The Difference that Inquiry Makes:

A Collaborative Case Study of Technology and Learning, from the Visible Knowledge Project.

Edited By Randy Bass & Bret Eynon

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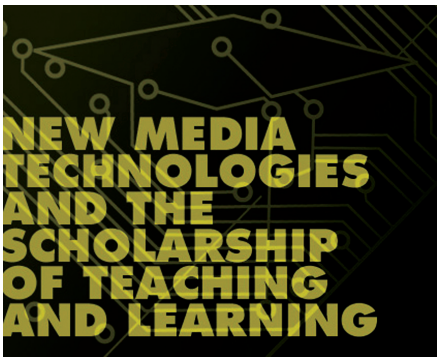

"The Difference that Inquiry Makes: A Collaborative Case Study of Technology and Learning, from the Visible Knowledge Project," *edited by Randy Bass and Bret Eynon*

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The Importance of Conversation in Learning and the Value of Web-based Discussion Tools

Heidi Elmendorf, Georgetown University, and
John Ottenhoff, Associated Colleges of the Midwest

From The Difference that Inquiry Makes: A Collaborative Case Study on Technology and Learning, from the Visible Knowledge Project[1], *edited by Randy Bass and Bret Eynon*

Abstract

Web 2.0 social tools have begun to permeate higher education pedagogies. Blogs, wikis, and discussion forums are now commonplace as a means of extending courses beyond the four walls of classrooms. Yet faculty and students' experiences with these Web-based communities are quite uneven, and this unevenness too often relegates the Web-based communities to peripheral roles within courses. The problem rests in how fast the technology has moved compared to our understanding of student learning in these new environments. In this essay we discuss the central role that intellectual communities should play in a liberal education and the value of conversation for our students, and we explore the ways in which Web-based conversational forums can be best designed to fully support these ambitious learning goals.

Introduction

Intellectual communities are the foundation of scholarly disciplines, and these communities are shaped by the intellectual discourse of that discipline: the vigorous, argumentative, evidentiary, passionate, and ultimately constructive, conversations that fuel our work. It is in these communities, in these conversations, that we play with new ideas and fresh perspectives to test their merits, to evaluate their flaws, and to assess their potential as they intersect with our previous understanding. It is largely in these communities, in these conversations, that we grow as thinkers and build knowledge collectively and rigorously. And thus it is largely in these communities, in these conversations, that we embody what it means to be an expert within our disciplines.

It then follows that as faculty we would seek to create such communities for our students, to foster their own rigor and creativity of thought and communication--to develop their own expertise. Yet too

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1 About VKP: In all, more than seventy faculty from twenty-two institutions participated in the Visible Knowledge Project over five years. Participating campuses included five research universities (Vanderbilt University, the University of Alabama, Georgetown University, the University of Southern California, Washington State University, and the Massachusetts Institute of Technology), four comprehensive public universities (Pennsylvania's Millersville University, California State University (CSU)--Monterey Bay, CSU Sacramento, Ohio's Youngstown State University, and participants from several four-year colleges in the City University of New York system, including City College, Lehman, and Baruch), and three community colleges (two from CUNY--Borough of Manhattan Community College and LaGuardia Community College, and California's Cerritos College). In addition to campus-based teams, a number of independent scholars participated from a half dozen other institutions, such as Arizona State and Lehigh University. The project began in June 2000 and concluded in October 2005. We engaged in several methods for online collaboration to supplement our annual institutes, including an adaptation of the digital poster-tool created by Knowledge Media Lab (Carnegie Foundation), asynchronous discussion, and web-conferencing. The VKP galleries and archives (https://digitalcommons.georgetown.edu/blogs/vkp) provide a wealth of background information, including lists of participants, regular newsletters, and reports and essays by participants, as well as a number of related resources and meta-analyses. For this article, the author gratefully acknowledges the students whose work is cited here. All students whose work is included have granted the author permission to use the material.

often in higher education both faculty and students recognize only the exchanges between the faculty and student as rigorous and therefore central to learning, with discussions among students seen as an interesting, but less meaningful or relevant, accessory. Hence, students primarily listen to faculty in class and write for faculty out of class, with the larger community remaining peripheral to these core academic exercises.

What is the source of this disconnect between principle and practice regarding academic discourse? We know, usually on an intuitive level, how social dialogue can allow students to explore the shape of knowledge and its construction, ask questions and experiment with answers, and build complexity from a broadened foundation of perspectives contributed by their peers. At their best, discussions provide our students with an opportunity to develop their own expertise within the context of an authentic intellectual community. Yet it is perhaps more honest to acknowledge openly that many course discussions fail to live up to these promises. In less formal settings, conversations readily degenerate into substance-free chats that avoid intellectual exercise, while in more formal settings, students are often more eager to talk than to listen–a form of intellectual posturing that also resembles what experts often do but again with minimal intellectual merit. And conversations in class are typically rapid and ephemeral--such that students must choose to either participate and have the conversation quickly fade from memory or abstain to take notes and capture the conversation for future reference. This tension between expectations and outcomes underlies the importance of detailed studies that help us to understand the nature of discussions that promote the intellectual growth of our students by emphasizing the process rather than the product of learning. Indeed, even our understanding as faculty of the qualities of in-class discussion is hampered because we're embedded in the same process, enmeshed in the give-and-take of the fast-moving classroom discussion.

