds in turning out sophisticated writers. And he is right that f-y comp is not a one-shot inoculation against lapses in correctness, poorly developed paragraphs, weak

theses, failure to supply enough evidence of the right kind, indiscernible structure, lack of audience awareness, or ignorance of genre requirements.

But f-y comp doesn't always *not* work, either. When taught by someone with an understanding of rhetoric, writing processes, and language, not only f-y writing courses but other writing courses as well can and do bring about improvement in student writing, as Rich Haswell has demonstrated in *Gaining Ground in College Writing*. In addition to practice, Isocrates also argued that direct instruction in the precepts of rhetoric increases the likelihood that the rhetor will be effective: "and the teacher, for his part, must so expound the principles of the art with the utmost possible exactness as to leave out nothing that can be taught" (49). Courses which emphasize "the principles of the art" can and do help young writers diagnose and repair problems in their writing, like those listed above. At their best, f-y courses demystify writing, supplying students with a toolbox of writing strategies and techniques that they can use for writing in a variety of other situations. When f-y courses do work, they teach students that they have something to say and can say it.

Unfortunately, f-y comp is not always at its best. As Joseph Harris explains: "I'm all for teaching writing to beginning undergraduates, but I worry that the present structure of the universally required course (a) provokes needless and not-useful resistance and resentment among students and faculty, and (b) virtually requires the exploitation of part-time faculty in order to staff myriad sections (at least in large universities like mine)." (And mine, too.) But the problem isn't just a moral one: the exploitation of workers by universities and colleges. WPAs and department heads often cannot find qualified people who will teach such a labor-intensive course for the available salary, and so we staff f-y comp with inexperienced graduate students and with too many unqualified teachers.

In addition to the problems of attitudes and staffing, f-y comp, as I have already said, typically has too many students per section. If we could reduce class size from the present 25, 26, even 28—the numbers I found two years ago at our peer institutions—to the 17 or 18 in first-year seminars or even to the 22 recommended by both NCTE and MLA, we would, I believe, see an immediate improvement in first-year comp courses. Peter Elbow has said that every child needs "a real audience for his written words—an audience that really listens and takes the interchange seriously" (184). I would argue that every student in a writing class, no matter the age, also deserves an interested, knowledgeable audience. But in these times when middle-class retirees have already seen to the education of their own children and university administrators refer to undergraduates as "consumers," public universities are unlikely to pay for the small classes necessary to give students this attention.

Some in composition and rhetoric argue that if the requirement were "a writing course" instead of "the first-year writing course," then departments could offer an array of writing courses at various levels that would fulfill the requirement. Departments could thereby determine both class size and qualifications for teachers, and when the classes were full, they would close. Where this is in place, such as Worcester Polytechnic, it seems to work. I don't know whether this plan is viable elsewhere, at institutions, for example, where the writing teacher is *not* John Trimbur. It is worth considering whether this solution would only shift the problem from the universities to community colleges and whether it succeeds generally in ameliorating the resistance to writing classes.

Before we abolish f-y comp, perhaps we could set a reasonable class size and offer only the number of sections that we can staff with qualified teachers. Whether this course is required is a secondary issue for me; its quality, now compromised, should be the priority. If we could actually offer excellence, would f-y comp then be so good that it will be preferable to f-y seminars?

I don't want this either/or choice; I want both/and. Both a writing course or writing courses and other courses, preferably several, that use writing consciously and reflexively to teach particular general education classes as well as courses in the various majors. I wouldn't even care which course were taught in the first-year: f-y seminar and the writing course later, or f-y comp with 18 students and WAC courses all over the place. As Cicero puts it in *De Oratore*:

> A knowledge of very many matters must be grasped, without which oratory is but an empty and ridiculous swirl of verbiage: and the distinctive style has to be formed, not only by the choice of words, but also by the arrangement of the same; and all the mental emotions, with which nature has endowed the human race, are to be intimately understood, because it is in calming or kindling the feelings of the audience that the full power and science of oratory are to be brought into play. (202)

Putting all our eggs in the WAC or first-year seminar basket and giving up the writing course means the neglect of rhetoric, which is more than invention, arrangement, memory, style, and delivery, as important as those things are to good writing. Rhetoric includes not only attention to persuasive argument, to finding the best means of persuasion in any case, but, more important, a focus on civic discourse and the ethics of language use: the public language of the discourse community we all share as citizens of the republic and the ethical use of this language to create knowl-

edge and to negotiate our differences. Where else in the curriculum can we ensure that students will be asked not just to compose, but to compose within these contexts of issues?

What I want is both/and. Both WAC and writing courses. Both the f-y seminar and f-y comp. But I have read Berlin and Connors on the history of writing in American colleges and universities, and I have taught at four medium to large state universities in four different states. I don't think I'll get what I want. What I'll get is what we've always got: An underfunded, overcrowded course, inured in the hierarchical politics of the university, disparaged by administrators, never given the resources to achieve excellence—which somehow seems to satisfy the public.

