A Reading and Writing Approach to Teaching Environmental Geology

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ABSTRACT

The course described here was developed to help improve student skills in reading comprehension, writing, and critical thinking. Journal articles on various topics in environmental geology are used instead of a textbook. Topics vary with interest and current importance. Each week, students read an article and write an abstract for that article. A different team of students leads the class discussion of the article each week. The students are encouraged to read the articles critically — to look for inconsistencies and poor reasoning. Abstracts are graded as much for spelling, grammar, and organization as they are for content. The students also pay attention to articles about environmental geology in print media and give a short oral presentation on a topic of their own choice that has been approved by the instructor. The continuous, weekly emphasis on reading for content and then proving comprehension by writing about the article, and further proving it by talking about the article, pays off in increased student ability to read critically and well. The equally continuous emphasis on good writing results in a marked improvement in student writing ability.

Keywords: Education — geoscience: education — by reading and writing: education — undergraduate: engineering and environmental geology.

Introduction

Environmental geology (GEY 109) is one of the most popular introductory science classes offered at Castleton State College. It would fill completely with seniors (who register for classes first) if seats were not reserved for other students. Each time it is offered, there is a waiting list of students eager to get in the class, and I always end up with a larger class than I had intended to have. Students from a wide variety of backgrounds, interests, and skills are attracted to the subject, necessitating a broad teaching approach. The impetus for developing a new strategy for teaching environmental geology came from my own dissatisfaction with the standard text-lecture-test format. This standard methodology was too easy for geology majors, moved too rapidly for nonmajors, and left me stuck with the topics and order of the text, with not enough coverage of individual current “juicy” issues and little opportunity for critical reading. In addition, campus-wide initiatives for “writing across the curriculum” need strong support from the sciences (Foos, 1987; Conrad, 1991; Davis and others, 1991; Peters, 1996; Kovac and Sherwood, 1999). Castleton has just approved a Writing Standards requirement for graduation, and GEY 109 will likely be the first science course to qualify. Finally, for a teacher in a college whose focus is undergraduate education and whose teaching load is heavy, using the same format for all courses is boring. So, the introductory environmental geology course at Castleton was redesigned from the very beginning, with an eye to presenting opportunities for reading, writing, and overall comprehension in a fresh format.

The following problems were tackled in the redesign of the course:

1) Students need to understand important current issues in environmental geology;
2) Many students do not read thoroughly or critically (when they read at all);
3) Many students do not write well;
4) Many students cannot give an oral presentation;
5) Students and professors need a break from the standard lecture-exam format; and
6) Textbooks can limit course scope and depth.

An added bonus is that students buy one fewer textbook, which can mean a significant reduction in out-of-pocket expenses for the semester.

The redesigned approach has students study important topics, read every week, prove they have read every week by writing every week, prove it further by leading a class discussion on the reading, and give an oral presentation on researched material.

Topics

Naturally, deciding what is “important” in any course is subjective. Since there are too many topics to cover in a single semester, choosing what topics to study allows for great flexibility for both the professor and the students. Carpenter and others (1999) suggest focusing on a small number of issues, emphasizing depth rather than breadth. Robinson (1987) chooses a single topic and has students read competing views of the topic. Student input on topics can be solicited, and the professor can vary topics from semester to semester as current issues and personal interest change and evolve. Having no textbook means there is no set list and order of topics to be studied; one chooses only what is needed for the semester.

Recent classes at Castleton State College have studied volcanic hazards in Iceland, landslides in California, deforestation in Costa Rica, earthquakes in Japan, the ethics of radioactive waste disposal, coastal erosion in the eastern United States, and water resources...
in the West. Any topic can be used, provided a reasonable article can be tracked down.

Because many students in the class have little or no background in the geological sciences, two of the three class meetings per week are devoted to providing enough information for the students to understand the week’s reading.

