

18 E-mailing Biology: Facing the Biochallenge

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How can one use e-mail in a large introductory science class? Why would one? Does it work? What do we mean here by “work”? These are the questions that guided an experiment in an introductory biology class for non-majors, one with two hundred students, some of whom wanted to learn, and some of whom . . . well, you’ve probably met them before.

What we’ll share here is a report in progress, the story of e-mail usage in two sections of this biology course: one in fall 1995, another in spring 1996. Not surprisingly, what was learned in the fall experiment shaped the e-mail design in the spring, and the success enjoyed in both semesters encourages us to move forward and use our experiences to shape next year’s iteration. Just stopping to review what’s been done, to listen in on the students’ perceptions, and to articulate for ourselves and others what we think is happening, as Lee Shulman (1996) reminds us, helps us to understand our classes and the learning that takes place there.

The basic question, then: Can e-mail work in a large general education class in science? Yes. How does it work? And specifically, does e-mail writing facilitate learning the subject matter of biology? Can it become an exercise in writing to learn? Those questions take longer to answer.

The Course

The class, taught by one of the authors (Langsam), is the first semester of a two-semester introductory biology sequence offered at the University of North Carolina at Charlotte for non-majors. The students taking the course are typical of the increasingly diverse student populations at many mid-size comprehensive institutions: there are full-time and part-time students, residential and commuting students, and students representing a broad spectrum of ages, educational

backgrounds, and ethnicities. The common denominator here is that the vast majority of the students in the course “have” to take it to fulfill their science requirements in general education. Not surprisingly, the students often bring with them negative attitudes toward science and to the course in general, and some of them seem almost science-phobic. More often than not, they come to the course convinced that they can’t succeed in science: it’s too hard, too technical, too detailed, too boring. Many display fragile commitments to the course; they give it a low academic priority, right after courses in their major, outside commitments, and life in general. As they claim, “it’s just a general education course”; “it’s not in my major”; “it’s general education so it shouldn’t be hard.” And what science faculty have said for years is also true: many students simply have poor science backgrounds.

Because the goal of the course is to help students become “biologically literate” so that they can understand biological issues as these impinge on their lives, questions related to personal and civic life are at the heart of the course. Do you understand enough about biology, we ask, to be able to ask informed questions about your health? Why are antibiotics generally ineffective against viral infections, we query? Why is the appearance of resistant forms of tuberculosis an “evolutionary” issue? Do you understand enough about biotechnology to make informed decisions about state funding for biotechnology-related research? How does the decimation of the rain forest contribute to global warming? The aim of the course, then, is to provide students with the type of background that they need to understand current biological events.

The course is designed to follow a “micro” to “macro” approach. It starts with cells and the chemistry needed to understand cell physiology. The students begin by working their way through “typical” plant and animal cells, contrasting them with cancer cells, bacteria, and “noncellular” entities such as viruses. This involves discussions about cell structures and metabolic processes such as photosynthesis and sugar breakdown, as well as what these activities imply about broader ecological issues such as global warming. And the course also includes material on cell reproduction and genetics which forms the basis for discussions about gene manipulation and its impact on medicine, the environment, and in industry. The course syllabus (available at <http://www.bioweb.uncc.edu>) suggests the kinds of tasks required in the course: primarily, four multiple-choice/short answer/essay tests and an optional portfolio used to award extra credit.

The Fall Experiment

Initially, the goals in using e-mail in this biology class were modest. Simply put, they centered on access. First, we simply wanted students to have another means of communicating with the instructor, and we thought e-mail could

provide that. Online, students could (1) ask questions, (2) clarify information from the course, and (3) raise issues—in biology—which they might see as peripheral to the course proper. In addition, we expected that students might find e-mail access to the instructor more efficient access than tracking the instructor down. Posted office hours don't always coincide with student schedules, especially given the urban setting and commuter population of the university; and even phone calls can deteriorate into telephone tag. We also expected that students might find e-mail less intimidating than talking face-to-face with an instructor or raising a hand in a lecture hall of two hundred students, where even extroverts fear that they'll sound stupid. And with the e-mail, we wanted another kind of access—a means for Dr. L., as the students call her, to find them, to give them extra material (in the way of study tips, thought questions, assignments, reminders, whatever) beyond what might be given in the classroom—and without running off reams of handouts or taking up yet more class time.

But even when we started, we knew that eventually we would want to use e-mail as a springboard to other things: to promote critical thinking skills and to introduce students to other online resources. So getting them online was really the first step toward beginning to develop a whole new generation of assignments, ones which could use the World Wide Web to promote student learning. As we began, our main concerns were thus related to the purpose of access: time, time, time. Could e-mail from students be handled in a timely fashion? Would answers reach students fast enough to make those answers relevant? What purposes would they find for this voluntary use of e-mail? And would students respond to a program which, by definition, was “voluntary”?