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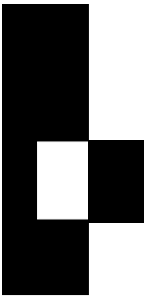

Response to Criticism

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Should non-composition graduate students be teaching freshman writing and writing-intensive courses? Or should the job be reserved for experienced, full-time professors of composition?

The most obvious answer to this question is that of course experienced comp professors make better teachers of writing than non-comp graduate students, and so clearly the task should belong to them. Wouldn't it be difficult to argue otherwise? Well—yes and no. I think that the obvious answer conceals a host of issues that should also be brought into consideration.

First of all, it is simply not enough to require undergraduates to take one or two semesters of freshman composition and leave it at that. No one learns to write that way; the Harvard seniors who show up in my classes and who routinely have trouble putting together a paragraph, never mind an essay, attest to that fact. Given this situation, every teacher, whether a composition professor or not, must be a teacher of writing, and every course must be a writing-intensive course. Inasmuch, then, as graduate students are teachers in training, they must be trained to teach writing, which should involve actually teaching it. For this reason, I think Cornell's John S. Knight Program is a step in the right direction. It may be flawed, and it may try to do too much in too little time, but it was the only consistent teacher training of any kind that I received in six years of graduate school. More programs like it are definitely needed.

Secondly, the structure of American universities is not conducive to the small, professor-led classes that are necessary if teaching writing is to be a priority. Increasingly, the bulk of the teaching in large universities is done by adjuncts and graduate students—a trend that the MLA lamented in a recent report. Most universities are top-heavy with administrators and named-chair professors, who do little or no teaching, while the number of full-time assistant professorships dwindle. The teaching slack is taken up by a growing underclass, people without Ph.D.s or regular appointments, who are hired to teach one or two courses on a part-time basis. Professors are rewarded with reduced teaching loads; they might

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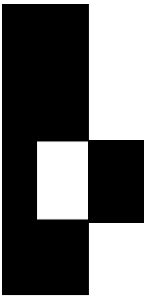
teach one lecture course of 300 students and employ a raft of TAs to do the grading.

This system is a tremendous cost-saving measure for the universities; the teaching of writing is its major casualty. At the three large universities I have been associated with, Cornell, MIT and Harvard, I did not see (and have yet to see) a single professor interested in teaching a writing-intensive course—and who can blame them? How can you teach a class of 300 students to write? It's impossible; and so, inevitably, the teaching of writing again gets left up to the TAs who actually read the undergraduates' papers.

I think the battle we are fighting between comps and non-comps over who should teach writing is a hopeless one, and a self-destructive one. We all have to be teachers of writing, and we have to fight not each other but a university administration that is making it as difficult as possible for us. Graduate students must get more and better training. Classes must be smaller, and there must be more of them. More assistant professor lines must be opened up, so that some of those adjuncts can be hired on a full-time basis to teach those smaller classes. Universities must reallocate funding, away from the Byzantine administrative structure that many of them have developed, and toward creating more positions for full-time faculty. (This would also help alleviate the current unemployment crisis among recent Ph.D.s.)

As a non-comp graduate student teaching 13 freshmen how to write, I was not the problem. I was only a symptom of the problem, the roots of which go much deeper, into the organization and reward structure of American universities.



Listening Skills and Students' Learning in Large-Enrollment, Introductory Courses

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Introduction

Every semester I teach either one or two introductory geology courses for non-science majors. Sections of these service courses typically have between 50 and 130 students and my department usually offers two to three sections of three different courses each semester. Approximately 1000 undergraduates enroll in these courses each semester, most of them to satisfy a graduation requirement in science. These students have the option of taking a laboratory and/or a discussion section along with the lecture but the bulk of them enroll in the three-credit, lecture-only section, which means their only exposure to the course consists of a "talking head" lecture in a large room. Courses of this type are typical in science departments (at least at those in which I was a student and the ones at which I and colleagues have taught).

Large classes can be a dreadful experience for both the students and the instructors. The courses tend to be impersonal due to their size; with one hundred or more students in the room it is difficult to establish a relationship with any more than a few of them. You can "speak" to only a few students, the ones who make eye contact with you. Taking attendance is time-consuming unless you use an assigned seating plan, a practice which regiments the students and adds to the impersonal atmosphere.

An experienced lecturer can deal with some of the problems arising from attempts to teach large numbers of people. Someone who is not intimidated by the size of the group, who is enthusiastic about the subject being taught, who tries to reach out to the group by asking questions and ensuring that the students know it is allright for them to ask questions, who engages them in the material with short assignments and gives rapid feedback and encouragement, this sort of instructor becomes known in a university for the ability to teach large lectures and often has oversubscribed classes. Dubrow and Wilkinson (1984) mention the joy of listening to such people but also note that their skills are not innate; developing the energy to teach large classes in that way is a full time job, and takes years

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to learn. They give a number of suggestions regarding the presentation of material and the logistics of dealing with large groups, but their discussion seems to assume that the real problem faced by instructors of large classes involves presentation. This assumption is equivalent to the belief that speaking is teaching; that if the instructor presents material carefully and enthusiastically, students will understand it and will internalize it. My experience suggests that for a variety of reasons, the communications channel we call a large lecture is "noisy" and that many students learn little in these classes regardless of how much they like the instructor.

