Helping Ecology Students to Read: The Use of Reading Reports

BY EUGENIA ETKINA AND DAVID EHRENFELD

To succeed, college students must be able to interact with written text (Simpson and Nist 1990). In recent decades, researchers have noted that college students often find it difficult to understand what they read (Doyle 1983, Anderson and Armbruster 1984), which some educators attribute to the impact of television and computers. As Sven Birkerts (1994, p. 119) puts it,_next to the new technologies, the scheme of things represented by print and the snail-paced linearity of the reading act looks stodgy and dull. Many educators say that our students are less and less able to read, or analyze, or write with clarity and purpose. Who can blame the students? Everything they meet with in the world around them gives the signal: That was then, and electronic communications are now.

Whatever the cause, the most significant results of this shift in the way students react to the printed word appear to be a decreased tolerance for long reading assignments; impatience with detailed, closely reasoned analyses of complex and controversial subjects; poor comprehension and retention of the material read; and, perhaps most ominous for science education, a deterioration of the ability to read critically. A survey of 6000 freshmen done annually at Rutgers indicates that during the past 10 years, the amount of casual reading students do has decreased by almost 80 percent. Experience in introductory English courses has shown that today’s Rutgers students do not possess the ability to read critically. Only 10 percent of surveyed students (all humanities majors) do casual reading (Kurt) Spellmeyer, Rutgers University, personal communication). If, as we believe, these changes are real and not transient, the implications for teachers are clear: The messages that we hope our assigned readings will convey may be altogether different from what the students perceive.

This paper gives the results of cooperation between a biology professor (D. E.) and a professor of science education (E. E.). Specifically, we describe a simple and effective assessment technique that completed the critical feedback loop between the professor and students, to their mutual benefit. The biology professor learned how his students were interpreting and misinterpreting the assigned readings; the students learned how to improve their ability to understand and evaluate what they read.

Course overview
For 25 years, D. E. has taught a midlevel, three-credit undergraduate course at Rutgers University called “Conservation Ecology.” The 35–40 students are mostly juniors and seniors majoring in natural resource management, biology, human ecology, environmental science, or related fields; some, however, come from the social sciences and the humanities. The demand for the course always exceeds the space available. The only prerequisites are 1 year of biology and the permission of the instructor. The brief permission interview, unusual for a course this large, serves to weed out prospective students who are not comfortable doing large amounts of reading and writing, as well as those who have mistaken ideas about the content of the course.

Conservation Ecology is run as a seminar, without formal lectures and with extensive student participation. The class meets once a week for 3 hours. Discussions revolve around the readings, which are numerous and sometimes lengthy. There is one take-home midterm exam based on an assigned book that is not discussed in class. In lieu of a final exam, there is a term paper on a topic of the student’s choosing. Paper topics must be approved by the end of the second month of the semester, a progress report is due at the end of the second month, and the paper is handed in on the last day of class. Acceptable term papers have ranged in length from 15 to 75 pages, with approximately 10–60 citations from the literature. The paper is the most important component of each student’s grade, but class participation, the grade on the midterm, and the quality of the reading reports (see “A model for change,” below) are also taken into account.

The purpose of Conservation Ecology is to acquaint the students with the many and varied threats to biodiversity and to the integrity of both natural and human-dominated ecosystems. The topics covered include such subjects as the ecological effects of modern agriculture, agricultural sustainability, new and reemerging infectious diseases, the
side effects of biotechnology and gene patenting, human population growth, ecological consequences of modern warfare, and the causes of species extinction. Because of the enormous scope of the course, the weekly readings are very eclectic: for example, one week’s assignment in 1999 included papers from Science and New Scientist, a chapter from a book on endangered pollinators, and a play by Ibsen. Each student is assigned to read approximately 70–80 items during the semester, including scientific papers, newspaper articles, numerous book chapters, and several entire books.

Problems with reading
Because the class discussions are based on the weekly readings, and because the turnover of readings is not more than 10–15 percent per year, it is easy to monitor the students’ reading performances and compare them with those of previous classes. From this comparison, two major observations have emerged in the past several years. First, only 30–40 percent of the students are doing the reading, compared with 60–70 percent 15 years ago. Second, an increasing number of those who are reading are unable to extract the significant details, or in some cases even the general conclusions, from the assignment. The effect on class discussions can be stultifying.

