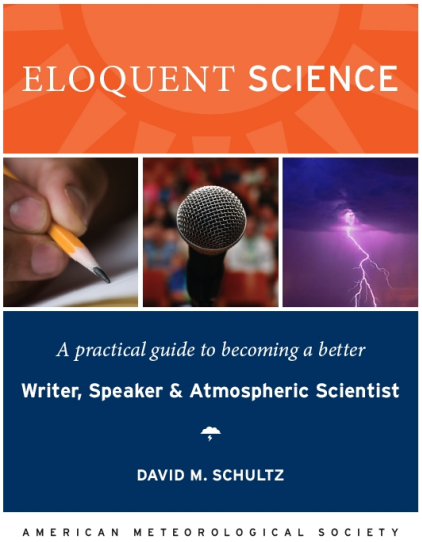

An outtake chapter from Eloquent Science: A Practical Guide to Becoming a Better Writer, Speaker and Atmospheric Scientist by David M. Schultz, published by the American Meteorological Society, 2009.

Incorporating Communication Skills Into Teaching

One of the best ways to improve your ability to communicate is through practice. Instructors can help their students gain that practice through assignments that are stimulating and challenging, as well as useful. This chapter is designed primarily for instructors looking for ideas on how to incorporate writing and speaking skills in the classroom.

> *The turning point for me was in my undergraduate technical writing course at Penn State when I asked the instructor what would make me take writing seriously. (I was trying to do so, but wasn't succeeding.) His response was that the light bulb would go on when I reached a point in life when I would be held personally accountable for the writing of colleagues, employees, and students.*–Prof. Dan Keyser, State University of New York at Albany

The penultimate chapter of this book is written for the professors, instructors, and teachers who know that the best education comes from *doing* rather than being lectured at. Making writing and speaking part of the cirriculum faced by students helps them in whatever career path they proceed down, even if they leave atmospheric science.

Yet, we cannot teach our students the same way we want to be taught. Students (and forecasters) do not learn the same way that professors do (e.g., Roebber 2005; Stuart et al. 2007). Students tend to be goal-seeking learners, wanting to see connections between theory and real-world applications. In contrast, professors tend to be knowledge-seeking learners, preferring theory and learning for

the sake of learning. Unfortunately, the curriculum in most atmospheric-science programs tends to be written from a knowledge-seeking perspective.

As if this mismatch between students and professors was not enough, students may learn in different ways, and to reach all your students, you have to teach to all these different ways. Broadly speaking, David Kolb categorized four different learning styles based on whether the students prefer to be doing or watching and whether they are more thinking or feeling. Each learning style typically asks one of the following questions: "why?", "what?", "how?", and "what if?" Different learning styles may like *or dislike* class discussions, textbook reading assignments, homework, field trips, group problem solving, presentations, or independent research, among others.

Sounds complicated? In reality, you may not be able to design a single assignment that appeals to all different types of learners, but by "teaching around the cycle," you can reach all students eventually. Clearly, Kolb's classification of learning styles also applies when giving a presentation. Although science professors tend to be a more homogenous group than the general public, audience members may come from all four groups. Therefore, your classes will want to touch upon the styles of learning that would appeal to each group.

The beauty of incorporating scientific communication skills into the classroom is that such assignments can appeal to all of the learning styles. Furthermore, such communication skills appeal to all levels of Bloom's taxonomy from the lower-level thinking skills (e.g., remembering, understanding) to the higher-level thinking skills (e.g., analyzing, evaluating, creating).

Teaching communication skills can take one of two general forms. Either a whole class could be devoted to teaching communication skills, the *communication laboratory*, or assignments that develop teaching skills could be incorporated into existing courses.

30.1 Communication laboratory

I refer to the communication laboratory rather than a communication class to emphasize the active role that students play in this course. This course is not a typical lecture-style course, although lectures can be an integral part of the course. Student assignments and in-class interactions are the bedrock of this course. Whether it be writing, reviewing or presenting their work, the focus of the course is on the student, not the lecturer.

The syllabus of the course is flexible, but it could loosely follow the content of this book. Having the students in the class each working on their own writing assignment (e.g., dissertation, manuscript, extended abstract) can invest students in the course, knowing that the outcome of their project benefits their immediate assignment.

If you have ever worked with students on their thesis or dissertation, you know how much time can be required to improve their writing. Clearly, a class of 10, 20, or more students in such a class will be especially challenging for an instructor to handle. The key to managing such a work load is to rely on peer

review of their work. Not only will students take criticism from their peers more constructively, but it eases the instructor workload, as well. The instructor can still comment on or grade the assignment after the peer review has occurred, grading both the author and the reviewer. But, instructor oversight ensures that students feel their work is being evaluated at the instructor level, yet allowing the students to develop their own skills in critiquing others' work, writing a review, and receiving feedback.