In surprising ways, the emergence of Web-based social tools--especially those that promote student conversation--have the potential to redress this imbalance. These new technologies have helped us address some of these fundamental questions about our pedagogies and improved the efficacy of discussions for our students. We have found, for instance, that new forms of technology-mediated discussion--particularly online asynchronous discussion boards--help to make visible to us and to our students the nature of discussion and to illuminate aspects of what "works" in successful discussions. In this essay we discuss how our use of reflective, informal, online discussions in our (mostly) traditional face-to-face Biology and English Literature courses increased our understanding of the characteristics of discussion that we most value and affected student engagement and learning. Perhaps more important is what this essay suggests about our own learning process as scholarly teachers. Despite the many differences between our courses and disciplines, our work together--our scholarly discussion as writing collaborators and speakers--has produced fruitful insights and unexpected congruencies in our understanding.

Defining the "Problem" in our Courses

Our own investment in Web-based discussion forums for our classes was in response to barriers that our students routinely encountered in their learning--barriers that more traditional pedagogies were unable to address. We briefly describe our courses and our students to better define these challenges, and though the details will clearly be unique to our own situations, we have found that the core issues resonate with many faculty, at many institutions, and in diverse disciplines.

Elmendorf: Biology 005 "Shall the Microbes Inherit the Earth?"

Biology 005 course is a general education science course at Georgetown University (a mid-sized private research university) that enrolls ~60 students, including first-years through seniors.[2] The course attracts students with extremely diverse preparation and interests, yet one common theme is the distance most of the students place between themselves and the subject matter: they see science as the domain of experts, and very few of the students see themselves as skilled at science. Thus, they perceive their role in the course as limited to obtaining (memorizing) information, rather than also using this information. This misperception stands as a significant barrier between my students and my primary learning goal that they develop the skills and the confidence they will need to engage with the science that is present in their everyday lives. To do so, my students require a rudimentary fluency in the language and ideas of science that will make possible the informal but important conversations that will typify their future encounters with science in the guise of doctor's visits, political debates, consumer decisions, etc. Hence, I refer to the concept of "conversational biologists" as a short-hand goal for my students. The central pedagogical problem that I face therefore is that the very nature of my course--both its size and the fact that most students enter seeing themselves as underqualified in science and reluctant to engage with it--renders these conversations difficult to have in class.

Using the discussion forum on Blackboard™Courseware provides one solution to this problem by providing an additional outlet for conversations about course material. My class meets twice a week for 75-minute periods, and students are required to "join the conversation about the readings" (my sole guidance for the content of their conversations) on Blackboard at least once each week. Their participation is worth 20% of their final course grade, but I have chosen not to assign grades to their individual comments. I begin class each day by printing out the conversation and devoting five-seven minutes for silent reading of the online conversation, enabling us to use the online conversation as a guide for our content and conversation in class. While I am careful never to participate in the online discussions as they are happening, I do frequently introduce and comment on pieces of the online discussion in class, thus correcting misleading comments and providing formative feedback to students about what characterizes fruitful conversations. Strikingly, the vast majority of students put in very high effort to the online discussion even with no grading.

Ottenhoff: English 354: "Shakespeare"

This upper-level Shakespeare survey course at Alma College (a small, private liberal arts college) is a small class serving mostly English majors and focused on careful reading of approximately a dozen plays. While these English majors are far better versed in the academic discipline than Heidi's non-science majors are, I also face the problem of students inured to the idea of receiving information and answers from the professor, rather than actively engaging with the problematic aspects of the work. Thus from the beginning of the course, I emphasized our "communal discussion" of the works: how the give-and-take involved in discussing literature forces each of us to shape our own opinions and to confront other ideas; being a full participant in this process, I stressed, is "crucial for understanding the material and for developing the critical skills this course seeks to teach and is far more valuable than receiving ready-made, tidy sets of Meaning from the Professor." In seeking to promote student discussion and interpretation, I was aware that I needed to help my students learn how to read and talk about Shakespeare's plays. I needed to help them shape an understanding of the plays that was

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2 For a fuller treatment of this course, see Heidi Elmendorf, "Learning through Teaching: A New Perspective on Entering the Discipline," *Change* (November/December, 2006).

open to their constructing of meaning yet responsive to Shakespeare's authorship and separate from my viewpoint. My students and I discussed this issue of authority and interpretation throughout the course.

The seminar met for 80-minute sessions on Tuesday and Thursday, typically reading one play each week. Before the Tuesday discussion, students were expected to post to the Blackboard discussion board an initial exploratory comment, "one that poses questions and first reactions." By the end of the week, students were expected to contribute a "follow-up posting" that commented or reflected on classroom discussion. Students were to "use this posting to continue our in-class discussions, write what you didn't get to say in class, react to the views of your classmates and professors, offer links to helpful articles and Web sites." I periodically reviewed the online discussion and assigned grades (√+,√, √-); the online discussion, as outlined in the course syllabus, constituted roughly 15% of the final grade). My presence in the online discussion was minimal. For the first two weeks, I made introductory postings for the plays, identifying key questions and suggesting lines of interpretation. For the rest of the term, I largely remained quiet, occasionally posting replies or pointing to resources.

Our Shared Findings

Each of us came independently to the conclusions we describe below, but we were immediately struck by the strong parallels between our projects as we began to collaborate. The congruence between our studies also provided external validation of our findings and opened up new questions and conclusions that only a cross-study comparison could provide. [See Table 1: A comparison of the emergent coding categories for our online discussion forums.]