One could argue that with the technologies available today there is no need to lecture to one hundred or more students at a time. For example, we can videotape lectures and let students view them in the university library or watch them on cable television. If we were to convey information at times convenient to the students, using modern technology, we could meet with students in small sections and concentrate on the kinds of interactions that foster critical thinking. That is, we could do these things if we could ignore the real reason we teach large sections. The basis of the argument justifying the use of large sections is economies of scale, which translates into small teaching loads, high faculty productivity, and large departmental budgets. The argument is more appropriate for an assembly line than a university because it neglects the differences in the backgrounds and abilities of the students. The assumption that teaching is just speaking and that all of the students respond to a lecture in the same manner ignores reality. Nevertheless, for economic reasons, the large lecture is not going to be abandoned. In fact, distance education technology lets us "teach" several large sections simultaneously, which lowers the unit cost of teaching the sections - an administrator's dream. Because this format is a fact of life in some disciplines, it is important that those who use it understand its limitations.

For many years I felt that the secret of teaching science to non-science majors in introductory courses involved explaining the material without relying on prerequisite subject matter. For example, rather than merely tell students that the properties of the water molecule make possible the efficient transfer of heat from the tropics to higher latitudes, I would explain at some length what those properties were and why they have the values they do, before discussing how they facilitate the movement of heat on the planet. I felt that if the concepts from geology, chemistry and physics were presented in a seamless manner, students would not realize that this was material they once thought difficult and would be able to concentrate on principles rather than facts. Eventually, I realized that I was assuming that I could bring all students to the same level — again, the assembly line analogy. In addition, I realized that it makes no difference how clearly I explain something if the students do not know

how to put the pieces of a lecture together. Part of the problem students have in doing that is caused by the fact that they do not realize that listening well is a difficult task, nor do they realize that listening is not enough: they must think about what they hear as they hear it.

From time to time I see notes taken by students in my courses and, on a few occasions, I have seen notes they have taken in other courses. Relatively few of the examples I have seen were what I would call a good set of notes. Most of the time they consisted of lists of short statements, few of which appeared to be related to each other. Even when the notes were fairly complete, in that they contained much of what was said in the class, rarely was there any indication that the material was organized in any way. Thinking about the notes students take in lectures led me to some of the literature on the ways people process language. Because I prefer to learn by reading, I also thought and read about the different ways we respond to spoken language and written text. I found interesting discussions of story grammars in the works of Rumelhart (1975) and Meyer (1975) but their approaches seemed too complex for me to utilize in designing lectures. Halliday's (1987) discussion of the difference between written and spoken text was informative and the work of Perfetti (1987) provided a valuable link between reading skills and listening skills. Finally, to obtain some empirical data, I conducted an experiment on myself to determine how easy or difficult it is to figure out the meaning of a lecture. I wanted to know what students taking my courses and other science courses must do to succeed, so I listened to several lectures and analyzed the notes I took in them. The experiment convinced me of the need to change the way I deliver lectures. Although in the past I used some of the techniques recommended in the literature on ways to improve teaching to large groups of students (McKeachie, 1980), I did not implement them consistently, so their effect was not noticeable. Some of the things I do now to affect the atmosphere in my large sections are discussed at the end, but specific techniques are not as important as the principles behind them. Metacognitive strategies help me design lectures and have the potential to help students learn from them.

Written and Spoken Language

One reason we can make sense of text written in a very formal manner, with its attendant ambiguities and complex clause structures, is that it is presented to us synoptically. We can peruse written material in any order we choose and review it any number of times, until the meaning becomes apparent. Determining the meaning of written text is facilitated by the recognition that patterns exist beyond the level of the sentence; a variety of structures exist in written materials that signal its meaning (Cook

and Mayer, 1988). On the other hand, spoken language is presented to us serially, as a set of linked clauses, which requires careful attention to relationships between propositions if one is to establish the meaning in "real time." Comparisons between written and spoken language are given by Halliday (1987), who recommends translating one into the other to illustrate the differences between the two. I have constructed an example of the difference between the spoken and written versions of English by using the verbatim transcript of a public meeting I conducted once that dealt with the creation of a sewer district for the private community in which I live. Some of the residents wanted assurances that the decision to install sewers would be put to a vote and not be made by a sewer district's elected trustees. I said that if I were on that board there would be a vote. In response to the question "And if you are not on the board?" I said

"Then the other people - I don't know. You should ask that. If we have a district and we have an election, you should find out what the attitudes of the people who are running are. And don't vote for anyone not willing to put it up for a vote."

That is probably typical of what should be expected after two hours of responding to questions from a hostile audience. If I had had the luxury of writing a response to a question submitted ahead of time, my response would have been something like the following.