Reading
Readings are chosen from “mid-level” journals (such as Scientific American, Earth, Environment, and American Scientist) and books. Appendix 1 lists a number of readings suitable for the course. Some examples (see Appendix 1 for complete references) are landslides in southern California (McPhee, 1989), the current state of radioactive waste storage (Grossman and Shulman, 1994), slowing the pace of global warming (Planagan, 1996), and assessing the possibilities of solar energy (Weinberg and Williams, 1990). Most students have never read a scientific paper, but many (even freshmen) quickly become proficient at understanding this new style and format. Readings with a clear focus such as these encourage the student to understand the impact of humans on the geologic environment, and vice versa. Students encounter a variety of writing styles when changing authors and journals every week, and many are surprised to find themselves enjoying readings that are more than fifty pages long.

The students are encouraged to read critically—not to believe everything simply because it is on the printed page. They are asked to look for mistakes or inconsistencies and to recognize good writing and logical construction. Many students are uncomfortable with this, believing that “Science = Truth,” and so any scientific writing is unquestionably correct and good. One goal of this course is to show students that they have the power to judge, provided they understand.

More Reading – The “News Story of the Day”

Students are strongly encouraged to be aware of environmental-geology events in the news. To help facilitate this, for each class a different student is assigned the “news story of the day.” The student scans newspapers, magazines, or the Internet for a news story on an environmental-geology topic and brings the story to class. I often bring in additional news stories as well. After class, the story is posted on a board outside the classroom. (The accumulated stories show the breadth of interest within the class and advertise the class to students passing through the hallway.) The student also brings in a prepared summary of the story, which s/he presents to the class. One benefit of the “news story of the day” is that, at least this once, the students are encouraged to become aware of current events. Another benefit is that it introduces a little public speaking (of a very non-threatening sort).

Students at first protest that it is impossible to talk for a whole thirteen minutes, then are surprised to learn how difficult it can be to talk for only 13 minutes on a topic in which they have invested a considerable amount of research and time.

Writing
Every week, each student writes an abstract of the week’s reading. (If an article already has an abstract, it is removed before the article is copied and handed out. For these articles, the source and date are also removed, to discourage students from going to the library, finding the original article, and copying the original abstract.) To write an abstract, the student must understand the reading (Foos, 1987; Conrad, 1991; Macdonald and Conrad, 1992; Kovac and others, 1999). Abstracts are graded on comprehension, content, grammar, sentence structure, and punctuation: the emphasis on correct, complete English sentences is as important as the demonstration of content comprehension (de Capraris, 1996; Peters, 1996). The course syllabus lists certain grammatical and spelling errors for which five points are subtracted from the abstract’s grade each time the mistake is made. The syllabus also states that I can add words to the list whenever I feel it necessary.

Writing begins the very first week of class. The students receive a handout and a short lecture on abstract writing, which is usually a new style for them. The first abstract handed in is corrected, graded, and returned, but the grade is not recorded. This indicates to the students what they should expect to do.

When students write every week, receive written comments and suggestions every week, and apply themselves to understanding and learning from the comments and suggestions, there is noticeable improvement in writing even before the semester is half over. This was one of the most remarkable and surprising outcomes of the redesigned course. I take it as a compliment when I overhear students grumble “I didn’t think this was an English class.” Learning is an integrated process: geology is not divorced from English (or any other subject) just because it appears in a different section of the college’s course catalogue. Writing about course material aids learning (Horton and others, 1985).

Speaking
Each week, on the day the abstracts are due, a team of two students leads the class discussion on the article. The team is chosen either by volunteering, or by lottery. The team may choose to summarize the reading, ask questions of the other students, or do whatever is needed to stimulate conversation. The student-led discussion section is a critical element in the success of the course; all students are far more likely to participate in a discussion led by their peers. There were even students who liked the concept so much they volunteered to lead additional discussions. And because everyone has just turned in an abstract on the reading being discussed, everyone has the necessary information to participate.