Ironically, the uses students found in this first e-mail experiment matched all too well what we had planned: they found access and little more. Over the course of the term, far fewer than 50 percent of the students used the e-mail, and nearly all who did employed it to “convey,” to inquire about administrative or procedural issues, generally to acquire information that had been provided to them already: when would the exam be given, for instance, or at what time would the extra study session take place? Perhaps more troubling than this instrumental, nonintellectual use of e-mail was the tendency of students to use it to talk about their grades, or more accurately, about their unhappiness with low grades. On the other hand, even this use of e-mail was useful in giving students a voice which could then be translated into mid-course improvements and corrections. In the fall, student concerns communicated via e-mail contributed to the development of a new grading option which we thought would boost student morale by providing an added incentive for students to study hard and do well on their cumulative final:

Here's a once-in-a-lifetime opportunity for Biology 1110 students. . . .
Currently, there are two ways to improve your grade in this course.

First, you can submit a portfolio of items at the end of the semester. These items include your responses to questions assigned from your text and to questions which accompany case studies and other readings. As you will recall, the portfolios will be used to determine whether students with borderline grades (58, 68, 78, 88) will receive the next highest grade. Everyone is eligible to do this.

Second, you have the option of taking a make-up exam on the last Friday of classes. This exam will be given at 2 p.m. in a room to be announced.

Third, and this is a new option. You may opt to allow your final exam score to count twice (if that final exam score is higher than your lowest grade). You may not use both option 2 and 3. You can *either* take the make-up exam on the last Friday of classes or you can opt to have your final exam score count twice.

What do you all think? Any takers on option #3?

Dr. L.

And students appreciated this option, as a student here suggests on e-mail:

I think the new idea you've proposed is a great one. I missed taking the third exam today, but did well on the first two. I was going to have to take the make-up exam on the last Friday of classes, but this new option will work out really well for me. Now I can take one test instead of two, which makes my life a little easier. Thank you. You've gone out of your way to make this class more convenient for us students, and I for one really appreciate your efforts.

Sincerely,

KH

But as the semester closed down and we reviewed e-mail usage over the fall 1995 term, it was pretty clear that what we exchanged on the e-mail was more in the way of information around the class rather than information deriving from or focused on the intellectual work of the class. It was also clear that the usage—under 50 percent of the students—was low. If we wanted e-mail to do more than provide access, we would need to design that more into its usage.

The Spring Experiment

In the spring, in addition to keeping e-mail a venue of access, “biochallenges” were introduced: questions that asked for applications of the material under study. Also, in order to motivate students, the biochallenges—which were still voluntary—“counted” for 1–5 extra credit points on an exam. So in attempting the biochallenges, a student had little to lose, much to understand. And if the understanding were persuasive, the student’s grade could reflect that. This e-mail design seemed much more likely to produce the kind of writing to learn and, through it, intellectual exchange that we’d hoped for from the start.

For many students, about half of them, this too “worked”: they took on questions that were new to the course, questions that students hadn’t really thought of before. Also, the e-mail permitted an iterative process between student and instructor; as students wrote, the instructor would comment back and ask them to expand their answers or to think in a new direction or from a new perspective. The students comfortable on e-mail were also comfortable enough to “write aloud,” to write on the e-mail in an informal, noncorrective mode; thus, we could often see evidence of their thinking as they talked through a biochallenge. Asked why rain didn’t soak a raincoat but did soak a cotton shirt, for instance, one student responded:

There are two types of fatty acids, which make up the lipids along with the glycerol molecule. One type is (poly)unsaturated. This means that there is only one double covalent bond in the fatty acid. This one double bond means that the hydrogens are less compacted, these fatty acids are liquid at

Okay, I need to start over because I think that I was confused on what the question was asking. Lipids are insoluble in water because they are made of non-polar covalent bonds. Water is made up of polar covalent bonds. In order for a substance to be soluble in water the substance must have some charged ends (also be a polar molecule). . . .

The student continues with relevant information, finally ending with this observation:

Rain does not soak through a raincoat because it has a waxy or oily coating. As I just explained lipids are insoluble so the materil of the rain coat does not get wet. The waxy or oily coating protect the material, this is much like the oil on a duck’s feathers or the wax on your car. Ducks feathers do not soak up water (“water off a ducks back”) and when your car is properly waxed then the rain beads up. A cotton shirt does not have this lipid layer therefor water soaks through.

Again I am sorry about the beginning when I was answering a different topic.