"The people on the board will have the final responsibility. But if we create a sewer district and have an election for its trustees, before voting for any of the candidates, you should question them carefully to determine how they feel about letting the community have the final decision."

The spoken version consists of four "phrases," some of which are complete sentences and some of which are not. That version would not make sense to anyone who was not aware of the context. On the other hand, the written version contains two sentences, one of which contains enough background material that knowledge of the context is not too important in interpreting what is being said. A writer cannot assume that a reader is aware of context, so writers normally do not rely on context to avoid ambiguities as much as speakers do. But the context of speech often provides hints about the way its propositions are linked. Few students think that the task of taking notes may be just as difficult a task as understanding the content of the lecture because the meaning of a lecture usually seems to be clear. The reason for that is that the instructor may have been lecturing on the subject for many years and is quite good at explaining difficult concepts. The temptation is to neglect writing anything about what is obvious, a practice that causes problems weeks later when studying for a test.

Learning from Spoken and Written Media

In principle, students listening to a lecture should take notes differently than when reading a book. Notes taken during a lecture will be influenced strongly by the manner in which the words are spoken. A narrative relating a series of events should be perceived differently from an explanation, which uses internal relationships to inform. But the difference will not be apparent to many students because either they do not normally listen for such distinctions, or they have no time to think about them during a lecture.

Think about what happens during a lecture. For students to understand a sentence and get its idea into their notes, they either have to be stenographers or they have to encode the idea and put that version into their notes. They cannot possibly write each sentence spoken unless they either repeated or the instructor speaks very slowly. Some students tape lectures but they find themselves spending much more time on the course than they intended because the linear format of an audio tape prevents them from going directly to the parts of the lecture that are missing in their notes. What usually happens is that students taking notes manage to get a few words of a sentence down and then must pay attention to the next sentence, which they are listening to as they write their version of the last one. Short term memory can store about seven plus or minus two items from anywhere from three to twenty seconds. By that time the items are either considered important enough to be transferred to one's permanent memory, or they are forgotten (Abadzi, 1990). Students' notes are a surrogate for long term memory but nothing goes into their notes that has not passed through their short term memories. Unrelated items rarely are stored permanently, so unless you give students some signals to assist them in the coding process, most of them will jot down an abbreviated version of what you say, not a coded version. Abbreviated notes introduce ambiguities that can only be overcome by some indication of the structure of the spoken material - perhaps an outline, or some key words designed to link the statements to each other. Without some indication of structure, lecture notes are little more than grocery lists; they certainly are not learning tools.

Notes made from a textbook will differ from those obtained by listening to a lecture because written materials display fairly clear patterns. We may digress in a lecture without realizing it, and without the students noticing it, but the editors of a textbook discourage that practice in authors. Written text contains various structures, such as lists, definitions, comparisons, etc., that are signaled near the beginning of a paragraph (cf. Cook and Mayer, 1988). For example, a paragraph might begin with the statement "This phenomenon occurs for three reasons..." Or, the opening

sentence might have the form "This process differs markedly from the one previously discussed because..." In addition, the last sentence of a paragraph often provides a lead-in to the next paragraph. And sometimes there are cross-references to relevant material in other parts of the book (which the students can turn to immediately or put off until later). These "signals" provide information about the overall semantic structure of written materials, and when used carefully, they compensate for the sparseness of the nominal structure. In a commonly quoted comment, Goethe supposedly apologized to someone for writing a long letter, saying he did not have time to write a short one.

A carefully prepared lecture will contain some of the structures found in written text; after all, the instructor has a message to convey, and the kinds of structures we find in written text are representative of the ways academics organize their thinking. But these structures are not characteristic of the language people normally speak and hear, so students may not notice them when they are contained in a lecture. Students may not even recognize hints given during the lecture that pertain to the meaning beyond the level of the sentence because relationships between ideas tend to be subtle and are easily missed due to the pressure involved in taking notes. So, students' notes often seem to consist of unrelated statements. Students tend to let the context they share with the instructor during the lecture lull them into a false sense of security, one which causes them to think that what they hear makes perfect sense. The explanation they hear seems clear and the ideas are all related, so a cursory set of notes seems sufficient. When students read their notes later, once the details of the lecture, the body language of the instructor, and the dialogue between the instructor and other students in the class (when that occurs) have all been forgotten, the organization of the presentation is not recoverable from what is in their notes.

Major Source of the Problem

The ability of students to learn from written materials such as a textbook or a laboratory manual, or from supplemental readings, depends strongly on the way they think about written materials. Perfetti (1987) noted that people who are not good at reading, tend to think of reading in terms of speech. That is, they approach reading as they approach listening to people speak. They view written communication serially, in terms of individual, loosely coupled statements. There is no attempt to look for subtle distinctions. Such people miss a lot because they overlook the fact that although written text tends to be sparse, there is a considerable amount of meaning packed into the sentences; the information density of written text tends to be quite high and there often exist multiple levels of meaning.

