Practicing Omega: Addressing Learning Outcomes in an On-line Case Simulation

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Abstract

Previous studies by the College of Engineering at Iowa State have shown that the workplace (e.g., internships) is perceived as one of the best places to assess and develop the competencies we have linked to our program student outcomes. The challenge we have undertaken is to craft educational experiences on campus that are more meaningful and that relate directly to workplace experiences. One effort has been a technical writing course, collaboratively developed with the Department of English, offered exclusively to students from the Department of Agricultural and Biosystems Engineering. We created a real-world case simulation of a biotechnology company, Omega Molecular, in which the students were employees. An on-line database provided company history, policies, memos, emails, and product data. "Employees" were charged with the task of developing technical reports in a virtual corporate environment that forced them to consider ethical and personnel issues. Students had the opportunity to develop and demonstrate these competencies which are linked to the ABET Criterion 3(g) communication outcome: communication, general knowledge, initiative, customer focus, and professional impact. This paper discusses the collaboration that took place to create the course, the infrastructure developed to deliver the course, student participation and learning, and an assessment of the student experience.

Introduction

Students in the 21st century come to the university expecting to receive a learning experience in which they are challenged to grow as individuals. A common criticism, however, is that once at the university, their teachers rely too heavily on lectures and workbook exercises, spoon-feeding them information in a pipeline model of communication which places the teacher in the role of "expert" and student in the role of "passive receiver" of knowledge. In such a situation, the danger is that students become less self-directed and engaged in their learning, consequently coming to see their university experience as being one of less engagement with both faculty and the subject [1, p.5]. Johnson, Johnson & Smith point out that traditionally, education works to compartmentalize faculty and students, where students are considered interchangeable parts in an "education machine."[2]. Fink argues that "If higher education hopes to craft a more meaningful way of educating students, then college professors will need to think a new and better way of teaching, one that focuses on the quality of student learning" [1, p. 27].

We believe that the new ABET 2000 Criteria [3] provide us with pedagogical opportunities for crafting educational experiences that are more meaningful. However, given the constraints of the modern classroom and available resources (budgets, technology, time, staff support, etc.), a major challenge for engineering faculty is to create learning experiences that address multiple student outcomes. This challenge is especially critical when experiential opportunities (internships and cooperative employment) may not be as available as in the past. To address

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these issues, we created a new learning experience in a technical writing course that sought to create a more meaningful and interactive learning experience through the implementation of case study pedagogy with an online database.

ABET-aligned Competencies

As ABET standards become a primary concern for Engineering departments nationwide, it is important to understand how these standards will be enacted within the classroom. The College of Engineering at Iowa State University (ISU) has undertaken a new initiative to help address the ABET 2000 Outcomes. ABET Criterion 3, Program Outcomes and Assessment, states, “Engineering programs must demonstrate that their graduates have…” and presents a list of eleven specific outcomes, now well known as ABET (a-k) Outcomes [3].

At Iowa State, we decided that the ABET (a-k) Outcomes (abilities, understandings, and knowledge) are too complex to measure directly. We observed that abilities are complex combinations of competencies. Competencies are the application of behavior and motivation to knowledge, understanding and skill. Key actions that demonstrate competencies can be observed and measured. Accordingly, we identified fourteen unique “ISU Competencies” (Table 1) as necessary and sufficient to measure the ABET (a-k) Outcomes [4, 5]. They have been mapped to the ABET (a-k) Outcomes and validated through engagement with contributing constituents (internship managers, industry, students, and faculty). A web-based assessment tool for the Competencies and related Key Actions is now in use for all engineering students in cooperative and internship experiences [6].

Table 1. Iowa State University ABET-aligned Competencies

Engineering Knowledge	General Knowledge	Continuous Learning
Quality Orientation	Initiative	Innovation
Cultural Adaptability	Analysis and Judgment	Planning
Communication	Teamwork	Integrity
Professional Impact	Customer Focus	

The mapping of the fourteen ISU Competencies to the eleven Criterion 3 Outcomes (a-k) is provided in Figure 1 [7]. The concept of ability-based outcomes being multidimensional is immediately recognized – a single Criterion 3 Outcome requires more than one of the fourteen ISU Competencies. For example, Outcome (g) “an ability to communicate effectively,” requires the demonstration of five ISU Competencies. In addition to the Communication competency, a student or graduate must also demonstrate General Knowledge, Initiative, Customer Focus, and Professional Impact to successfully demonstrate this Outcome.

A single ISU Competency can contribute to multiple Outcomes. For example, the ISU Communication Competency is required for the successful development and demonstration of four Outcomes, including the obvious connection to Outcome (g), “an ability to communicate effectively.” Thus, by providing a multiple opportunities for students and graduates to develop and demonstrate the Communication Competency in their education, we help them achieve a significant number of Outcomes.

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Figure 1: ABET Outcomes Versus ISU Competency Matrix.