SIDEBAR: Sample Exercises

Eloquent Science can serve as a textbook for a communication laboratory class. As such, small exercises can be derived from the content in this book. Here are a sampling of such exercises, and the corresponding parts of the book that relate to this exercise. Think of your own!

Exercise 1: Go to any journal table of contents, looking for examples of good and bad titles. Rate these titles on each of Lipton (1998)'s five qualities (informative, accurate, clear, concise, and attention commanding): 1=excellent, 2=average, 3=poor. Obviously, to score some of these qualities, you would have to be familiar with the topic of the paper and the authors' intent, so do not worry if you cannot make such assessments. If one or more of the characteristics rate a 3, rewrite the title to address its weaknesses. (Chapter 3)

Exercise 2: Read the introduction sections of several papers in the literature. Include some that are not in your area of expertise. Identify the structure of the introduction using the Booth et al. (2003) scheme (contextualizing background information, the problem statement, and a response to the problem). Discuss the relative success of each introduction based on this model. (Section 4.6)

Exercise 3: Take a section of a paper or a whole extended abstract, and précis the text. Aim for something around 100–200 words. Have several people share the same text, so that their individual results can be compared. (Section 13.3)

Exercise 4: Pick a paper and discuss the quality of the figures. Describe the strength and weaknesses of the figures and how the author could have improved them. (Chapter 11)

Exercise 5: Take an article from the literature, and write a peer-review of it, as if they were giving it a formal recommendation. (Chapter 20)

Exercise 6: People love to take pictures of themselves in front of their conference poster. Google "poster presentation," and select "Images" to see what I mean. Download some examples, and offer criticism of their posters. What could be done to improve the posters? (Chapter 27)

30.2 Incorporating communication skills into existing courses

The skills taught in this book do not need to be taught in a separate class for communication skills. Practice for students in written and oral communication in most atmospheric-science courses can be incorporated into the regular cirriculum.

Successful assignments stimulate the student's interest in the project by making the outcome more than just a class assignment (e.g., Booth et al. 2003). Link the outcome to a user group, whether it be a customer outside of the class (e.g., a small business who needs improved weather information) or inside the class (e.g., a student lecture to the rest of the class). If no such opportunity exists, simulating such a customer can also engage student interest (e.g., a weather derivatives game). Students should have opportunities to interact with the audience with whom they communicate. Like the real world, assignments should have due dates for various components of the project. For example, a small research project may entail due dates for the initial project topic, a bibliography, a research proposal, an outline of the report, and the final report. Getting feedback along the way is required, either through external or internal peer review or from the instructor. The more aspects of real-world assignments that can be worked into student assignments, the more reality and the more student investment in the outcome.

Reading others' writing can be a first step toward being a better writer. Whereas humanities classes read classic literature as part of their curriculum, most science classes do not (e.g., Montgomery 2003, p. 3). When was the last time Rossby et al.'s (1939) "Relation between variations in the intensity of the zonal circulation of the atmosphere and the displacements of the semi-permanent centers of action" was read in dynamics class? Reading historical literature benefits learning in many ways. When set in the proper historical context, reading the literature provides a means of story-telling (Knox and Croft 1997), introduces students to foundational papers in the science, and, if coupled with biography, also can provide role models. But, reading historical literature needs to be coupled with writing or discussion exercises to expand upon what the students have read. Examples of how reading literature can be incorporated into teaching are provided below.

Literature synthesis A list of topics is provided by the instructor (or students propose their own topic with the approval of the professor), and students write a literature synthesis on the selected topic.

Student lectures Perhaps as a result of the literature synthesis, students lecture to the rest of the class about their knowledge gained from the literature synthesis.

Debate Take a topic of some debate that was played out in the literature, and have the students divide into groups and debate each other in an organized

format. Include opportunities to present arguments, offer rebuttals, and vote on the winner.

Write an abstract Remove the abstract from an article or find an article without an abstract, and ask the students to write the abstract. (Although they may find the article online and be able to read the abstract themselves, their abstract should be at least as good as that of the original article.)

Class discussions Give the students a reading assignment, then provide them with a list of questions about the reading. Break the students into small groups, have the groups prepare answers to the questions, and lead a class discussion on their responses.

Research projects are a common way to not only develop the communication skills of the students, but also their research abilities. Research projects can be individual, group, or whole-class efforts. In classes I have taught like this, students are required to submit a written report on their research project and make a presentation in a conference-style setting. I schedule a block of time for the student presentations and advertise the conference to the department. Opening up the conference to the rest of the department is a way to showcase the student's research, get feedback from professors, staff, and other students, and show other professors that such a teaching approach can be effective for student learning.