In the same manner, students who consider the formal speech in a lecture as a series of loosely coupled statements underestimate that medium. They hear statements but not relationships between the statements. In effect, they misunderstand both media.

It seems that the traditionally taught lecture course suffers from several problems: students who do not read well do not get much from the written components of the course; these students also tend to have relatively poor vocabularies, so they may not understand some of the points made in a lecture; and their lack of reading experience and proficiency makes it unlikely that these students will recognize the underlying structure of a lecture. Poor reading proficiency is not the only reason the traditional lecture is inefficient, but it should be a major contributor.

For reasons mentioned earlier, most instructors in science departments use lectures as the major component of communication with students in introductory courses, so we wonder how often students "see" beyond the immediate points made in class. How can we get students to recognize the existence of levels of understanding in what we are saying in class, and to recognize their importance? Telling them about such things does no good. We tell them things every day, things which get lost in their notebooks. Perhaps we need to think about how we would learn the material instead of concentrating on how we think the students should learn it.

Note-taking in a Lecture

More than 30 years have passed since I was an undergraduate, and what little I recall about the introductory courses I took is that they were of the "talking head" type. The instructor usually stood behind a podium and read

prepared notes to us. The notes I took in those courses were discarded long ago, so I cannot say much about how I learned at that time but I passed all of the courses, so I must have developed some strategies that were successful. Because my past experiences were not available for me to learn how I learned in large-enrollment courses, I decided that the only way to learn what students face in the kinds of courses I often teach was to attend some lectures myself. That is, I decided to learn how to take notes in the lectures of a large-enrollment, introductory course in which I was as much a neophyte as the students. I chose Psychology because I never did any course work in that area and have not made a conscious effort to learn about it since I graduated. In this experiment, I did not actually attend the classes because the lectures were available at the university library on videotape. So, on four consecutive days I viewed the tapes for four seventy-five minute lectures. One lecture was on Theo-

ries of Personality, one was on Stress, another was on Social Psychology, and the fourth was on Abnormal Psychology. They were not chosen randomly; the first three were delivered by the same instructor and the fourth by a different one. I wanted to hear the same person lecture on different topics, and I used the lecture by a different instructor for additional control.

The experience was quite interesting. All four lectures were delivered smoothly. The instructors clearly had rehearsed the presentations, and were delivering material with which they were comfortable. They did not use a teleprompter (from time to time they glanced at some index cards), but they managed to make eye contact with the audience (the camera) as completely as do the anchors on the evening television news programs, who do use one. Although no outline was shown on the screen, and very few visual aids were used, the material delivered seemed to be so reasonable as I heard it that I should have had no trouble taking coherent notes, from which I could easily prepare for a test. Yet I was satisfied with my results in only two of the four attempts. Because I often present lectures in outline form, I tried to take notes that way. That was easy to do in the first two lectures but I found it very difficult to take notes in outline form in the third and fourth lectures. My notes in those two lectures were little more than lists, each item recorded and embellished, but with no obvious relationship to previous items.

Does a Lecture Have a Semantic Structure?

The outline form that I assumed would be appropriate for lecture notes is designed for the retrieval of material organized hierarchically. This form displays clearly the relationships and relative priorities that exist between levels of the material. It provides information about the semantic structure of the material delivered. In a lecture, details are embedded within statements about principles, so in outline form, lectures combine the spontaneity of spoken language with the clause structures of written text. When the material is suitable, and when the instructor thinks about the material in this manner, taking notes in outline form should be fairly easy to do. This appears to have occurred in the first two lectures I viewed.

What about the other two lectures? If I could not take notes in outline form, perhaps the material was not hierarchical in nature. It is hard for me to imagine lecturing for seventy-five minutes without some sort of structure in mind, so I am sure that the instructors had mental maps of the material they presented, maps which organized the content in a coherent manner. But it was not obvious to me that they existed, so I probably did not organize the material in the way the instructors would have hoped.

This experiment was instructive because it showed me that even a professional student can experience difficulty in understanding the structure underlying a lecture in an introductory course. If I cannot recognize a pattern in a lecture when I am looking for one, how can I expect beginning students to do so?

I should note here that students in the Psychology course mentioned do more than watch videotapes. No more than 20% of the course involves the videotapes I watched. Students also attend discussion sessions and are expected to read sections of a textbook before viewing the tapes, so they have more opportunities and more ways to learn than I did in my experiment, and some of those opportunities and ways undoubtedly provided contexts for the material which I lacked. I am not criticizing the manner in which that course is taught; I am saying that my experience convinced me that extended oral delivery of course content (the way I have taught for many years) does not always work as well as many instructors assume.