Deray Krueger

Here the student seems to write the e-mail as though it’s a journal entry—with misspellings, a dearth of punctuation, and even a few biological misconceptions mixed in with solid knowledge—but the writing is both for self and for other. As important, the other is not James Britton’s teacher-as-examiner (1975), but teacher-as-coach, teacher-as-fellow-biologist. The e-mail welcomes different kinds of information, both the academic—*lipids*—and the *non-academic* that suddenly, in the act of learning, is germane—*water off a duck’s back*. Perhaps most interesting, when the student takes a “wrong” turn, she doesn’t start over: the *process* of arriving at the right answer is itself part of the right answer.

We also used e-mail as the springboard to introduce assignments which asked students to access information from the World Wide Web that was too current to

be represented in their text. In one assignment, for example, students were asked to gather information about the fat substitute *Olestra*. They reported back with summaries of their readings and the appropriate URL's used to gather their information. And at the end of the semester, a number reported positive experiences with the technology that was new for them:

Doing the internet was my first experience; I'm glad she assigned it. I used it in research for another class and got a 100.

More than just "busy-work"—thought provoking and relevant.

Even for those students who simply had questions—and there were many—the e-mail was instructive; it provided (1) a place to try to articulate the questions, (2) a person who would respond, and (3) an opportunity to learn just in the asking of the question. And as the e-mails show, students had to know enough to phrase the question that stumped them:

I'm confused about the amino acid Tyrosine. I understand that it is inside the melanocytes, but what does it have to do with melanin? Also, I'm confused about phenylalanine. Could you explain it a little better? Thanks for your help!
S. A. S.

Or from another student who is interested in the same topic, but carries the question beyond the confines of the classroom and into a "real life" situation:

Dr. Langsam,
I have a question concerning melanin. I am taking melatonin pills that are 3mg. They also contain 25mg of B26. I was wondering if this would really help to boost my melanin? I am very pale and am scared of the sun. I brought them over-the-counter but when I run out of them I am going to have them prescribed to me in a stronger strength. Is this ok for me? HC

In this instance the student has actually made a logical, but erroneous connection (between melatonin and melanin); the e-mail, however, provides a venue for the question that might have gone unasked in the large-lecture classroom setting.

Other student questions are less detailed, but again they are related to content:

Dr. L.:
In osmosis, diffusion, Active transport, exocytosis, and endocytosis, is equilibrium the main objective? Or am I totally confused?

This second time around, then, e-mail worked better. Using it with a new, e-mail-explicit task—the biochallenge—encouraged learning in two ways: the students could attempt the task without risk to their grade if they failed; and they could earn higher grades. And beyond the value of the biochallenges spe-

cifically, just incorporating them into the e-mail helped define it as a place to learn, a place to write about what students were thinking, a place where real questions and even confusion were welcome, a place where a real person would respond. With this version of e-mail, writing to learn was migrating online.

But there was a downside: not all students participated, and upon reflection, a number of issues may be at play. For one thing, our students are not technically proficient, nor are they scientifically literate. Asking them to acquire literacy in a field and in a medium both of which they find strange and forbidding compounds the learning problem. This is especially so when the “techno-phobia” is coupled, for many students, with “techno-access” problems. As one student noted, again, in end-of-course evaluations:

I never used e-mail because it is too much of a hassle to get to computer lab.

The majority of our students have no home access to e-mail and must make a special trip to the biology lab, where computers are available, or to the campus computer labs, where they may have to wait or where they may be frustrated by glitches in the system:

I only used e-mail twice, the first time was in lab and the second time I went to Colvard and I couldn't get my email, so I did not use it anymore.

It's also possible that the rewards being offered (a few extra credit points) may not be perceived as generous enough to warrant the time it would take to be persistent: to go to the computer lab, or to gain technical proficiency, or to respond to the challenges.

But it may be misleading to conclude that techno-hassles were the only obstacles to student participation. If technical proficiency and aversion to e-mail were the only issues, then it would follow that more students should have taken advantage of a number of nontechnical extra credit opportunities connected with the course. But participation was sporadic there as well. Indeed, 25 percent of the class took advantage of none of the extra credit assignments offered in the spring semester. These included the “computer related” activities of e-mail and World Wide Web assignments, but they also involved writing an article for the school newspaper based on material they'd learned about sunscreens, developing a study guide for one of the exams, and answering a series of questions about a “human interest” essay in their text. These activities could be e-mailed to the instructor or done in standard low-tech pen and paper mode. It is true that the e-mail activities elicited the lowest percentage of participation, and here's where the techno-phobia and lack of access problems rear their heads. But the bigger issue here may be the students' fragile commitment to the course because of a lack of interest or the presence of competing activities of higher priority.

And it's also likely that the actual design of the e-mail component requires a little "tweaking" in order to engage more student interest. To be sure, students who responded to instructor-posted messages or who initiated e-mail communication with us could count on a timely reply to their queries. But those who were just "listening in" to the general messages posted to the list might only be rewarded with a new message every two to three weeks, at a rate which didn't captivate students or communicate a sense of urgency about the list to convert the casual participant into a more active user.