ABET OUTCOMES VERSUS ISU COMPETENCY MATRIX

Engineering Criteria 2000 Criterion 3 Program Outcomes and Assessment		ISU Competency													
		Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis and Judgment	Planning	Communication	Teamwork	Integrity	Professional Impact	Customer Focus
(a)	an ability to apply knowledge of mathematics, science, and engineering	✘		✘		✘			✘						
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	✘		✘	✘	✘	✘		✘	✘		✘			✘
(c)	an ability to design a system, component, or process to meet desired needs	✘		✘	✘	✘	✘	✘	✘	✘	✘	✘			✘
(d)	an ability to function on multidisciplinary teams					✘		✘	✘	✘	✘	✘	✘	✘	✘
(e)	an ability to identify, formulate, and solve engineering problems	✘		✘	✘	✘	✘		✘		✘	✘			✘
(f)	an understanding of professional and ethical responsibility		✘	✘	✘			✘	✘				✘		
(g)	an ability to communicate effectively		✘			✘					✘			✘	✘
(h)	the broad education necessary to understand the impact of engineering solutions in a global and societal context	✘	✘	✘				✘	✘						
(i)	a recognition of the need for, and ability to engage in, life-long learning			✘		✘									
(j)	a knowledge of contemporary issues		✘	✘				✘	✘						
(k)	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	✘		✘	✘	✘		✘	✘						

During the validation process, constituents were asked what the probability of developing and demonstrating Competencies in various settings [8]. For many of the Competencies, the engineering workplace had the highest perceived probability. The classroom generally had low or the lowest perceived probability of learning key competencies. For example, the results for the Communication Competency are given in Figure 1, and show the classroom lagging far behind other learning sites both at the university and on the job.

Although the classroom can be an engaging and fruitful place for learning, we must recognize that at least the perception exists that it is not the most important arena for learning the necessary professional skills of being an engineer, especially when applied to Communication Competency. Relying on internships and co-ops to make up for this perceived lag in learning is a precarious course at best given the vagaries of economic development and hiring practices. For example, recent changes in the economy have resulted, at least temporarily, in a decrease in the number of experiential education opportunities at both Iowa State University and nation-wide [9]. Figure 2 shows the decrease in engineering internships and co-ops at Iowa State. As opportunities for important experiences such as internships change, new pedagogies must be explored to help our students enhance their learning experiences and competencies that otherwise would be developed on the job.

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Figure 1. ISU College of Engineering constituency response to the "probability of developing and demonstrating the Communication Competency in various settings."