Each student researches a topic of the student’s choosing (and approved by me) and turns this into a
short oral presentation at the end of the semester. A preliminary bibliography is due about a third of the way into the semester, and a final bibliography is due about two thirds of the way through the semester. This project provides an opportunity to research a topic of personal interest – for example, coastal erosion on Long Island, alternatively fueled homes in central Vermont, or the impact of James Bay hydropower on Vermont’s electric grid.

The presentations are thirteen minutes long (Geological Society of America format). Students at first protest that it is impossible to talk for a whole thirteen minutes, then are surprised to learn how difficult it can be to talk for only 15 minutes on a topic in which they have invested a considerable amount of research and time.

Schedule

A typical week’s schedule for a class that meets Monday-Wednesday-Friday (50 minutes each class) and once a week for lab (3 hours) is as follows:

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday:</td>
<td>Turn in abstract on reading handed out the previous Monday</td>
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<tr>
<td></td>
<td>10-minute quiz (based on previous Wednesday and Friday material)</td>
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<tr>
<td></td>
<td>Student-lead discussion of the reading</td>
</tr>
<tr>
<td></td>
<td>Hand out reading for the coming week</td>
</tr>
<tr>
<td>Wednesday,</td>
<td>Background material presentation (by professor)</td>
</tr>
<tr>
<td>Friday:</td>
<td>on topic for the next week’s reading and discussion</td>
</tr>
<tr>
<td>Lab:</td>
<td>Related to the week’s topic</td>
</tr>
</tbody>
</table>

The short weekly quiz helps focus those students who need a bit more stick than carrot when it comes to learning a new subject. It also helps fill out the class period on Monday, as thirty to thirty-five minutes turns out to be the optimal length of time for the student-led discussion.

Results

The results of student course evaluations for six semesters of GEY 109 are presented below: one semester (20 students) was taught using the “old” format (textbook/lecture/exam), and the other five (a total of 85 students) were taught in the “new” format (reading and writing). The evaluations were analyzed for specific relevance to the reading and writing format and for general student satisfaction with the course. The total number of usable evaluations is less than the total number of students because of student absences or incompletely-filled-out evaluation forms.

The evaluation items used here are:

7) “Why did you take the course?” The three main responses are that students take GEY 109 (i) as a requirement for their major, (ii) to fulfill general education (“core”) requirements, or (iii) out of interest. Responses to this question demonstrate the wide variety of students enrolled in GEY 109.

8) “What is your class standing?” This also shows the diversity of students in GEY 109.

9) “How many hours each week do you typically spend in study or course work for this course?” Choices are 0-2 hours, 2-4 hours, 4-6 hours, 6-8 hours, and 8+ hours. This can indicate if a student is actively involved in a course or just scraping by with a minimum of effort.

10) “What grade do you think you will receive for this course?” This can suggest how critically students perceive their own abilities to master the course material and requirements.

11) “How well did the text/reading materials help you achieve the objectives of the course?” Responses are given on a 1-to-5 scale, with 1 meaning “not at all” and 5 meaning “very.” This question specifically addresses the reading aspect of GEY 109.

Student responses to these questions are given in Tables 1 and 2. For each item, the percentage of students giving a particular response is calculated. (Not all percentages sum to exactly 100% because of rounding errors.) When GEY 109 was offered in the fall of 1992, it was not yet approved for core credit, so the student population consisted of either science majors or those simply interested in the subject. This had the potential of skewing the results to more favorable results than with the harder-to-please core students. Table 1 contains old-format results from Fall, 1992 (20 students, 15 evaluations), and Table 2 contains new-format results from Spring, 1995 (18 students, 12 evaluations), Fall, 1995 (19 students, 13 evaluations), Fall, 1997 (17 students, 13 evaluations), Spring, 1998 (18 students, 15 evaluations), and Fall, 1999 (13 students, 11 evaluations).