Addressing these issues is the next (bio)challenge.

E-mailing and Learning

Still, reviewing the year, we see e-mail as an important addition to any class, but particularly to a large lecture class. While it cannot transform a class of hundreds into a class of even seventy-five or forty, it does change the tenor of the class. Certainly, it gave a voice to some students who might not have communicated with the instructor in other ways:

Email was great especially if you are a shy person and didn't want to ask the professor questions in front of a big class.

Others didn't have to fear a one-on-one, face-to-face conversation. They could write their thoughts and take as much time as they needed to compose what they wanted to say, so they weren't caught off guard; this could have special significance to some of the students whose language of origin isn't English. And those who wrote got a more thoughtful response to their queries since typing was much less tiring than writing out comments by hand. Also, it freed all of us from the endless sheaves of papers that seem to envelop us.

It's also true, however, that a minority absolutely hated e-mail:

I did not like E-Mail, it is very impersonal.

I hated email. It's just one more way of introducing technology into our lives. And I don't like being a guinea pig!

Most students, however, expressed the opposite view. They felt this was a more personal approach and that the instructor was more accessible.

I enjoyed e-mail—I felt I was always in touch with the professor.

It was a great source of information. Extra credit over E-mail a great idea.

Ironically, many of those who commented had never written a private e-mail note, so it's not clear if the perception was based merely on "knowing" the instructor was there, or monitoring the messages sent out to the group.

But particularly encouraging were several messages expressing sentiments along these lines:

A wonderful use of time management. A great way to drag people (kicking and screaming!) into the 21st Century.

So at the least, even the fall e-mail usage enhanced students' overall general education experience.

And the spring usage delivered more:

- the integration of another mode of learning—a writing to learn that is e-writing, not quite writing, but not quite speech either (Spooner and Yancey 1996) that many students seem comfortable with;
- an opportunity for a kind of communication that we don't usually see in large lecture classes, with chances to ask questions, where even the phrasing of the question is a learning act, a real writing-to-learn activity; and
- through the biochallenges, a chance for students to apply what they were learning, to connect it to everyday experience, and to link understanding with the processes through which we achieve understanding.

Recommendations

In some ways, the introduction of e-mail is no different than the introduction of any new course initiative: you have to be clear about why you want to do it, related assignments have to fit your agenda, and, if you want students to take you seriously, you have to assign credit to the assignments. But there are issues specific to e-mail, particularly as it relates to large classes. On the basis of our experiment, we'd like to offer some recommendations for its use in these settings:

- Start small; it's wiser to be less ambitious and experience limited success rather than be too ambitious and "fail."
- Factor in the techno-hassle time; unless you are unusually proficient and have abundant time, secure technical support.
- Develop a regular schedule for e-mail assignments so that students receive them early in the term and at regular intervals throughout. This creates a kind of expectation and routine that helps students, especially those not technically proficient, to enter into the system.
- Be ready to respond personally (and in a timely fashion) to e-mail messages—or else students will quickly believe that e-mail is just another black hole from which they're ignored.

Perhaps most important, and these are issues we are still contending with:

- We mentioned before a concern: time, time, and time. This concern is still alive. The model that we have outlined here is student-teacher, with some student-student interaction, and it is very teacher-labor-intensive. Both to reduce the time and to increase time students spend working with students, we are currently considering a two-model system: the first model would be the access model, used for disseminating information and providing another venue for administrative access; the second model would be comprised of multiple listservs where student groups would work together and present a single response to the group at large. One question we are pondering as we consider this change is the impact on student learning in switching to a group-based rather than individual-based list.
- It's important to include in any e-mail design reward/exigency/urgency. Students in our large general education classes won't participate in any activity if we don't assign some value to it, and this maxim is true for e-mail also. How we do assign value to the e-mail tasks—in terms of moving to e-mail that is not optional but required and integrated and in terms of how we assess student response without losing the benefits of e-writing to ask and to learn—is the second part of our next (bio)challenge.

Note

Techno-hassles comprised another category of concern. The first was focused on setting up a list, but a laboratory manager who knows computer systems inside-out took over that burden, among others—students not getting their e-mail, e-mail addresses being confused, the list not working properly, to name the incidents that happened the first three weeks of class. The second techno-hassle involved the students more directly: training them to use e-mail. Since there were too many students for a single instructor (even with the help of a lab manager) to train personally, we trained TAs to train the students in their laboratories (within the first two to three weeks). They explained the e-mail system while in their labs, sat with students while they logged on to e-mail, and provided written directions (which need to be clear and user-friendly). Although this training model worked fairly well, some students didn't catch on to the training. In some cases, it may have been poor training by the TAs; in other cases, the students were so techno-phobic that they were willing to let that part of the course go rather than face the computer.

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