Design of the Online Environment

One of our most important conclusions concerns the design of the Web-based discussion environment. Our own use of the discussion forums has evolved over time as we have refined our understanding of the power and limitations of asynchronous discussions and have sought a scaffold that would best function within these constraints to support our learning goals. We have been struck by how such similar designs have emerged from our independent studies. We have also been struck by how often we encounter other faculty whose own efforts with Web-based discussion forums have been (in their own estimates) less successful and how their online environments are quite differently designed. We therefore think it worthwhile to comment on the purposeful correlation between our design and our goals.

We believe there are four design elements that optimally support the intellectual growth of individual students that, in turn, can develop of a successful intellectual community:

1. *Informality.* We created the online discussion forums as informal venues, giving only loose guidance and permitting students to direct the range and scope of the discussions through the use of conversational threads. The forums consequently served as places to play with new knowledge and perspectives and to practice the persuasive exchange and critique of ideas.

2. *Responsiveness.* Our one mandate was that the students should both listen and talk in the forums. They were intended not as places to merely display knowledge, but as places to engage one's colleagues with ideas. The forums consequently served as places to build community and generated threads with many contributing authors.

3. *Autonomy.* We designated the students as sole owners of the discussion forums by staying on the sidelines and not intervening in the online discussions. Indeed, the student contributions to the discussions were either not graded or graded on a simple (√+,√, √-) scale to reflect effort. We found that this element freed students from the perceived need to 'perform' for us and permitted a more natural expression of questions and uncertainty to each other that served as fuel for vibrant conversations. Yes, students sometimes stated incorrect ideas in their conversations, but in our absence, they took responsibility for correcting each other and when that failed, we would address the misconceptions in class.

4. *Importance.* We ensured that the value we placed on these discussions would be accurately conveyed to the students not only by the weight we placed on participation (respectively, 20% and 15% of the course grade) but also by bringing the online discussions into our classrooms as the starting point for our face-to-face time. In both of our classes, students know that their online conversations will have a significant impact on the content of the subsequent class.

Indicators of Expert-like Behavior in Online Discussions

Through methodical coding and analysis of online discussions, we have come to understand better the traits that characterize productive conversations and present evidence of the rich intellectual processes that this type of social activity stimulates. (See Table 2: Online Discussion Forum for a Non-Majors Science Course.)

What emerged for both of us was the recognition that these forums --for all of their relaxed language and unscripted format--were noteworthy as venues in which students developed expert behaviors and skills we believe are integral to our disciplines. We focus here on five key features we found in our online discussions, features that were reinforced by their commonality across our two very different courses. The online discussions foster:

1. *Extended engagement.* Students are motivated and supported by one another in the difficult first encounter with new material before class and provided with an outlet for re-engaging material after class;

2. *Rich exchanges.* Students invest the time to create rich and responsive conversations and seek out good evidence for their arguments than is possible during in-class conversations;

3. *Reflective understanding.* The online format preserves the exchange of ideas, allowing students and faculty the opportunity to reflect on their understanding and revisit the conversations as new ideas emerge later in the course;

4. *Intellectual Play.* The online conversations inherently value process over product by rewarding the act of engagement, and students seize this opportunity to test their own ideas and stretch their thinking;

5. *Community building.* The conversations, even as asynchronous exchanges, cultivate the development of intellectual communities, which in turn encourage students to take a more active approach to their learning.

Strikingly, these five attributes of online discussions align with the dimensions of learning that characterize "adaptive expertise" and speak strongly of the value of online discussions as a pedagogical approach. Cognitive research tells us that individuals with "adaptive expertise" are characterized both by the extensive knowledge they possess and by the qualities of their approach to knowledge.[3] Adaptive experts embrace the affective dimensions of learning, similar to what we see in the ways that students' enthusiasm and confidence are boosted by their peers in the online discussions. Adaptive experts continually reinvest in their learning, similar to what we see in the investment students make in deepening their understanding in these conversations. Adaptive experts are self-aware of the strengths and weaknesses of their knowledge, similar to what students gain from the ability to revisit the conversations. Adaptive experts use knowledge fluently and flexibly in new situations, a talent that students practice through their ability to play creatively with ideas. And adaptive experts relish challenges and proceed confidently from positions of uncertainty, much as we see students do within the community to work to build a collective knowledge that exceeds their individual understanding. We discuss below in detail how the nature of online discussions provides opportunities for students to make this transition.

Online Discussions Extend Engagement with Ideas

Barbara Walvoord introduced the idea that in traditional courses students' first exposure to new ideas takes place within the classroom, while their struggles with higher-order reasoning and faculty feedback take place at various times outside of the classroom.[4] The premise of encouraging students to read and think before class is that it shifts the timing of their first exposure to make class meeting time available for thinking and feedback. This move, however, leaves students experiencing that first exposure in isolation, and their insights and questions are too often forgotten before the in-class discussions--or their points of confusion go unanswered and obscure the remainder of their reading efforts. The use of online discussions addresses this problem by placing students in a community of readers and providing a venue for expressing (and receiving peer feedback on) their most pressing questions and ideas. Likewise, using online discussion forums as extensions of classroom discussions after the course meeting time provides further opportunities for students to practice the higher-order reasoning skills in a social setting that can support and give feedback on their efforts.