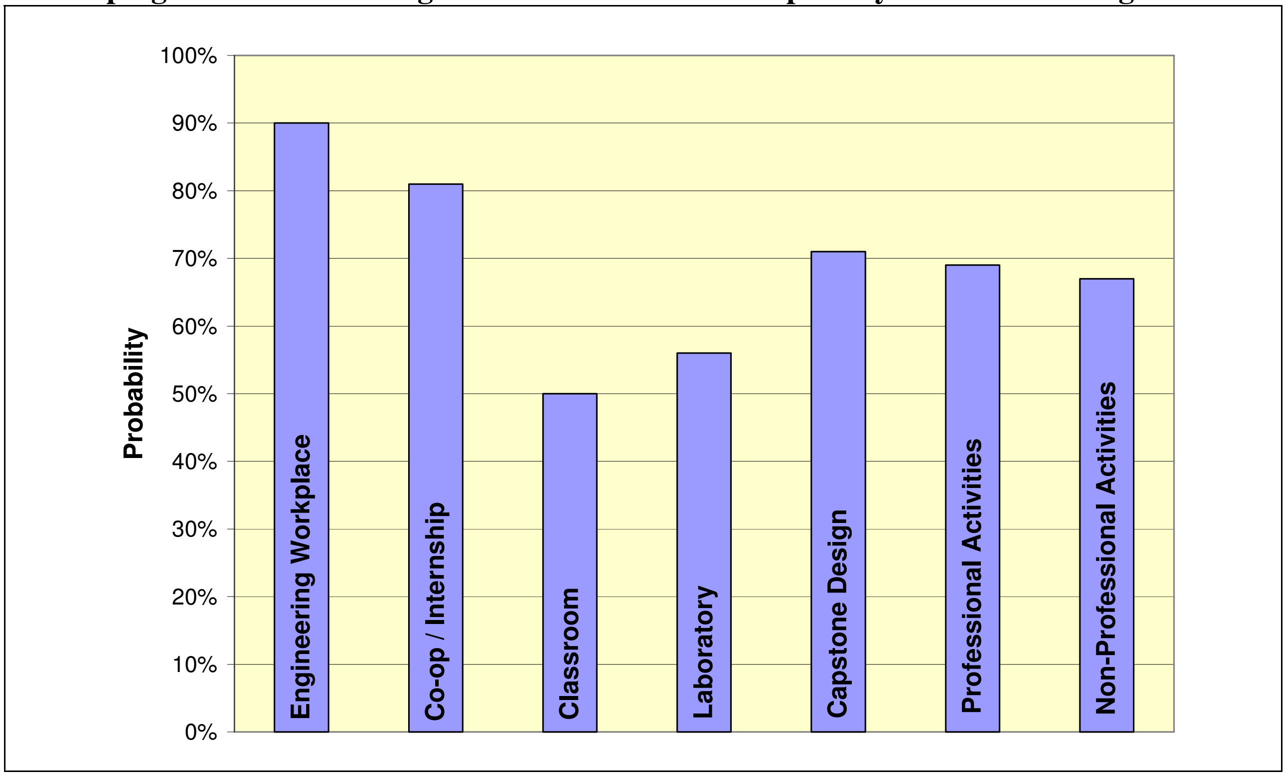
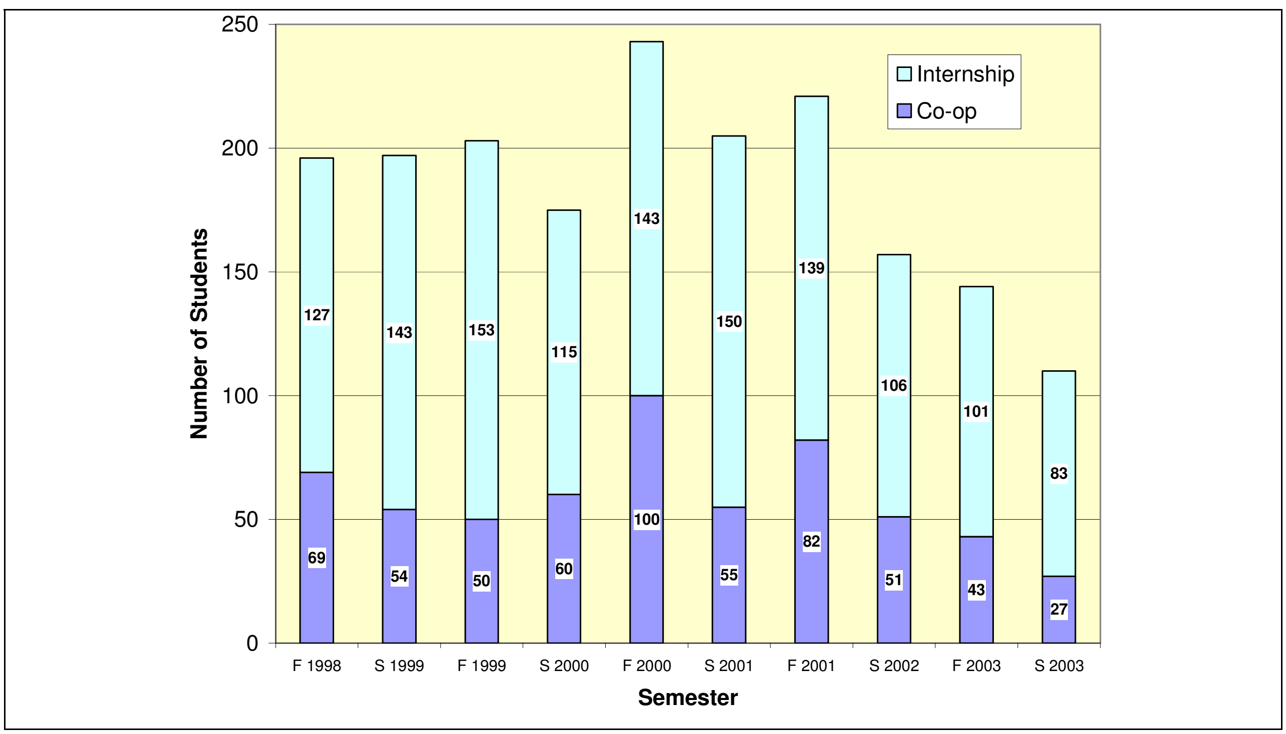


Figure 2. Number of students in engineering internships and co-ops at Iowa State University.



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Given these economic and pedagogical realities, we argue that the ABET 2000 Criteria is our opportunity rethink, reinvent, and reinvigorate our pedagogy in the creation of significant learning experiences for our students in the classroom. As Fink describes it, "In a powerful learning experience, students will be engaged in their own learning, there will be a high energy level associated with it, and the whole process will have important outcomes or results" [11, p. 6]. Pedagogy centered on significant learning draws students into a process rather than product driven experience in which they have to engage their learning with meaningful activities that involve complexity of thought and action situated within real world experiences [12 p. 7-9]. Significant learning involves the student in an immersive experience in which multiple disciplines and contexts are combined to challenge the learner to see connections in an active and organic way. We believe pedagogy that attempts these types of innovations has the power to excite our students to see their classrooms as places where powerful and practical lessons are learned about their chosen profession, and we believe that we can take the model of how students learn their competencies on the job and bring it into the classroom.