A similar, and probably related, deterioration can be seen in students’ written work. The average length of term papers has grown shorter each year, and the general structure of the writing and word usage have come to resemble casual speech much more than scientific or other writing. For example, a third or more of our students do not know the distinction between “affect” and “effect”—a distinction that can be learned only by reading.

The conclusions seem inescapable: For whatever reasons, many students at this rather typical state university are uncomfortable reading and writing; their reading abilities do not permit them to extract the informational content and full meaning from scientific papers and other complex written material, nor can they evaluate the material critically. Indeed, many seem so uncomfortable with the written word that they are unable to proofread their own papers (despite explicit instructions to do so) or correct their own mistakes, except for those picked up by spell-check software. Such shortcomings are especially disturbing in a class whose students are handpicked and unifying principles of the course and make them readily apparent to the students from the beginning. Equally important, we devised a feedback mechanism for continually monitoring the students’ conceptual understanding of what they were being taught (Gunstone and Mitchell 1998).

Before the course began, E. E. spent several hours teaching the teaching assistants and professors the critical ideas of the human constructivist approach and discussing practical issues, such as the use of group learning methods during recitations. She pointed out that to acquire a deep understanding of a subject, it is not enough for a student to listen passively to an instructor (Redish 1994). Instead, gaining understanding requires an idiosyncratic, dynamic construction by the students themselves. The job of the instructors is therefore to help the students find the meaning in the material (Phye 1997). The foundation of the human constructivist approach is the idea of metacognition, that is, helping students to understand how they know what they know (Ausubel et al. 1978, Baird 1986).

If students are to construct their own understanding of the material, reflect on their knowledge, ask questions, and plan their own learning, it is necessary for the instructors to have methods that assess the students’ progress. Accordingly, the team agreed to institute an assessment technique of biweekly “course reports” (Etkina in press), which are structured journals (Bagley and Gallenberger 1992, Lester et al. 1997) in which students answered the following questions:

A model for change
This collaboration began in another and much larger course (200 students, primarily sophomores and juniors) in general ecology, which D. E. coordinates as part of a team of five professors and four teaching assistants. For 2 or 3 years, the course had been stagnating and losing effectiveness, an opinion confirmed by the student evaluations. To help reverse this decline, the faculty sought the advice of a professor of science education, E. E., an expert in the human constructivist approach to teaching (Mintzes et al. 1998) who had successfully employed this approach in introductory physics courses at Rutgers. Human constructivism is the approach to teaching whereby a learner constructs the conceptual understanding of material through guided exploration and leading questions from the teacher instead of through listening to lectures.

An analysis of the syllabus and teaching methods used in our ecology course led E. E. to the conclusion that the course had two problems: an absence of clearly defined goals that were communicated to the students and a lack of feedback mechanisms that could provide the teaching team with information on students’ actual understanding of the material. Before the team’s contact with E. E., efforts to improve the course had been concentrated on improving the lecture presentations and exams. Afterward, the team decided to redefine and clarify the objectives and unifying principles of the course and make them readily apparent to the students from the beginning. Equally important, we devised a feedback mechanism for continually monitoring the students’ conceptual understanding of what they were being taught (Gunstone and Mitchell 1998).

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What did you learn during the past 2 weeks?
What didn’t you understand in these lectures?
If you were the professor, what questions would you ask on a test to determine whether your students had understood the material?

The reports were graded on the basis of the effort that the students had made to reflect on what they had learned, and the teaching assistants wrote comments to provide feedback to the students. Thus, the loop was completed: from student to instructor and back to students.

This approach is deceptively simple, but the reports provided astonishingly useful information for the teaching team. It became clear that most of the students had no conceptual understanding of the basic scientific method, an understanding that had been taken for granted—although rarely tested—by their teachers. The students were completely unable to grasp the distinction between observations, hypotheses, and tests of hypotheses. To them, everything they learned was “information” (Hammer 1996). Also, many were unable to express coherent ideas in direct, concrete, unambiguous language. Instead, they used strings of metaphors and abstract nouns that betrayed the incompleteness and incoherence of their thoughts. The students who were most confused, judging by their answers to the first question, were least able to formulate what they didn’t understand in response to the second question. And the low quality of the answers to the third question indicated that the generally poor performance on the first exam was probably related to the instructors’ failure to convey in advance the goals of the lectures and recitations and how a student could assess his or her progress toward meeting those goals.