By actively engaging students in discussion outside of class, online forums also serve to increase the amount of time that students spend working with the material. The importance of "time on task" in learning theory is supported by studies indicating a positive correlation between time expended and material learned.[5] Yet, even more important is how that time is spent. In *How People Learn*, John Bransford and colleagues argue learning for understanding requires students to monitor their own learning--to seek and learn from feedback. In particular, because of the novice status of students and their lack of familiarity with the epistemology of academic disciplines, "it can be difficult for them [students] to learn with understanding at the start; they may need to take time to explore underlying concepts and to generate connections to other information they possess. . . . Providing students with

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3 See Giyoo Hatano and Yoko Oura, "Commentary: Reconceptualizing School Learning Using Insight From Expertise Research," *Educational Researcher* 32 (2003): 26-29, http://edr.sagepub.com/cgi/content/abstract/32/8/26; Brophy, Hodge, and Bransford, "Work in progress--adaptive expertise: beyond apply academic knowledge," *Frontiers in Education* 3 (FIE 2004, 34th Annual): S1B/28- S1B/30, http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=1408679 .

4 Barbara Walvoord, "Teaching Well, Saving Time," (talk given at Lilly Conference on College Teaching in Miami, Ohio on November 21, 2004).

5 On "time on task," see Arthur W. Chickering and Zelda F. Gamson, *Applying the Seven Principles for Good Practice in Undergraduate Education* (San Francisco CA: Jossey Bass Publishers, 1991).

opportunities to first grapple with specific information relevant to a topic has been shown to create a "time for telling" that enables them to learn much more from an organizing lecture (as measured by subsequent abilities to transfer) than students who did not first have these specific opportunities."[6] Thus it is important that we design courses to provide a supportive environment for students to engage in the time-consuming tasks of learning with opportunity for frequent feedback. In their online discussions, students find just such a "time for telling" where they can work at their own pace to deepen their understanding and gather feedback from their peers in conversation.

Online Discussions Lead to Rich Exchanges

The nature of in-class conversations reminds us of a comment from Heidi's daughter when asked how "circle time" had been in preschool that day. At the wise age of four she replied, "Sometimes I find it hard to both listen and think. Because to listen I have to pay attention, and to think I have to not pay attention." Yet face-to-face discussions in classrooms routinely ask students to listen, think and reply all within a single conversational burst. We routinely complain that students talk but do not listen during class discussions--that the discussions devolve into forums for students to display their knowledge rather than a dialogue where they shape their understanding--but perhaps in retrospect this is unfair criticism, and it should be our responsibility to provide forums more conducive to dialogue.

We find that students develop multi-layered exchanges with one another in the online discussions. The discontinuous nature of the discussions provides ample time for students to think and reflect before responding to the conversation; this invites participation from students who too often feel discouraged by the rapid-fire approach of in-class discussions. The online discussion also involves, by design, every student in the class allowing for a much broader base of ideas and perspectives to be brought into each discussion. This breadth not only serves to better inform the class but also provokes more thoughtful conversation in response to the inevitable differences. We find that the students invite input from their peers by asking questions, and their peers respond by building layers of responses with students working from one another's contributions to build richer answers and to provide community validation. We find students frequently building new lines of thought and answers to a peer's question through a series of exchanges involving many students working collectively. These wiki-like conversational products are a hallmark of the online conversations.

Online Discussions Provide Opportunities for Students to Reflect on their Own Understanding

The ability to slow down and capture the conversation is perhaps the most obvious benefit from online discussion forums. The ephemeral nature of in-class discussions means that when it comes down to "whether this will be on the test," the ideas and arguments from in-class discussions are usually exempt. Students who take notes assiduously when a professor speaks put the pen down when a peer is talking. Yet, if we value these discussions as locations of intellectual development and concept exploration, we must find ways to make them a legitimate part of the course core. Because online conversations are preserved, they readily become part of the intellectual content of the class that students can access and reference. We routinely use the initial online conversations as a launch pad in class the following day, as stimuli for later online discussions, and as sources for essays and new research. This instills in students an appreciation of the value of discussion as an intellectually critical task--and not simply "down time" in a class. Students can be encouraged to see the discussions as worthy of repeated re-visiting and re-mining for ideas and insights--a worthy

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6 National Research Council, *How People Learn: Brain, Mind, Experience and School* (Washington DC: National Academies Press, 1999), 56-58.

goal if we hope for our students to build connections and integrate across diverse concepts. Perhaps most critically, the preservation of the online discussion brings to the intellectual exchanges of the students the same level of respect typically reserved for the texts and articles of experts. It explicitly acknowledges the expertise and value inherent in students' ideas and questions.

Online Discussions Stimulate "Intellectual Play"

While the online discussion forums can also be used as a venue for faculty feedback, we have both chosen not to participate in the online discussions, hoping to reinforce that they exist as a student-owned intellectual community. We have also chosen to make these a forum for free exchange of ideas by reducing or eliminating our judgment through grades of the value of their individual contributions. One of the key signs of intellectual play within the online discussions that emerges during the semester is the students' comfort with ambiguity and their ability to play with and build upon ideas that are not certain (deferring true understanding). Students also link out slightly more as the term progresses; the links become more notable for fewer references related to personal experience and more references to other disciplines or sources of ideas. This flexibility of cognitive engagement is an important accomplishment–and a critical embodiment of expert behavior–for students begin the semester by seeing texts as compartmentalized sources of knowledge, not as opportunities for expansion and questioning.

We are often asked what we do about student comments that are incorrect or discussions that digress far from the designated readings. Surprisingly, factual errors are less of a problem than many assume; something of the Wikipedia phenomenon takes hold and the forums often self-correct as students read and respond to one another. We talk further about the intellectual strengths that emerge from the online community below. Digressions, too, are often as interesting and stimulating as they are seemingly tangential. In fact, the tangents often serve as vehicles for students to make connections to their own lives, world events, and other courses, thereby allowing them to contextualize the readings better for themselves--and also often for their peers who share similar reference points.