Why an On-line Case Simulation?

The College of Engineering at Iowa State requires all engineering students on an approved internship or co-op to participate in a competency assessment. Their supervisor assesses them on the 14 ISU Competencies and the student self-assesses. The results so far have been enlightening. For example, the results from the assessment of Agricultural Engineering students identified Communication as one of the weakest competencies demonstrated in this setting [6]. This is a major concern for us because the Communication competency is linked to important student outcomes: an ability to design a system, component, or process; an ability to function on multidisciplinary teams; an ability to identify, formulate and solve engineering problems; and an ability to communicate effectively. Our students with internship experience also told us that competency in communication was vital to their success in their jobs. In focus groups conducted with students returning from internships Fall semester 2002, one senior remarked,

> *On my second internship, I did a lot of day-to-day communications with contractors as well. One thing I learned this summer was to take one piece of information and tell that information to a manager, an operator and an engineer, and how the same bit of information can be told differently to get your point across effectively to different individuals at different levels in the plant.*

Another senior commented,

> *I had to do quite bit of presentations that were pretty involved. We had to sit in front of people on Friday morning and tell them what happened. We talked to everybody from salespeople to the company president. I had to make sure that I got it done right the first time so that we didn't have to have another meeting. One thing is to know how to adapt your information to make it meaningful for everybody.*

In order to begin addressing this problem of giving our students more communication training before going on internships, we tailored a required English technical writing course that taken by

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students in ISU's Department of Agricultural and Biosystems Engineering (ABE) Learning Community. The ABE Learning Community is an innovative curricular approach that uses, among other things, linking of non-engineering to engineering courses to retain students, build community and enhance student learning through participatory and active learning pedagogy [10]. Since learning community effort is well-established, it was natural for us to use our learning community to help bring meaning to a course that had previously been viewed by students as merely another requirement for graduation. Linking with the technical writing course also allowed us to place sophomores in a class that is normally available only to seniors, past the time when technical writing skills would be useful in most undergraduate classes, labs, internships and co-ops.

We specifically choose to work with a communication course because of the vital and foundational role that it plays in important student outcomes. A linked technical communication course, with two sections exclusive to students from the Agricultural and Biosystems Engineering department, allowed us to wrap up many different competencies in various lessons, and it also allowed us to simulate the type of work environment that our students might encounter in a number of internship/co-op experiences. We wanted this class to simulate the workplace as closely as possible because we believe that one of the things that makes the workplace so successful for the development of competencies is its combination of knowledge and practice in the building of professionalism. We join these two concepts of practice and knowledge because we believe that students need to learn how to practice their professional skills not in the sometimes vacuum of textbook and classroom, but rather in the juxtaposition of the classroom with the workplace and the world at large. We believe that students need to see the activities that they do in the context of their position as peripheral participants within the engineering discipline, and to see that these activities constitute a set of what Wenger has defined as social practices that join them into a community of engineering professionals:

> The concept of practice connotes doing, but not just doing in and of itself. It is doing in a historical and social context that gives structure and meaning to what we do. In this sense, practice is always social practice. Such a concept of practice includes both the explicit and the tacit. . . It includes the language, tools, documents, images, symbols, well-defined roles, specified criteria, codified procedures, regulations, and contracts that various practices make explicit for a variety of purposes. [11]

Therefore, in order to help our students see themselves as a part of a community of practicing professionals, and to bring some of the experiences that they might normally have on a co-op or an internship within the sphere of the classroom, we decided to try an innovative curricular approach with the technical writing course. A software and case development team, lead by David Fisher, met with ABE faculty to create a real-world case simulation of a biotechnology company. After development, David was also primary instructor for one of the technical writing sections. Anthony Ellertson did qualitative research both in and out of the classroom with focus groups, and Dr. Tom Brumm and Dr. Steve Mickelson served as consultants to the class for technical issues. Again, because of our ABE Learning Community ties, it was relatively easy to assume these roles with the framework of the course because our students are used to having linked instructors play roles within non-engineering classes.

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Our approach was different from typical case study pedagogy because the case presented to the students was hosted within online databases. Having the case online allowed us to present information in a variety of multi-media formats (text, video, audio, graphics), and to change and update information in response to real-time experiences of the students in the classroom. It was important to us that this case simulation be dynamic and responsive because we wanted the students to have an organic experience with the material. We purposefully would change the case throughout the course of the semester in response to student questions, student work and even world events. Assignments were given with clear end goals in mind, but the students were not given explicit directions on how to achieve them. Instead, we encouraged innovation, teamwork, and initiative, all ISU Competencies, in an effort to help students see that "real world" work experiences are not neatly bound by the schedule of the syllabus, and that learning is not confined to the lecture hall or lab. What we did with this approach, in the parlance of operations management, was to create a "pull" system in which students were responsible to a certain degree for pulling the materials they needed from the online case environment and from the textbook. We wanted the students to experience the excitement, uncertainty, and dissonance of having dynamic and long-term projects that require them to think "outside of the box," and to see their actions as having consequences beyond simply handing a project into a teacher. We wanted our students to see that the decisions that they make (design, technical, communicative, and ethical) have consequences besides simply receiving a grade. Our hope was that they would begin to understand that their decisions about communication affect the people around them and the organizations for which they work.