With this knowledge of how the students were perceiving (or misperceiving) what we were teaching, we began to restructure the course. In recitations, we shifted weight from the teaching assistants’ presentations to students’ talking, including structured group interactions. In every lecture, professors tried to make clear how newly presented material related both to data and concepts already discussed and to those that would come later; when discussing ecological examples, they attempted to distinguish clearly between observational facts, hypotheses, and tests of hypotheses. Both teaching assistants and professors tried to use the biweekly course reports to help them understand the critical difference between what they thought they were teaching and what the students were, in fact, learning.

This constructivist approach to teaching was a revolutionary change from the traditional, unidirectional teaching style the professors were accustomed to, and it was neither easy nor uniformly successful. Yet, for D. E., the increased numbers of students who were excited about ecology and the improvement in the students’ evaluations of the course demonstrated the value of the new method. Equally encouraging was the steady improvement in the grades on the course reports. By the end of the semester, nearly all of the students could tell the difference between an observed fact and a hypothesis, and they recognized that a hypothesis cannot be confirmed by the original fact on which it was based.

Applying the method
These changes in the teaching of the general ecology course, begun in 1998, were taking place while D. E. was contending with the poor reading and writing abilities of his students in the Conservation Ecology seminar. Therefore, he decided to modify the idea of course reports for use in the seminar in 1999. In other words, D. E. wanted to find out what the students actually perceived when they read a journal article or book chapter, and he wanted to see how this perception might affect their understanding and writing. Drawing on the biweekly reports of the general ecology course, he instituted weekly “reading reports,” using a similar structured format to allow him to assess progress over the semester.

The reading reports comprised responses to a standard list of instructions about the readings for the coming week:

• Give the title, author(s), date, and source of each reading. (A handout entitled “Guidelines for Writing Papers” included a discussion of citation style.)
• State the senior author’s affiliation (e.g., Department of Zoology, University of Michigan; or Environmental Defense Fund).
• In 1–3 sentences, summarize the main point(s) of the reading.
• In 1–2 sentences each, describe the major strength of the reading, the major weakness, and give your overall opinion/evaluation of the reading.
• In 1–2 sentences, state why you think that this reading was assigned.

All reports had to be typed and handed in at the beginning of each class, before the readings were discussed. (Students were encouraged to keep a duplicate copy for use in class that day.) They were corrected, graded, and handed back the following week. Grades, in addition to the comments written on the reports, were for the purpose of allowing students to track their own progress. Initially, four possible grades were recorded: 0, report not handed in; 1, inadequate job; 2, acceptable; 3, very good. After the fifth week, D. E. found that another grade level, 3+, needed to recognize exceptional reports. By the sixth week, students who had handed in all reports for previous weeks were allowed to skip up to two report assignments without penalty, at their own discretion. Writing comments on the reports was time-consuming at the beginning of the semester, but by the third or fourth week the students had improved and the comments took far less time.
Getting feedback

The reading reports proved to be as informative and useful for the Conservation Ecology seminar as the biweekly course reports had been for the general ecology course. The first set of reports included many that had incorrect citations and no affiliation given for the senior author. Students demonstrated an inability to understand and evaluate the reading, little comprehension of why the article was assigned, and, commonly, a vagueness of expression that often made it impossible to determine what students thought the reading was about or what their opinions of it were. The most frequent “weakness” listed—especially for anything longer than 5–10 pages—was that the reading was “boring.” Many of the students receiving grades of 1 or 2 on the early reports proved by their questions during class discussions to be intelligent, motivated to learn, and interested in the subject matter. These students simply did not know how to approach a reading assignment that was scientifically or sociologically complex or that presented ambiguity, unresolved questions, or controversial issues.