Online Discussions Cultivate the Building of Intellectual Communities

Perhaps most striking is the increased willingness of students to take intellectual risks by attempting to answer questions (both their own and those of others) even when they are uncertain of the answer in an effort to build the conversation of the community (in Heidi's class, this kind of post changed from 12% to 25% of comments over the course of a single semester when the online discussion were first introduced). Students also shift from referring heavily to the text and refer more often to each other's comments; thus early in the term they talk mainly to the text and to us through their "postings," but as the term progresses, the "conversations" become richer as they build community by inviting answers to questions from their peers and respond to/amplify/dispute the postings of classmates. Less obvious from the statistics is the movement away from asking simple factual questions toward asking deeper multi-layered questions that often build for several rounds of question-postulated answer-fresh question before the student pauses.

Together these shifts highlight the development of an online community that in which students practice and develop skill interpreting and interrogating science information from text and news sources. The ungraded nature of the forum is also important in permitting these discussions to be informal--critical for allowing students the space to gain comfort with conversations around microbiological topics.

Broader Conclusions

Putting our Inquiries Together: Fruitful Lessons at the Intersection of Two Non-Intersecting Liberal Arts Disciplines

Too often it seems that our questions about student learning are embedded in the particular contexts, assumptions, and philosophies of institutions and disciplines, courses and instructors. Hence the complexity of the question asked, and the richness of the evidence collected, feel non-transferable. Perhaps then the most surprising finding of our individual projects was the discovery that, starting from two completely distinct institutional and disciplinary settings, we have arrived at strikingly similar conclusions about the role of online discussions in our classes: a liberal arts college and a research university, the humanities and the sciences,a course for majors and a course for non-majors. They couldn't be more different, could they? We're quite sure that our students would never group them in the same category, and honestly neither did we. Despite participating in the same Carnegie Scholarship of Teaching and Learning (CASTL) cohort for a year, we didn't really ever share our work as it developed. Yet when we presented jointly on our coding techniques for the online discussion, we found that we had not only coded for the same categories, but also saw the same trends emerge in student intellectual processes as the discussions developed over the semester.

Although our arguments focus on evidence of student learning in online discussion forums, our efforts to develop and understand our common ground has required us to explore (more richly than we might otherwise have done) fundamental aspects of student learning in our analysis. We have grappled with what we mean by "deeper understanding" and "expertise," what constitutes evidence of them in our respective fields, and what commonalities unite our definitions. Like other authors in this volume, we began with an interest in examining evidence from student work to help us understand the role of technology-enabled pedagogies in student learning; and like the other authors, we have found that this question is more about our expectations of our students' learning than it is about the technology. What matters most is our conception of the critical elements of student learning; technology then becomes the tool to foster that type of learning and allows us to capture the evidence of subtle and often hidden learning processes.

Building Expectations for the Practice of Expert Processes Early in the Curriculum

It may seem counterintuitive for courses that enroll relatively novice learners that we should frame our expectations for student learning in terms of 'expertise', but we believe this is an important--and determinedly realistic--perspective to hold. Experts are notable for both the knowledge they possess and how that knowledge is contextualized and organized in ways that let them flexibly use it to recognize unifying concepts and patterns when solving novel problems. For most students, college marks the end point of their formal education, yet their need to integrate new knowledge into their own internal schema and apply their knowledge to new situations will continue throughout their lifetimes. Preparing students for a lifetime of such encounters is a daunting premise and one that clearly demands the skills of an expert because knowledge will quickly move beyond what students have been taught in classes and every situation they face will be 'real world' and consequently complex and unique. Functional expertise across a wide range of disciplines should be an expectation of an educated life, and it is the responsibility of our educational systems to provide students with expert-like skills.

We cannot convey expert-level knowledge in the brief exposures to disciplines that characterize student undergraduate education. In such a limited engagement with disciplines, what then do we

want the students to take away? What aspects of expertise are attainable under these constraints? In a recent address (June 2003) to the graduating class at Princeton University, Dr. Shirley Tilghman, president of the university and a leading biology researcher, argued, "We know full well that you will forget most of the facts that you have learned. But what we hope you will retain is the capacity to integrate ideas and exercise thoughtful judgments across many aspects of human endeavor."[7] This perspective challenges us to think beyond courses as opportunities to convey information, and instead to think of them as opportunities to understand "knowing" as a process rather than a terminal product. What we can aspire to then is to convey a sense of the epistemology and process of the disciplines: how questions arise, how new knowledge is discovered, critically assessed, and integrated into an evolving framework, how ideas are constructed, challenged and defended. We can impart to them the recognition that academic subjects manifest themselves daily in our personal–and often professional–lives and give them the tools to seek and use their knowledge to inform their understanding of the world.

This is obviously easier to say than it is to do. How do we move ourselves and our students beyond the standard expectation of courses as venues for the delivery of information? What pedagogical approaches will best facilitate our move into this "Learning Paradigm" envisioned by Barr and Tagg?[8] We focus our attention here on the value of conversations and the role they can play in turning faculty and student attention to learning processes.