Lecturing Introspectively

As I deliver lectures now, sometimes I try to listen to what I am saying. This kind of exercise is more instructive than listening to someone else because it shows me the difference between what is in my notes and what I actually say (and how I say it). I like to think I deliver what is in my notes, but sometimes I realize that what I am saying does not correspond to how the material appears in my notes. In addition, although most of the time the material I hear myself delivering has a structure that is clear to me, sometimes I find myself rambling and realize that I am delivering a sequence of loosely related "paragraphs." These clusters of statements are related to each other, and to the main topic, but I have noticed that I do not always remember to point out how they are related. Using the overhead projector, as I usually do, does not seem to have an effect on my delivery. I find that my delivery is not structured by what I write. Instead, the style of the delivery affects what I write. So if I ramble verbally, the written material on the screen rambles too.

It is easy to change my style when I become conscious that I am rambling, and impose onto my delivery the structure that is in my mind and my notes, but I wonder how often I do not realize when it is necessary to do that. I wonder how often my lectures consist of little more than lists of facts. How can I expect students to recognize the forest if all I present to them is a list of trees? I recall a story about Alfred Wallace, the Nineteenth Century Biologist, who illustrated the diversity of tropical rain forests by saying that if he leaned against any tree anywhere in the forest, there would not be another one of the same type within sight. The spatial scale

over which relationships between components of the forest ecosystem existed was not apparent to the eye. The relationships that define a forest ecosystem will not become apparent by just counting the trees: empiricism alone is not sufficient in science; empiricism guided by some prior knowledge is what provides insights. The tasks involved with studying a forest provide an excellent analogy for the tasks faced by students listening to a lecture. Students must be aware that the delivery is structured and must have some idea of how it is. We must communicate the nature of that structure if students are to "understand" what is said to them, as opposed to just hearing what is said. Many people, especially students, think that hearing is equivalent to understanding.

To communicate, you must establish a context. If you tell students something will be on a test, they will all write it down and note its importance. You will have connected with a schema they all use. They know it is important material. On the other hand, if you merely say the material is interesting, or even if you say it is important, without saying why, students may not connect the material with anything, in which case it will join the rest of what is in their notes, as just another statement. As an example of providing a context, when I give a class on septic systems in an Environmental Geology course, I begin by asking how many people in the room live in a house that is connected to one. Then I ask how many do not know if they use a septic system or a municipal sewer system. There are always a few who respond to the last question; waste disposal is not something people think about too often. By spending a minute or two explaining how to tell what kind of system they use and why it can be important to know, I establish a connection between the material and their lives (albeit one that is not as strong as by assuring them that the material will be on a test), and ensure that students will pay a bit more attention than to a "normal" lecture on waste disposal. Without some kind of context, little will be accomplished during a lecture to a large class.

The Efficacy of Alternative Activities

Lest I be accused of killing paper tigers, I will say here that I am aware that many instructors do not rely solely on the passive pedagogy associated with "talking head" lectures. A variety of techniques to help students maintain attention have been recommended and a number of "active" learning approaches have been promoted for a number of years. Under labels such as situated cognition, cooperative learning, and collaborative learning, cognitive scientists and educational psychologists have stressed the importance of hands-on activities and the social nature of learning. But, for at least two reasons, not all alternatives are necessarily any better at stimulating learning than the traditional lecture. First,

some techniques rely on proficiency in reading, and if poor reading skills affect one's ability to listen, they can also affect the efficiency of some alternative activities. Communication with students requires conscious attention to the problems they face in deciphering what we say. The second reason alternative activities may not be effective is that having students do something other than listen accomplishes nothing unless they are aware of how the task is going to improve their learning. They must understand how they are going to learn as well as what they will learn.

Activities that Enhance Communication with Students

There are many ways to learn but the traditional lecture format puts a premium on listening well. Perfetti (1987) suggests that this format will likely be successful only with those students who read well, so a mix of activities seems called for if we expect students to learn in large-enrollment introductory courses.

Abadzi (1990) discusses a variety of ways to provide new stimuli to maintain the attention of a class. All of the techniques are familiar to anyone who teaches large classes, but I repeat some of them and give some others in order to provide reasons for doing each one and to emphasize the importance of making students aware of how each affects their learning. Richardson (1990) claimed that merely recommending techniques in an article such as this one is a sterile exercise; the important thing is to show other instructors what principle underlies a technique so they can evaluate its effectiveness. He used the example of "wait time." If you ask a question in class and wait for an answer, the length of time you wait is a measure of the importance you give to learning what the students have to say. Wait time is more than a technique: it represents a value judgment that is communicated to the class. We probably use many techniques without realizing the subliminal messages they send or could send. The principle behind each of the techniques discussed in the next section is the stimulation of metacognitive processes in a traditional lecture course.

A Few Things That Can be Done in the Classroom

Asking questions and using examples are simple things that most instructors do. One which was recommended by Abadzi (1990) is called rearranging the material. She suggests stopping the lecture occasionally and having the students explain the material to their neighbors. Disagreements between students are of interest because they show the class how much variation there is in understanding what was said. This technique

can require a lot of class time, so the frequency at which it is used will depend on the instructor's priorities.