More than half the students, to judge from their answers on the reports, were unaccustomed to readings that were not textbooks, in which information comes presorted and organized under clearly defined headings. Consequently, the idea of critically evaluating the readings—looking for opinions, points of view, and errors of fact or logic—was strange to them. One does not usually evaluate a textbook in this way. For these students, criticism often did not go any deeper than approval or disapproval of a reading’s general theme or conclusions. The last question—Why was this reading assigned?—proved even more troublesome: The answers indicated that many students viewed the readings as discrete, unrelated units, not as interconnected elements in the larger context of the course.

The main conclusion drawn from the first sets of weekly reading reports was that many of the students were not used to reading journals and books as a way of learning, possibly because reading was not a regular part of their lives. This conjecture is supported by Woiwode (1990), who claims that after Americans finish high school, 60 percent of them never read another book, and most of the rest read only one book a year. Sample reading reports, one of which received a grade of 1 and another that earned a 3, are provided in the box on page 606 (Reports 1 and 2); both reports were turned in early in the semester.

The reading reports helped D. E. understand that the poor quality of the reading performance was not, in most cases, likely to be improved by an increase in the number of tests or by giving lower grades to encourage harder work. The reports themselves constituted a better strategy—they not only explained the reasons for the poor performance but were the means of teaching the students how to extract meaning from their assigned readings.

Table 1. Distribution of grades on reading reports for Conservation Ecology for 3 weeks at the beginning of the course and 3 weeks near the end of the semester (spring 1999). 0, report not handed in; 1, inadequate job; 2, acceptable; 3, very good.

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<th>Week</th>
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<th>Grade = 2</th>
<th>Grade = 3</th>
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<td>22</td>
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<tr>
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<td>3</td>
<td>9</td>
<td>13</td>
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Outcomes

The positive effects of the reading reports were brought about in two ways: through the students’ act of preparing them and through the feedback that they provided to both instructor and students (Simpson 1983). The structure of the reports, followed repeatedly during the semester, taught the students a simple, reliable, general method for getting the most from any reading assignment. The five instructions seem elementary, but for students unaccustomed to critical reading, they provided a stepwise way to bring a mass of hazy material into sharp focus and a framework on which they could construct their own knowledge in a way that would be useful to them. The first two questions, although seemingly trivial to an experienced reader, served an important purpose: For the first time, many students learned how to cite a reference reliably and realized that opinions expressed in a paper can be affected by the personal bias and affiliation of the author. The third and fourth questions accustomed the students to look for and concisely summarize the main conclusions of the reading and to read or reread the assignment critically to discover its strengths and weaknesses. And the last question showed them the importance of figuring out how the reading met the goals of the course—that is, how it fit in the context that the professor had delineated. The regular feedback provided by the comments written on each report helped the students learn how to do these steps (Black and Wiliam 1998). We did not teach them to read, but we did help them read to good purpose.

During class, students were able to use their duplicate copies of the reading reports as an aid to discussion of the readings. The discussions allowed them to see how other students had perceived the readings and became a way of helping students evaluate the quality of their own reports. The original copies of the reports, with comments, were handed back during the next class session, before the
Sample reading reports

The following are reading reports that were submitted by students in Conservation Ecology in 1999. Report 1 was submitted early in the semester and received a grade of 1 (unsatisfactory). Report 2 was submitted by a different student the same week as Report 1. It received a grade of 3 (very good). Report 3 was submitted late in the semester by the same student who wrote Report 1. It received a grade of 3 and is typical of the kind of improvement in reading (and writing) skills that occurred during the semester. The marginal comments provided by D. E. on the original reports are shown in italics.

Report 1

The Death of Ramon Gonzalez, Angus Wright (Austin, Texas: Univ. of Texas Press, 1990), Chaps. 1–6 (pp. 1–187).

Angus Wright is the author of The Death of Ramon Gonzalez. This does not tell me who Angus Wright is. Is he a farmer, a journalist, a professor? The author discusses some of the major agricultural problems that we are currently facing. Wright discusses the effects of pesticides on both human health and the environment. The strength of the book is reflected in the depth and effort spent examining each area. The author provides the reader with a complete description of the results of this type of farming. Although the argument is strong, some of the points used to support the hypothesis fail to adequately enforce the overall position. In general, Wright provides a solid critique of practices that should be thoroughly examined for both their health and environmental impacts. This assignment expands students’ current knowledge of the situation, and provides a view that many individuals hold. This conveys no useful information about what the book was about, why it was assigned, or what its strengths or weaknesses are. You do not even mention Mexico, Ramón González, or any specific pesticide. I assigned this reading to demonstrate the effects, on land and native peoples, of modern, industrial, cash crop agriculture in a third world country, and to lead you to question the sustainability of this system.