Although it would have been helpful to have a larger number of evaluations for the old format, a few general observations can be made. The new format served a greater diversity of students, as seen from their reason for taking the course and their class standing. This could potentially skew downward the ratings of the new format, since nonmajors often have negative feelings about science classes that color their evaluations of science courses (Carpenter and others, 1999: Robinson, 1987). However, students in the new-format classes spent more time on course work (48% spent more than four hours each week on the class, compared with 27% spending that long with the old format), suggesting greater engagement with the new-format class. Students in the new-format course also appeared more respectful of the rigor of the course’s requirements, with 67% expecting a B or lower grade in the course. With the old format, 47% expected a B or lower.

There was a much more positive response to reading materials in the new-format course, with 71% of the students indicating that they really liked the articles (rating reading materials 5 on a scale of 1 to 5). With the old format, only 47% gave the textbook an equivalent rating.

Student satisfaction with the course structure, and their overall enjoyment of and respect for the course, are best seen in their comments, which address the questions:

12) “What features of the course did you like?”

13) “Which would you like to see changed?”
No students in the old-format class commented on either the textbook or the class format. A total of 47 students in the new-format classes provided unsolicited written comments concerning the reading and writing format of the course, and these comments can be summarized as follows:

- 15 students (32%) liked writing abstracts/felt writing was improved;
- 14 students (30%) liked having no textbook;
- 27 students (57%) liked variety/relevance/interest of articles;
- 2 students (4%) liked having no tests;
- 7 students (15%) liked student-led class discussions; and
- 3 students (6%) thought too many abstracts were required.

A few specific comments are worth quoting:

- "I liked improving grammar and writing techniques...I loved the current issues that were covered."
- "I liked doing the abstracts and actually credit them for the improvement in my writing."
- "I liked that we did not have a book. This allowed us...to read articles by different people with various views. We had a lot of writing...which was at times tedious but...gave a chance to improve."
- "I liked using actual science articles rather than a textbook when studying a topic. It seemed much more 'real' and 'purposeful.'"

These data back up what I have observed over the course of each semester of GEY 109. Student reading comprehension improves. I notice the improved quality of the discussions, including greater amounts of constructive argument and criticism as the semester proceeds. Students are also much more likely to bring in personal experience and discuss it in the context of the week’s reading.

Student writing improves. This is most obvious to me in that the average time needed to read and correct an individual abstract decreases from about 20 minutes to about 10 minutes. However, improved writing requires constant vigilance. It is easy to tell when a student has rushed writing the abstract, because old mistakes pop up again. But it is gratifying to know that college is not too late to learn better writing skills.

Student public speaking improves. There are several different practice formats built into the course: leading class discussion, bringing in the “news story of the week,” and giving an oral presentation on their researched topic.

Limitations

This professor can’t handle more than about 20 to 25 students per class, because of the amount of time needed to grade all the abstracts well. Also, the instructor must be able to devote time to going over the literature, often in journals that are not near the instructor’s field of expertise, or in libraries that are geographically removed from the instructor’s institution.

Conclusions

Continued writing practice improves writing skills. Handing in an abstract of each week’s reading ensures critical comprehension. Student-led discussions promote participation. A textbook is not needed. The class is fun to teach.

References Cited
Davis, Larry E., Corner, Harriet M., Eves, Robert L., and Urbanczyk, Kevin M., 1991, Student abstract writing
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Appendix 1 – Suggested Readings

Ausubel, J.K., 1997, The Universe and the teacup
Food for Thought


Helen Mango received her BA in geology from Williams College and her MS and PhD from Dartmouth College. She came to Castleton State College in 1991. She teaches environmental geology, geochemistry, hydrogeology, igneous petrology, and general chemistry. Her research interests include the geochemistry and environmental impact of ore deposits, currently focussed in Mexico.

Miller, G. Tyler, Jr., 1994, Living in the environment, 8th edition: Wadsworth, Belmont, CA, 701 p. (This is a wonderful source of references.)
Wuerthner, George, 1991, How the West was eaten: Wilderness, Spring, p. 28-37.