The Simulation

For the simulation itself, Dave Fisher actually played two roles. The first was as a teacher of technical communication, and the second was as a manager of the student consultant teams working for Omega. In his role as an instructor, Dave gave small lessons and lectures on various aspects of technical writing, visual communication, web documentation, and oral presentations. As a consultant manager, he assigned various tasks to be completed by individuals and groups, and he was the contact point between the groups of students and Omega simulation management. During their immersion with the case, students work (individually and in teams) within Omega Molecular, a small, privately held biotechnology company that produces a fungal-resistant variety of Golden Rice (high in Vitamin A) and various strains of pharmaceutical corn (http://learn.ae.iastate.edu/omega/login.cfm username: guest password: guest). The virtual organization has various patents and a genetic engineering process called the Omega Targeted Ecosystem Program (O-TEP) that enables them to quickly engineer desirable qualities into native plant varieties. The Omega portal provides access to the following elements:

- information sources—video footage of meetings, video/audio interviews with characters, access to organizational documents, access to an organization's intranet and
- collaboration tools—discussion boards, polls, and surveys—which students can use to communicate with each other about the case.

The main workspace (Figure 3) is designed to look like a desk blotter.

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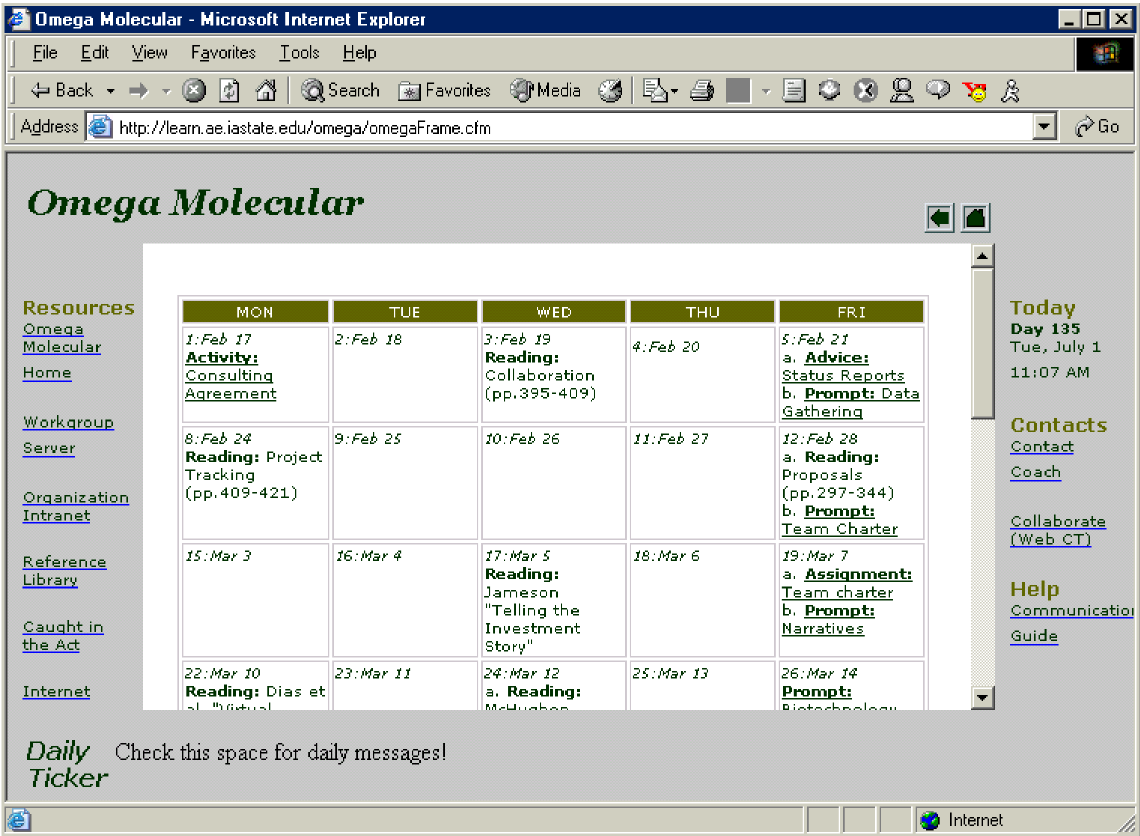
Figure 3. The Omega Portal



On the left side of the page, a list of information spaces appears. The students can click on any of these links to explore the space. The middle page consists of a calendar that contains due dates for various documents that students must complete as well as links to assignment sheets describing those deliverables in detail. The right side of the page contains links to various means of corresponding with the instructor and classmates, including email, chat, and threaded discussion. At the bottom of the page is a space for the "Message(s) of the day." As the simulation proceeds, various messages about the organization and its employees, other organizations, and local, regional, national, and international events appear here. This feature adds real-time elements (progressive contingency) to the simulation experience, encouraging participants to consider their actions in relation to varying circumstances at various levels. Occasionally, questions about some aspect of the simulation appear in this space and students are asked to vote on various issues (e.g., the implementation of a insurance policy for cohabitating significant others).