A very valuable technique is to have students work through an in-class exercise. During the first lecture each semester, I have my Environmental Geology class work through an exercise that is a qualitative cost-benefit analysis of a water quality problem (de Caprariis, 1985). Students fill out a form that requires them to make decisions and establish priorities. I display the class response on an overhead projector by asking for a show of hands to see how everyone responded to each part of the exercise and I plot histograms of the numbers who made each choice. The choices made are not technical; they involve the kind of environment in which each student would like to live. For this reason, all answers are "correct." This exercise shows students the wide range of attitudes about a subject (clean water) that few would consider controversial. It helps students understand the controversies over topics covered in the course such as development in wetlands.

Concluding Remarks

The activities discussed in the previous section are just a few of the many designed to cause students to think about course material for periods of time considerably longer than it takes for them to listen to a few sentences and write something about the ideas in their notes. As such, these techniques should help students to overcome some of the language problems caused by poor reading skills. One might go farther and say that such activities are necessary to improve students' learning in large-enrollment courses, whose environment is not conducive to learning. But even if they are necessary, it is not clear that they are sufficient. Bruer (1993) called such methods of stimulating learning "weak" methods, because most of them represent a general, domain-independent approach to teaching skills and are not always useful. The poorest students in a class benefit from weak methods because those students will probably benefit from any alternative approach.

Bruer (1993) noted that metacognitive strategies seem to work with all students, not just with those at the bottom end of the grade spectrum. Students learn best when they are taught in such a way that they are aware of things such as when they understand or do not understand something; when the strategies they use are working or not working; and when the answer they get is reasonable or unreasonable. He stated that the way we teach is as important as what we teach. Students learn best when they are taught to think about the process of learning, rather than about just what is being said in class. The techniques discussed in the last section can all be successful if they are used properly. They must be

considered means not ends. The techniques will not stimulate learning if it is clear to students that they are just one more thing done to break the monotony of a class. Students must be made aware that such methods are valuable and why they are. They must learn to recognize how an approach provides insights and why it does. These things will not happen unless we provide some instruction about the process. It is not enough to tell students that they must do more than memorize lecture material; we must teach them how to do more than memorize if we want them to become active learners. An instructor does not have to become an expert in Cognitive Psychology to recognize that hands-on activities alone do not make active learners; these activities will do little good unless students are aware of the principles behind them. It is necessary to make students aware that they cannot succeed by being passive recipients of information; they must monitor what they receive and interact with it and with the instructor. Only then can they be said to be learning. Only then are students likely to be successful in transferring knowledge and skills learned in one domain to another. And that kind of transfer is the main diagnostic criterion of a learned person.

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Book Reviews

Joseph Petraglia, *Reconceiving Writing, Rethinking Writing Instruction* (Mahwah, New Jersey: Lawrence Erlbaum, 1995), 272 pages.

Reviewed by Linda S. Bergmann, University of Missouri-Rolla

Reconceiving Writing, Rethinking Writing Instruction, by Joseph Petraglia, is a collection of essays that reconsider from a variety of perspectives what most of the contributors call "General Writing Skills Instruction"("GWSI") particularly as this approach is manifested in first year composition courses. GWSI is based on the idea that there is a common core of writing skills that provide a basis for more specific disciplinary writing. The definition of those skills ranges, in various institutional situations, from the mechanical (spelling, basic usage, grammatical etiquette) and organizational (including thesis, transitions, and contemporary variations of the modes of discourse), to more obviously intellectual skills like critical reading and thinking. Most of the contributors to this volume cast serious doubt on the value of teaching anything like "general writing" or "general academic writing," and some, like David R. Russell, even doubt than any such a thing as "general writing skills" exists or can be taught. Coming for the most part from various venues of constructivism, the writers pursue in a number of directions the implications of the idea that writing is always domain-specific, and pursue them farther than most of us who have been involved in first year composition dare. Certainly, the essays speak to my own doubts about the value of what I have done over the years in first year composition--and I know I am not alone in my vague but persistent malaise concerning the purposes, processes, and goals of composition instruction.

The first section of the book, with articles by Robert J. Connors and Maureen Daly Goggin, places the current reconsideration of general writing skills instruction in the context of the history and the institutional situation of first year composition. From its origins at Harvard in 1885, the course was conceived as preliminary: it was supposed to overcome the

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deficiencies of high school education and to prepare students for the "real writing" desired by faculty teaching upper level courses. It has thus always been a course that senior faculty want their students to have taken already, but not a course that anyone really wants to teach. And so from the beginning it has been relegated to more marginal and powerless faculty members: junior faculty, women, etc. As early as 1911, and in pretty much every generation thereafter, there have been calls for its abolition or reform; and, indeed, this volume is seen as following in that tradition, although the "new abolitionists" come from inside rather than outside the field of rhetoric and composition.