One innovation that Prof. Lance Bosart of the State University of New York at Albany started in his advanced synoptic laboratory class was for the students to address a problem from many different angles. The class would break up into groups and each work on some aspect of the problem. In the fall 1993 version of that class, we studied the rapidly developing Superstorm of March 1993, one of the most intense recorded extratropical cyclones in the northeast United States. The class broke up into three groups, each group studying some aspect to the storm: the planetary-scale flow pattern and path of the precursor shortwave troughs as they moved through the flow; the cold air behind the storm, which formed unusual frontal structures and gap flow through the gaps in the mountains of Mexico and Central America; and why the medium-range forecast model failed to adequately capture the intensity of the storm during its early development over the Gulf of Mexico when forecasts for the storm over the East Coast were much better. The class was largely conducted outside of class time, with class time reserved for coming back together and discussing each groups' individual progress. Eventually, each of these groups' work developed into a manuscript and a published paper (Bosart et al. 1996; Schultz et al. 1997; Dickinson et al. 1997). Later classes studied the Southern Hemisphere split jet, tropical cyclones and the North American summer monsoon, and the influence of Southern Hemisphere mountain barriers on cool surges. Such a class can promote student confidence in being scientists and expose them to the world of writing and publication before their M.S. or Ph.D. degree is completed.

ASK THE EXPERTS: Teaching Writing Skills in a Measurements Class–Petra Klein

At the University of Oklahoma, the School of Meteorology requires all students to take a course in Meteorological Measurements during the fall semester of their junior year. I have served as the instructor of this course over the last five years, and one of the biggest challenges in teaching this course has been the lack of communication skills of the students upon entering the course.

Two major components of the course are (i) bi-weekly lab experiments and (ii) a semester-long project for which students install meteorological instruments, take measurements over a certain time and then analyze their results. These hands-on activities are essential for teaching students how to work with state-of the art instrumentation and data analysis techniques. Students also get a better understanding of typical measurement and exposure errors, which is important for training students to critically evaluate data quality. The lab experiments and project studies are generally well received by students, and, overall, we have received positive feedback from students.

However, both components require that students summarize their results in formal lab or project reports, and, after I started teaching the course for the first time in 2003, I soon noticed that the majority of students had very poor writing skills and needed more instruction on how to write scientific texts. It appeared that most students had never written or even read scientific texts; did not know how to integrate and reference figures and tables in a text; and had no idea about how to conduct a literature review and correctly cite other people works. It was also clear that the reports were mostly written in a rush and submitted without ever being proofread by their authors or their peers. I have thus worked on improving the descriptions of their lab and project studies and have created a detailed guide about the required format of their reports. I have also integrated help sessions focusing on communication skills into the course, for which I mostly use online resources.

Additionally, I require that students submit the literature review portion of their project reports as midterm reports early in the semester. This assignment serves several purposes: students get started early in the semester with their project studies and the related writing, by reading published papers students learn about the typical writing style of journal articles, and I can provide feedback on their writing styles early in the semester.

Last year, I have also collaborated with universitys writing center and had instructors from the writing center come to one of the help sessions and conduct a peer review with the student's midterm reports. The quality of the project reports has certainly improved over the last years and the efforts in teaching better communication skills start to pay off. However, to bring the students' communication skills to a level that they can successfully communicate in their future careers, teaching modules focusing on writing and communication should become an integral part of several courses of their curriculum.

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versity of Oklahoma. She is known for her expertise in urban meteorology and as an instructor that integrates hands-on learning experiences and modules on writing skills in meteorology courses.

30.3 Tutoring students on their writing

When I include writing assignments in my class, I have an open-door policy. I encourage students to come and see me in my office to discuss their work. Unfortunately, few students actually take advantage of this. An alternative approach is to schedule a mandatory meeting with each student to discuss their progress during the course, although this might appear too confrontational for some students. Also, I usually offer a deadline a week or two before the actual deadline for students to submit drafts of their work for comment. This opportunity allows me to view the students' progress and provide initial comments that can improve their final work.

One of the challenges in working with students in this manner is that they will want you to give them all the answers to improve their manuscript. Giving them comments that fix their writing without explaining why these changes are necessary only promotes further dependency. Instead, refocus the expectations of the student from a seeker of information to an active learner and participant. Simultaneously, the tutor is recast from the source of all information into a facilitator, allowing the student to come to the answers to their own questions.

Ask questions, rather than expressing your views. Do not be perceived as taking over the student's paper. Ask the student what they want to gain from the meeting. What specific problems are they having with their writing? What is the purpose of the essay or paragraph? Asking questions allows such refocusing to occur. Ask open-ended questions that do not have short answers. Such questions get students using higher-level thinking skills.