In the "Workgroup Server" (left side) students can work with documents of several kinds including financial reports, scientific and engineering data, status reports, instructions, proposals, graphics, PowerPoint presentations, meeting minutes etc. (see Figure 4).

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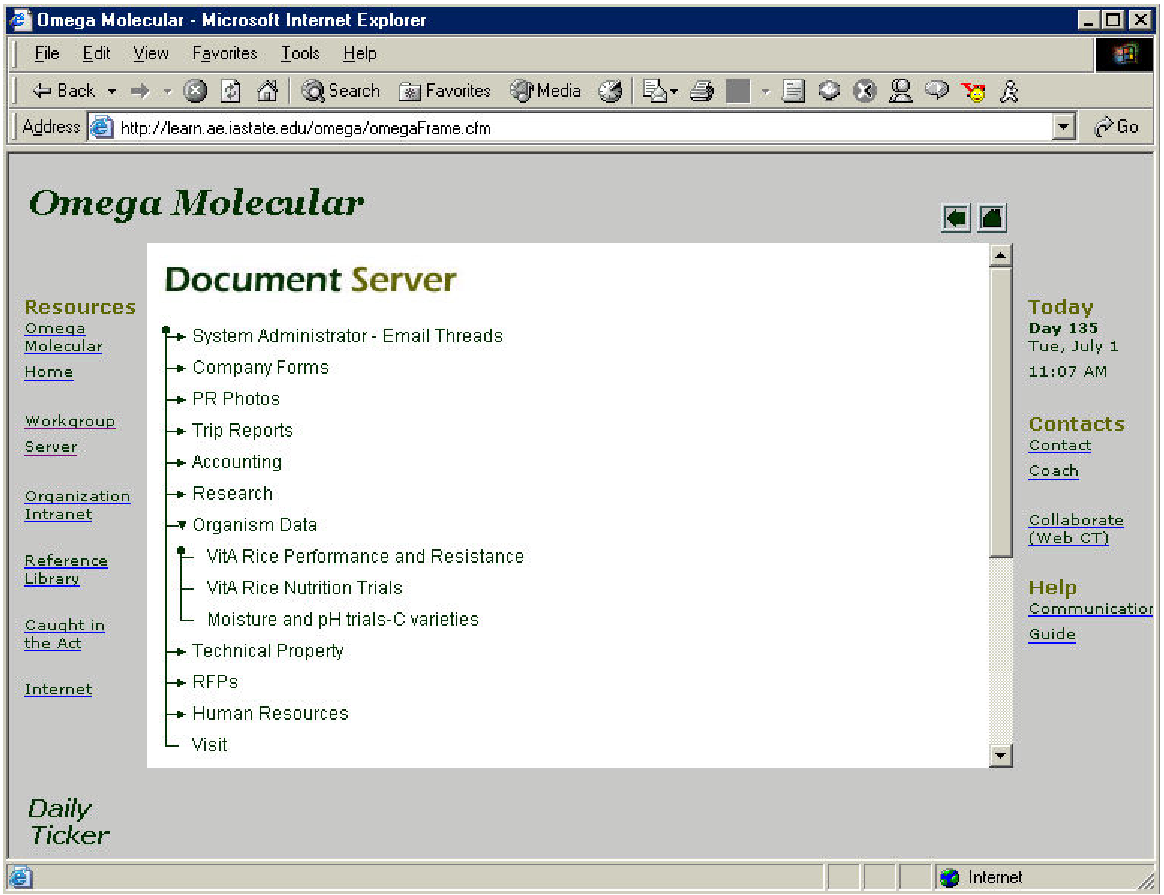
Figure 4. The Omega Workgroup Server



Taken together, these documents tell the many stories that comprise the organization's history. Within them, as well as within the other materials outlined above, reside the narrative threads that students must interpret and (re)articulate as they generate the various written, oral, and visual products required within the simulation. Piecing together these artifacts, students might realize that there are significant power imbalances within Omega that have completely marginalized certain groups and that have affected hiring practices, company performance, and personnel retention. They might also come to understand that Omega faces tough ethical questions about recent laboratory results that throw the effectiveness of Omega's products into question.