The Central Role of Conversation in Learning

At their heart, conversations are the epitome of social learning–a scenario where individuals engage one another in a dynamic exchange of ideas to shape and hone their thinking. In his recent publication *Clueless in Academe*, Gerald Graff talks about developing the art of conversation and argument as central to deepening disciplinary understanding. He argues against current educational practices that leave students either silent or responding only to prescribed questions from the teacher and argues instead that students must learn that "...talk about books and subjects is as important educationally as are the books and subjects themselves. For the way we talk about a subject becomes part of the subject...." Providing speaking opportunities for students is thus critical not only for engaging their interest and providing them with a chance to work with the new language, but also as an essential entry point to disciplinary understanding. Graff continues by emphasizing that "the problem is not simply that knowledge of facts is useless unless students can use such knowledge in relevant conversations. The problem is that for many students knowledge of information is virtually unlearnable unless it is tied to conversations that those students see some point in entering."[9] Thus conversation works to 'conditionalize' knowledge by retelling and contextualizing it in ways that parallel how experts store, retrieve and use knowledge.[10]

It is also important to recognize the role of conversation in the expert process. In higher education--where the pithy motto "publish or perish" reflects the pressures of the academic world–the value

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7 Shirley Tilghman, Commencement Address , http://www.princeton.edu/pr/news/03/q2/0603-smt.htm, (Princeton University, 2003).

8 Robert B. Barr, and John Tagg, "A New Paradigm for Undergraduate Education," *Change*, (November/December 1995).

9 Gerald Graff, *Clueless in Academe: How Schooling Obscures the Life of the Mind* (New Haven: Yale University Press, 2004), 9, 30.

10 National Research Council, *How People Learn: Brain, Mind, Experience and School* (Washington DC: National Academies Press, 1999), 17.

of conversations can be easily overlooked in formal appraisals of expertise. Yet discussions--from the casual talk over coffee to working group meetings to national conferences--are where ideas are exchanged, weaknesses in arguments are revealed, and collaborations are forged. Publications are deeply refined products of an idea; discussions are instead places of process--where ideas are developed and vetted, where the evidence of the intellectual path that characterizes expertise can be found. Discussions are an essential part of the intellectual fabric of an academic discipline.

Yet productive conversation is complicated in school settings by multiple barriers. Large class sizes can make it impossible for the majority of students to contribute to a discussion; providing opportunities for students in large classes to hold conversations in smaller settings (separate course discussion sections, small group work, etc.) is one partial solution, but the professor is then often unable to hear what happens in these conversations and cannot provide feedback or integrate the conversations into the development of knowledge in the course. Conversations that stimulate intellectual growth are also thwarted by the fact that students are also more accustomed to raising their hand in classes when they have answers, and many are unfortunately-- though understandably--quite reticent to speak when they are uncertain; yet these moments of uncertainty are the precise ones in which students would benefit most from the opportunity to more fully explore the topic and their understanding of it. Many students are also unaccustomed to navigating the fine line between polite conversation and fruitful debate around ideas, and too often class discussions never fully challenge students to sharpen their intellectual skills. The fleeting nature of in-class conversations also hinders durable student learning. Time constraints reward rapid responses and do not easily accommodate comments that emerge only after the students have had time to think through and assemble richer insights and questions. Capturing the in-class conversations for such prolonged re-reading, re-thinking, and reflection is also a challenge. Effective discussions that accomplish the goals set out by Graff require solutions to these obstacles.

Conclusions

Discussions--including online discussions--do not exist in vacuums. In describing our work and coming to conclusions, we must stress at the outset that the assumptions and motives that shaped our classes and assignments contributed to the outcomes. Our desire to build intellectual communities no doubt helped build the elements of community we describe in our online discussions. Similarly, our assumptions that students must develop a sense of personal authority--as interpreters of literature and practitioners of biology--and recognize the concept of multiple points of authority shaped our assignments for online discussions and feedback to students.

We believe there are several conclusions we can derive from this work and build on:

1. Our discussions show a rich pattern of student interaction that encompasses a wide variety of interpretive and authoritative modes. This variety can make the content of online discussions difficult to explain or value; at the very least, we should be skeptical about any blanket generalizations about what online discussions can or cannot do until those discussions are put in the full context for what kind of discursive modes are valued in the course overall.
2. Excellent postings for the online discussion all show a rich variety of discourse modes, at least in terms of the values we created for our classes. In terms of our coding schemes, the discourse items with multiple codes showing facility in the various modes were generally the most effective. Similarly, the students who showed most

flexibility with these forms of discussion were the most successful students in the class in terms of final grades and the degree to which they established strong, authoritative voices in the classroom.

3. The online discussion contributed to changing patterns of authority and developing multiple kinds of authority. Students found a variety of methods for sharing knowledge and shaping discussion; our lack of presence in the online discussion cleared space for their voices and enabled a form of "intellectual play" that is difficult to create in even the most egalitarian classroom. That strength of student voices was, in turn, brought into the classroom through citation and carryover of the online discussion.

Notes

We thank our students whose work and voluntary participation in our projects provided us with our insights into their learning processes. We are indebted to our mentors and colleagues in the Carnegie Academy for the Scholarship of Teaching and Learning (2003-2004 cohort) who helped to stimulate our thinking and shape our work on these projects. We are also grateful to Randy Bass for his invitation to first join and then co-present to the Visible Knowledge Project for providing us with additional stimulating colleagues and the opportunity to explore the strong intersection between our projects. Special thanks, also, to Clare Elmendorf Singer for her precocious insights and the reminder that all students (no matter how young) have important insights into the teaching and learning process!