In working with student writing, most students are looking for the microscale comments to improve the paper (as viewed from the perspective of the forecast/writing funnel in Fig. 7.1), not considering the larger picture. Do not fall into the trap of allowing the student to focus on small-scale issues, when the work needs the larger-scale issues addressed. Clearly distinguish the revisions the student thinks are necessary (microscale) with those that would best serve the paper (synoptic-scale). Do not deny them the discussion of grammar that they seek, but redirect their emphasis saying that improving the focus of the paper needs to be done first to better serve the grammar. Then, later sessions can focus on improving the microscale aspects of the paper.

Discuss that you are trying to focus on the large-scale issues first, and the small-scale issues are linked into that. Use a specific paragraph to relate the small-scale issues to the larger-scale purpose of the paper. How does the purpose of this paragraph relate to the theme of the paper? How this paragraph fit into the body of the paper? Then, go down the writing funnel to the sentence level

and word level. If transition is a problem, ask how paragraphs are designed to link together.

Only work through part of the manuscript, allowing the student to learn from the material you do work with and repair the rest of the material on their own. Be patient, especially with ESL students, who may need extra time to answer your questions.

Finally, you will need to lower the student's expectations by treating the session as a step toward producing a revised manuscript—students will expect a perfect draft to be the end result of the meeting. You know that writing takes time and many revisions. Impress upon them the same.

30.4 Grading writing assignments

Two challenges face an instructor who poses writing assignments: how to grade the assignments fairly, and how to find the time to do it.

Students should know what the criteria are upon which they will be graded before the assignment. Like Fig. 2.1, I grade assignments on the quality of both the science and presentation. Gross Davis (1993, p. 224) advocates not splitting content and writing as that "reinforces the false notion that content can be divorced from the clarity and precision with which the ideas are expressed." Alternatively, the following five criteria could be applied: focus, organization, development, sentence structure, and mechanics.

As a reference, I always specify a style guide for the students to follow. They may not follow it or may follow it too closely, worrying about every detail, but your expectation is clear for what you envision.

Making effective comments on grading student's papers: largest first, generalize issues into groups. Only work on small-scale aspects at the latest, or state that you are not revising their work completely.

Just like you would a review (chapter 20), read through the paper first without making any corrections. On your second pass through, do not coat the paper in red ink. Instead, pick out major concerns that appear repeatedly. Instead of circling all typos and minor errors throughout the manuscript, identify errors on just a few pages, leaving the student to find and correct the rest. Do not overmark the manuscript, and do not undermark the manuscript.

Rather than writing comments such as "awkward" or "unclear," provide more specific comments such as "If I understand what you wrote, you meant . . ." or "Do you mean to imply that . . .?" By refocusing comments into questions, you demonstrate your willingness to understand the text rather than criticize it.

Balance good and bad comments. Where the student has demonstrated good form in some locations, but not in others, call that to their attention. Finally, explain your grade. Include some text at the end of the manuscript, or on a separate page, about the strengths and weaknesses of the manuscript and why the given grade was received.

With a class as large as 30 students, providing complete reviews, as if you were a coauthor of the paper, is simply not feasible for most people. On the other hand, the students deserve feedback on their assignments. One approach is to use peer review by the students themselves to help grade the papers. Such an approach also teaches the students about how to write and receive peer review.

When you provide comments, maintain the focus on the large-scale issues (e.g., organization, transition, content, scientific quality, purpose) of the assignment rather than focus on small-scale issues. To focus on small-scale aspects of student writing, have them do shorter writing assignments (abstracts or 1–2-page essays). Such shorter assignments allow you to focus more on specific writing problems that the students have, without being bogged down by pages and pages of text. Furthermore, shorter writing assignments are often more difficult for students to write because of the added importance of coherence in telling a clear, concise story in just a few paragraphs.

30.5 General strategies for assignments

Each assignment should be accompanied by a handout explaining the specific task, the audience, expectations of the final project, what skills you expect the students to gain, approximate length in number of words (not pages), format of the paper, style guide, grading criteria, and schedule for policy on missed deadlines.

Mix up the student groups over the course of the class. Small groups should ideally be 3–4 people. In selecting group members, avoid placing a single woman in a group of men. Studies show that women tend to participate better in groups when they are in the majority. So, in a group of three people, two or three should be women.

Inevitably, you will discover strengths and weaknesses in particular assignments as they occur and afterward. Student evaluations can also help in discovering their successes and weaknesses. Record what worked, what did not, and ways to improve the assignment in your notes, as the issues come up. Waiting until the next year when you offer the course again is too late to remember all the details of what you would have done differently.

For further reading

Tools for Teaching by Barbara Gross Davis (1993) is a kind of literature review in book format for teaching. Innovative teaching strategies are referenced, so more details can be found in the literature. Part VII discusses writing assignments specifically, but the whole book is a wonderful addition to any instructor's book collection.

The Craft of Research by Booth et al. (2003) has a postscript for teachers that describes the five characteristics of research assignments and provides some comfort for instructors struggling with how to incorporate the lessons of research

into the teaching process.

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