As the case progresses, students begin to understand that they can use information from these online documents and evaluate them as possible models for their own work. Finally, students can post their drafts, status reports, timesheets, etc. to the document server. Thus, all the students participating within the simulation have access to the documents created by the other teams and individuals. Their work actually becomes a part of the organization's archaeology; and they come to see how their practices perpetuate or change the structure of Omega. The detailed attention to the context of the information and its representation in the development of an electronic case is the pedagogical analogue of providing a "wider range of information about companies and their work" [12]. Glynda Hull argues that "work must be organized to allow, and even require, workers to take responsibility for reading and writing on the job" [12]. That is exactly what we did with the Omega case simulation. Rather than reading "because the teacher said so," students learn to read in order to respond (write, speak, visually represent) appropriately to a situation posed within the case. In so doing, we believe students started to see how reading and writing, rather than being a tangential part of "real work," actually comprise much of what it means to be a worker in a high-tech organization in the United States. Indeed, during the pilot of the Omega case, Dave Fisher, an experienced technical writing teacher, had more students taking notes fastidiously and asking better questions than he had ever had in the past. Suddenly, there was a reason for learning what Dave was teaching them. The textbook Dave used in the course became a reference where they could look for clues about how to solve the problems they encountered, rather than a burdensome tome they were forced to confront in chapter-by-chapter fashion.

Assessing Omega

The research for this article is an exploratory study and comes out of our experiences teaching with the case simulation in the linked technical communication course. For this article, Anthony Ellertson met with three different groups of students (14 students totally) drawn from both sections, as well observed the classrooms during the course of the semester. Focus groups were chosen randomly before any work was begun on the simulation. Two focus group interviews were conducted during the course of the semester, using a semi-structured interview protocol. One set of interviews took place approximately one week after the simulation began, and another set of interviews was conducted about two weeks before the end of the semester. All participants in this study remain anonymous. The purpose of these focus groups was to see how students came to negotiate their position as members of a team of consultants in the simulation, and how they came to understand the practices used within the Omega simulation community. Member checks were conducted after the completion of the study, and participants were shown relevant materials that they contributed to see if they concurred with the findings.

Practicing Omega

Through the course of the study, we found that our approach helped students develop technical writing skills and the Competencies linked at Iowa State to ABET 2000 criterion 3(g), that is, "an ability to communicate effectively." We also found that students began to see themselves as participants in a community, albeit an electronic simulation, where they saw their activities and practices as having value in the "real-world."

At the beginning of the simulation, the students were very disoriented with the case, and seemed lost as to what they were suppose to do. One student remarked in the first set of focus groups, "I have no idea what is going on with Omega. I am the type of person who needs to see an end point so that I can see what needs to be done and what steps to take to get there instead of just looking at all the little steps and not getting the big picture." Another student echoed this sentiment by saying, "I think everyone in my group would agree that we don't have a clue. I don't know what the instructor wants. I think the instructor needs to give us more details."

Students were also very upset that the class did not seem to follow the usual prescribed procedures in a normal syllabus. A student remarked, "Most of the time in our regular classes, the professor gives you a document telling you what you are trying to achieve, or something you can follow. It seems like in the Omega simulation that we are just jumping around in different places and working with different things—but as a group we really don't know what our end product is going to look like" [13]. Overall, in the first set of focus groups, students wanted the instructor to guide them through a process step by step. One student typified the general sentiment by saying, "I guess I just want an outline of what the instructor wants us to do—like a step by step thing—like right now here's what you should be doing meeting with your group and getting this done next week, and then this and then this."

Their reactions were not surprising to us given the type of work environments that they are used to at the university, and coming before that in elementary and high school education. They have been trained in a community of practice in which it is expected that the teacher will provide a very structured learning environment in which they will be given information with specific tasks on specific timelines. But any teacher knows that this will not be their experience once they enter the workforce where projects do not conveniently end during the course of a week or a semester, and where the finality of a project is not guaranteed by a grade. Therefore, the ambiguities of the Omega simulation is very different than most of their educational experiences. Groups and individuals have tasks to perform, are given great leeway as to how they perform them, and face the possibility of new information and requirements being introduced into the middle of a project. Practicing Omega, however, is not that different from the experience of an intern or new professional entering a workplace as a peripheral participant in what is already an established organization with its own set of rules and dynamic practices. The students' experience, therefore, is closer to what Dias argues is a part of learning to become a member of a discipline—which is often a less than tidy process involving dissonance, complexity, and open-ended tasks,

> As the learner moves out from the classroom toward professional practice, the moments and sites of learning become less clearly defined, and certain key features of learning and teaching change. There is a gradual increase in the authenticity of tasks; that is, their consequences and their influences on others and on activity escalates, and there is a parallel growth in their complexity and messiness: workplace tasks lack the exact moment of beginning and ending, the stated evaluation criteria, and the sharp divisions of labor that usually characterize school work. [14]