Appendix

Table 1: A comparison of the emergent coding categories for our online discussion forums

Biology 005 – "Microbes"	English 354 – "Shakespeare"
Summarizing content	Introductory/closing remarks
Directly citing the author/text	Directly citing the author/text
Referring to outside source/personal experience	Referring to outside source/personal experience
Directly referring to a peer's comment	Directly referring to a peer's comment
Asking a question	Asking a question
Responding to a peer's question	Responding to a peer's question
Venturing an answer/idea despite uncertainty	Stating an opinion
Expressing interest/enthusiasm	Expressing awareness of reasoning process
Referencing scientific process	

Table 2: Online Discussion Forum for a Non-Majors Science Course

This table displays a single conversational thread with comments from 9 students excerpted from a larger online discussion that involved 35 students from the course. The left column contains their postings, paired with an analysis in the right column. The online conversation largely takes place over the course of a single evening, with date and time of postings indicated. Also indicated is the number of times that each entry was read by other students; the frequency with which entries are read is taken as a strong indication that despite the absence of a face-to-face connection in the on-line forum, the students see this as a conversation and first "listen" to one another before "speaking." Although student entries are not anonymous in the online discussion board, their names have been omitted from this work for their privacy and they are referred to as Student A, etc.

Student A Times Read: 33

Date: 11-12-2003 16:55

When I sat down to do this reading I had a nice glass of cold water next to me. As I was reading the water became more and more unappealing. The process of waste management is so messy! Humans are not only producing waste from eating and cleaning but from chemicals we have created (PCB...). Fact is that we have made a mess of the world but fortunately there are microbes that are willing to help us do the clean up work. So although we don't have simple magic wands to wave we have several microbes that deconstruct our messes.

An issue in the reading was brought up about creating microbes that could help do this job for us. I was wondering if this would present an issue like that of bioengineered food. By creating new and strong microbes it may be possible that we create more diseases. PCB serves as a perfect example of human made science that didn't turn out as planned. What does everyone think about making microbes for the purpose of cleaning our biosphere?

Commentary:

In the initial posting for this thread in the larger daily discussion forum, a 2nd year student starts the conversation by summarizing several key points in the text (the abundance of chemical waste from human activities, the potential for microbes to help "deconstruct our messes", and the possibility of developing bioengineered microbes to enhance their natural degradation properties). But she adds the provocative comment that bioengineered microbes might create unforeseen problems – citing other evidence from the course in support of her concern - and then explicitly invites comments from her peers.

This student not only displays evidence of her own emerging expertise with her effort to bring evidence to her position, but also works for community-building with her invitation for other opinions.

Student B Times Read: 34

Date: 11-12-2003 18:46

I think [Student A] makes a valid point; what if things don't pan out as planned because of faulty/careless science? A lot of the reasons why PCBs and CFCs and all those other nasty compounds got into the environment was because there was no regulatory agency that made environmental impact assessment reports before products were entered into the market to understand how they might affect the biosphere. I'm not saying that it is flawless now, but I'd like to think we have come a long way.

I think you're right that people sometimes jump to conclusions and look for the "next great thing" that will cure all ills and end up creating more problems, but just because that has happened before doesn't mean research should stop research because what might happen could be scary. You probably wouldn't be reading this if it weren't for PCBs. They made the forerunners of the plastics that coat your computers, your pens, and your microprocessors. What is important is to be conscientious about the fact that humans, unfortunately, don't always look at the big picture and screw up. We can usually fix it if we try hard enough... and if there's money to be made there is a better chance that it will get done, which is why I think bio-remediation has such potential. Think how much cheaper it will be to clean up a future oil spill if microbes do it for us? As we said in class, bioengineering is dirt-cheap.

Finnish researchers should be careful with enzymes though. We discussed how enzymes go both ways. It would be kind of embarrassing if once you clean up the oil spill the enzymes take the waste and turn it back into oil.

The most important caveat the author makes is that just because nature can cope with it doesn't mean we should go crazy. Prevention is still the best way to keep the Earth nice and clean.

Commentary:

In a response to the first comment, this 4th year student takes up the challenge and after stating his general support for the concern raised, goes on to elaborate on several aspects of the topic. He brings in his background in government studies to suggest that changes in federal regulatory policies should alleviate the extent of our concerns. He further argues (displaying a good understanding of the scientific process) that scientific research is critical for our desired technological advances, and while it cannot be risk-free, what it demands is our vigilance – not a retreat from research. He also – accidentally – starts the lengthy exchange that follows in several postings by commenting on the action of enzymes.

There are glimmers of emerging expertise in this comment with his ability to provide a meaningful context for the reading and to link diverse ideas into a common argument. There is also good evidence of playfulness here with ideas as the student explores multiple avenues when discussing possible concerns underlying bioengineering. (NB – Although his last point is factually correct, but he is missing a key idea that would render his concern invalid. Still, I see this as a nice effort to grapple with the nitty-gritty of the science. Based on the interest and confusion around enzymes, this is a point we discussed in much more detail the following day in class.)

Student C Times Read: 33

Date: 11-12-2003 19:05

I totally agree with you- - this reading did make my stomach turn a little bit. . .I can't believe everything that microbes can do-- - is there anything they can't do?? I'm still a little uncertain of how exactly the microbes break everything down?? Can anyone explain??

~Thanks,

Commentary:

This 2nd year student's comment is clearly not yet at the level of sophistication displayed by the previous two students, yet she has picked up on the central molecular challenge of this section of the course – the biodegradative capabilities of microbes – and uses this forum to ask a direct information question. Though simple, her question drives the remainder of the conversation and provides other students with the opportunity to solidify their own understanding by working through explanations.

Student D Times Read: 26

Date: 11-12-2003 20:17

Not totally sure this is right, but I'll take a chance... My guess is that the microbes "digest" the contaminants and internally break them down into another substance. Although digest might not be the best word, because it's not like they eat them (they don't have mouths). But I suppose they look for a chemical or protein and bind or absorb it, and then break it down internally with other enzymes. The enzymes take one thing and then break it down into more specific parts; then use some of it for food or energy to make more cells\parts - and then it probably just excretes whatever else it doesn't need.