Report 2


Angus Wright is a professor of environmental studies at California State University, Sacramento. Partial funding for the research used to write this book was provided by a Fulbright scholarship. The first six chapters give an overview of the types of pesticides used in Mexico. These include persistent pesticides that have half-lives of months, years, or decades, such as most of the chlorinated hydrocarbons like DDT, BHC and the “drins” (aldrin, dieldrin, endrin, etc.) and nonpersistent pesticides, with half-lives of hours, days, or weeks, including organophosphates such as parathion and guthion, and the herbicide paraquat. Wright describes the dangerous misuse of the nonpersistent pesticides that he noticed during his travels in Mexico, during the 1980s. Using the Mixtec Indian community as the subject of his study of migrant laborers, he uses his investigation into the mysterious death of one of these workers to trace back the multiple causes which have led to the present use of ecologically abusive agricultural methods in Mexico. In examining the social, economic, political and historical reasons which have led to the abuse of Green Revolution technologies in Mexico, he not only unravels a complex structure of corruption, over-bureaucratization and ignorance, but brings to light the strength and intelligence of the Mixtec community. An excellent summary, although a bit long. I like the way you go from the specific to the general.

The major strength of the reading is that Wright spends a significant amount of time discussing the culture and history of the Mixtecs. By focusing on the Mixtecs’ lifestyle, Wright provides the appropriate context for understanding the problems of these people. But I feel that Wright often repeats himself, and therefore the text becomes redundant. Although the reading can be rather dry because of the explicitness, I enjoyed it because of the different ways he approached the problem: economically, politically, socially, and historically. A very good analysis. I agree that Wright repeats himself.

I believe this reading was assigned to show us the problems with high input agriculture in third world countries and that it can be driven by politics and economics.

Report 3


David Pimentel is a professor in the College of Agriculture and Life Sciences, Cornell University.

The article emphasizes how the interaction of humans with their environment is extremely complex. This makes understanding how different factors adversely affect health difficult at best. These factors such as unregulated population growth, high localized populations, and pollutants in air, water, and soil contribute to the majority of deaths experienced worldwide. Exponential population growth is leading to malnutrition and rapid spread of infectious disease. Unless a cooperative effort is made between safeguarding the environment and maintaining appropriate levels of human inhabitants, it is inevitable that a high price must eventually be paid. Good summary. Your use of the phrase “majority of deaths” is, I think, a correct interpretation of Pimentel et al.’s message.

The combining of data from different areas, such as disease, population growth, and malnutrition, into one unified theory help in explaining possible solutions to these problems. A weakness is that implementing such a strategy would require immense cooperation between diverse individuals with different ideals and goals. Overall, the article is helpful in providing the reader with a perspective from which they derive insight as to possible future consequences of current actions, and potential methods to avoid these results. Good, but last sentence is too vague.

This article was assigned to show that population growth and environmental degradation are contributing to an increase in the prevalence of disease around the world. There is a complex interaction between humans and their environment, and unless an effort is made to act appropriately, devastating consequences will result. Very good.
It was more adept at scientific journals and books. And by the end of the semester, students had become more comfortable with reading scientific papers, the students were limited to no more than two references of poor writers or foreign students, and they did put an added burden on them to extract the meaning from their assignments and place them in the larger context of the course.

The underlying educational philosophy of this approach is metacognition—helping students to understand how they know what they know through a system of carefully selected questions. As our results indicate, metacognitive skills are necessary for conceptual understanding and allow students to construct a coherent picture of their knowledge. Thus, a relatively simple intervention produces a surprisingly positive effect. Although it is not possible in a one-semester biology course to identify and address the underlying causes of our students’ initially poor reading performance, we can give them an active method for coping with the problem themselves and making sense of their academic environment. We believe that the kind of interdisciplinary cooperation described in this paper can significantly improve the teaching of biology (and other sciences) by providing biologists with educational strategies that help them understand how their students learn and what they are actually learning.

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References cited