The second section looks at the social and cognitive contexts of writing classes. For me, the most telling metaphor for what we try to do in first year composition was posited by David Russell, who observes that writing is like ball playing: a course in "general ball" would not do much to improve the games of golfers, football players, and baseball players. Russell's analogy of GWSI to "general ball" highlights the issues of content, rigor, and assessment that teachers of first year composition continually face. Russell suggests replacing the mandatory composition courses that are supposed to "take care of" writing instruction with extended Writing Across the Curriculum programs, and proposes creating courses in writing that are liberal arts courses--not preliminary skills courses. A liberal arts course in rhetoric and language would teach students *about* writing rather than promise to develop writing skills; it would be discipline-specific in *our* discipline, rather than pretending to be non-disciplinary or inter-disciplinary. I must admit to having a lot of sympathy for Russell's argument, which speaks to my own dissatisfaction with "contentless" writing courses and with my soon-abandoned efforts to teach first year composition as a writing across the curriculum course.

Equally interesting is Cheryl Geisler's review of several studies that cast doubt on the general efficacy of "writing to learn"--at least as most university departments currently define undergraduate learning, and particularly in the context of general education, whose historical roots and common practices are more archival than critical. Geisler argues that "Only specialized education effects social change" (117); without a deep disciplinary context, school writing like essays and research papers--no matter how critically and creatively designed--merely reinforces students' role as consumers of knowledge. Joseph Petraglia, like Geisler and Russell, cuts through some of what have become the commonplaces and pieties of composition studies, specifically the assumption that the student should not write for the teacher and should ignore the institutional situation of the writing course. Petraglia claims that because we require a high level of pretense from our students in the "unnatural act" of classroom writing, we get distorted and contorted writing from them. If we want students to do

real writing in the classroom, he suggests, we must design assignments that rely on the actual rhetorical situation of the student, whose real audience is the teacher and whose real purpose is to demonstrate that the student understands the material that has been read and heard in the class. Petraglia draws on research that shows that much of learning to write--like language acquisition in general--is tacit rather than explicit, research that accords with at least my experience as a teacher and a writer. Aviva Freedman, and also Charles A. Hill and Lauren Resnick, continue this examination of "school writing." Freedman looks at the complexity of school writing and the relatively *greater* "teacherly support and guidance" in disciplinary classes than in composition, suggesting that students outside the academic mainstream may be disadvantaged by the tacit expectations of general writing skills courses. Hall and Resnick analyze the disjunction between school writing and workplace writing as the result of the failure of composition courses--and university education in general--to situate discourse in its social, political, and institutional context.

Two essays in the collection consider broadly philosophical issues: Daniel J. Royer speculates that GWSI, with its focus on skills, may drain the creativity from invention. Fred Kemp, in a similar view, looks at GWSI as supporting the "container model of writing," a model that can and should be superseded by the creative and dialogical potential of computer technologies. The final section of the collection offers case studies of the evolution of first year composition (Lil Brannon) and its transformation (David A. Jolliffe; David S. Kaufer and Patricia L. Dunmire). Brannon describes a program that dropped the requirement of first year composition in favor of a menu of freely selected writing courses and a strong Writing Across the Curriculum program. The programs described by Jolliffe and by Kaufer and Dunmire, who are less "abolitionists" than "reformers" of first year composition, aim to re-create the course as a domain in which serious and reflective writing actually can take place.

The final essay in the section, and in the collection for that matter, is a response by Charles Bazerman to the preceding essays. A distinguished scholar of disciplinary writing, Bazerman has some sympathy for the abolitionist position, as well as some caveats for its proponents. Bazerman warns against throwing out the composition baby with the bathwater: he reminds us that although first year composition should not be the end of writing instruction or the sole focus of research in composition studies, there is nonetheless a considerable body of research into its pedagogies and practices that has contributed to the professionalization of rhetoric and composition during the last couple of decades. He observes that although bad composition courses can be bad indeed, there are advantages to first year composition that should not be lightly dismissed. Com-

position serves as a transitional course for many students, affording entrance into the discourses of the university and a chance to reflect upon them. Bazerman warns of the danger of overly-focused education that serves merely to train students for comfortable slots in the corporate enterprise; he suggests that composition can offer a kind of critical space for the development of a self separate from, as well as responsible to, a chosen profession. I have considerable sympathy with Bazerman's concern for composition as general education, a concept which seems increasingly vulnerable to attack from both outside and inside the academy, from both the advocates of professional training and the defenders of traditional academic disciplines.

Bazerman's response underscores the fact that this is by all means an important book, one that raises crucial and complex issues in undergraduate education. This book invites us to look over our basic assumptions about the functions and practices of first year composition courses, to think seriously about what we are doing and evaluate rigorously the extent to which we succeed. I seriously doubt that many schools will move to abolish first year composition: too many graduate programs, faculty positions, and other institutional interests depend on it. But many schools are under pressure to re-think it, as state legislatures and other governing bodies press for assessment and accountability. This book offers a firm corrective to those who would mandate a return to "basics," refuting alike the advocates of teaching "general writing skills" before specific rhetorical tasks and those who would just like students to get the grammar and spelling over with before the "important" classes get underway.

Special issue of

Language and Learning Across the Disciplines

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Guest editor: Steven Youra, Cornell University

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Please send 500- to 700-word proposals by August 1, 1998 to:

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