That's my take at least.

Commentary:

The response to the previous question given by this 4th year student is an excellent example of the value of these conversations. This student was typically quite quiet in class – unlike the first four students who were among the more vocal ones during classroom discussions – yet the direct request for help not only elicits an answer from him, but provides the incentive to stretch himself into areas of uncertainty. He gets the science right, explains it in simple but clear language, and further acknowledges his uncertainty.

The student's efforts to answer the question clearly demonstrate the existence of an intellectual community that has taken on a sense of responsibility around its learning. His ability to understand and then stretch the limits of his knowledge reflect emergent qualities of expertise.

Student E Times Read: 27

Date: 11-12-2003 20:31

yeah, it seems like the microbes strip the pollutants of important chemicals that change its chemical makeup and make it into a completely different compound all together.

Commentary:

This 2nd year student provides validation to the previous answer and rephrases it in her own language. She adds to the intellectual foundation of the community in doing so – and in another posting a few minutes later initiates an entirely new thread of the conversation. While not common, the on-line forum provides the flexibility of time for students to publicly pursue several interests about a reading.

Student F Times Read: 21

Date: 11-12-2003 23:04

Hey, yeah guys- I think enzymes are important components in the breakdown process. When microbes go to work, they break down the complex substances in pollutants and convert them into simple, harmless, elemental substances.

I'd guess that when there's a higher concentration of pollutants, the microbes may need to be strengthened- I'm having a hard time understanding what the effects are when scientists try to add nutrients or help the "good" microbes thrive in an environment in which they can readily break things down. Is the danger just that there's a high degree of uncertainty as to what will happen if we add nutrients and other things to the microbes in such an environment? I was just having a hard time figuring out what the problem was with interfering with them.

Commentary:

Here again we see a subtle reworking of the answer from another 2nd year student. But then she shifts gears and raises a her own point of confusion concerning how scientists enrich for biodegradative microbes. This is a subtle scientific point and her public grappling with it is evidence of her intellectual engagament and willingness to play with ideas even when the answer is elusive. The on-line discussion never answered her, so we made sure to talk about it in class the next day.

By now there are multiple threads of conversation going in the daily discussion forum, so the students who comment from this point out have done not only the reading, but have also read through several different ideas for topics and decided to join this one. With 35 comments total for the day, you can see that over half of the students are reading this thread even if they choose to comment elsewhere. This multiplicity of concurrent conversations is another advantage of the on-line asynchronous discussion forum in that students can use it to both gain broad perspective and to focus on areas that have greater significance for themselves.

Student G Times Read: 20

Date: 11-12-2003 23:26

I'm still kind of confused about the role of enzymes. I agree that they're probably behind the ability to breakdown chemical/ other substances we've released into our environment, but what exactly do they do and how do they work? I know that they're the "powerhouses" of the cell, sort of like the mitochondria we've all learned about in previous classes, but how can they break down toxins without harming themselves?

Commentary:

One of the things that stands out most about these on-line discussions is the persistence of students in confronting and working to resolve their confusion. All too often in class, students nod along even when they don't understand, yet here this 2nd year student probes further into the working of enzymes even after a series of prior explanations. She has taken the time to consider the limitations of her knowledge and doesn't simply ask a question but also provides the broader context of her understanding from which the question derives.

Again, because this discussion is taking place before we have talked about this topic (and enzymes in particular) in class, she is not correct in her analogy that enzymes are the "powerhouse" of the cell. But her attempts to refine her question have led her to a very interesting point regarding how cells protect themselves from the degradative capabilities of their own enzymes. This new twist is a great conceptual link and clear evidence of play.

Student H Times Read: 9

Date: 11-13-2003 01:36

[previous student], if I'm not mistaken, enzymes are basically proteins that catalyze reactions that would otherwise take place very slowly in nature if at all. They'd be a certain shape, which can draw in to itself to a certain other molecule (called the substrate) at a hole (called the active site). I'm not sure how exactly, but somehow the substrate then becomes separated into smaller molecules.

I guess when you compare it to mitochondria, you mean that it releases energy, which is certainly true. To answer your last question, I think it's about the nature of how enzymes work. The different shapes of the active sites make them specific in what they break down. So, in this case, they would target only the toxins. That's my guess...

Commentary:

Here again we see a pattern of response similar to that of Student D above. In this instance it is a 1st year student that is taking an intellectual risk by going deeper into an explanation of enzymes despite his own lingering uncertainty. His answers address the questions Student G asked – both by discussing the basic science of enzyme function and specificity and by directly discussing how that specificity allows enzymes to degrade toxins without harming the microbes.

Student I Times Read: 8

Date: 11-13-2003 08:10

I'm not sure what you mean by toxins in this case, because what's toxic to one species is not necessarily toxic to another. I guess theoretically you could avoid killing yourself with toxins if you can send enzymes to get to a toxic substance and break it down before you get there, but I think most likely it's just that substances we consider toxic are not toxic to certain kinds of microbes.

Commentary:

This 2nd year student provides the ninth and final comment in this thread. Again we see that she, like students E and F, considers a single answer to a question insufficient and continues to develop the idea with her own insights. In the process she begins a tangential thought with her comments about what constitutes toxicity. It is this slowly evolving richness of understanding that the students take responsibility for developing that is a signature of these threaded discussions.