The initial dissonance in the class continued for the first few weeks of the simulation, and we witnessed several incidents in which students complained to their peers about the difficulty of the projects. By the middle of the semester, however, this seemed to change as the students began to organize their activities within the assigned consultant teams. In the beginning, the tasks laid out for them within their roles as consultants to Omega seemed impossible, and quite frankly were if they remained the responsibility of one individual alone. Each group of student consultants was tasked with reading and understanding hundreds of artifacts and links within the simulation and then turning them into documents, reports, presentations and web pages, an impossible task for one student alone given the constraints of the semester. What students started to see as they struggled with these requirements is that they could divide up the assigned tasks amongst their

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team members to make their work more efficient. They began to understand that each group member did not have to read everything in relation to the Omega simulation, but rather that each member of the team could take particular areas of the company and *report back their findings* to the team. In the second set of focus groups, one student told Anthony about this process, "I think if you're in a group it's obvious that there's going to be someone in the group that can do a different task better than what someone else can do. It's best to allocate the tasks—give the task to the most proficient members that can tackle it." The dividing of the workload allowed the teams to construct an image of what was happening within the company through the interpretations of individual group members looking at specific areas of Omega. Just as in a real company, where different departments operate together side by side in a semiautonomous way, the students began to take on tasks within their teams that fit their particular strengths. This was a positive experience for most and even students who normally felt that working on teams was difficult found this process of having to rely on and communicate with each other to be very useful. In another of the focus groups conducted at the end of the semester one student explained, "In this class, I feel I've gotten better at working with a group. In my other classes, I work by myself. I don't usually like working with other people because I like trying to figure things out by myself. In this class, you have to depend on the group more and it makes me focus more towards the team as a team member—and think about what's best for the team."

By the end of the semester, students came to see their experience in the Omega simulation as being more authentic than what they would have normally had in other classes. One student remarked, "I won't say I enjoyed it, but it's been a good learning experience just because I think this is more how the real world operates. You don't go into a job that is a start up for everyone. Most of the time you go into a company and you are getting stuff right in the middle of everything and you've got to figure out what happened before and what's going to happen in the future and what you can do to change this." As the communication products were produced, the ambiguities of the case began to go away as students saw their interpretation of Omega's story within the artifacts that they were creating. As a student explained, "I guess my personal feelings are from the last time we meet is the course is pretty much done a 180. The last time we met, we were all up in the air and didn't know what was going on—and from then it's leaps and bounds to now. We've learned so much and we've actually gotten something done—maybe it's the reason why I feel the course has changed because we have something in front of us and can say 'Hey we did this.'" Students came to see that learning to communicate within a community was process driven, involving adjustments to the environment. One student said, "I think this class is a lot different because I haven't had any class here that's even been close to resembling this. Like we said before, how much we were confused when we started—I think that really resembles a real life situation you go into something and you don't know what's going. You just kind of have to weigh it out and do what you can to get it done because then eventually all things will work out."

In the process of understanding the case, students saw themselves adopting roles to play within the simulation. More than a textbook, Omega became a narrative that students could enter into not as readers, but rather as active participants with roles to play in the construction of meaning. As one student said,

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> *I think the Omega story—you really don't think about it but it puts you in a state of mind that you really don't know about and every decision and everything from there on goes back to that certain state of mind. I mean you honestly don't comprehend it while you are doing it but you are—like—well Omega is like this and this. I don't know--it's kind of like playing a role, if you say you go home with your parents you act completely different than you do when you are with your friends. It's like you walk into a different environment and your mind changes and you don't even think about it.*

Students began to care about the Omega story, and thought about how the decisions that they made about the communication were affected by the story. They considered how their documents would add to Omega's success, as well as influence potential customers opinions of the company. Part of the narrative in the case is Omega's need to attract investors while also trying to appear as a humanitarian company working to feed the world. This presented problems that had to be worked through by the students to strike the right balance in some of their documents. A student explained,

> *One thing Kurt Danzer [CEO of Omega] is trying to say is it's a small group and their main focus is to help people in other countries with their product but still make money—although you kind talk about the money thing under your breathe. So, I think that's one thing that we've all though about as a group even though we don't really recognize it. Like with the website, the whole thing was set up [to appeal to certain customers]. Like the reason why we picked the colors and set it up in a certain way is because we were trying to portray that it's a small company and they care about the environment and it sets the tone for the whole thing.*

Students also told us that working on the case reinforced their awareness of audience and the impact of the documents they were both reading and creating. One student remarked that after working through the process of creating professional documents it changed how he read other documents. He began to see how design choices affect the delivery of the message, "One thing we did with graphs and stuff that we thought about was the way you can manipulate a graph to make it seem like a company is making leaps and bounds when it's not doing too great—or when its doing bad you can make it look like it good." Another student told us that he came to understand the relevance of a message delivered to particular audiences, "

> *One thing that I really learned about is that I really didn't have any knowledge before is like information relevance. Like if you were going to present something to a customer you need to pick who your focus group is and then organize the information that you are presenting to them around what they need to know or there capabilities of something. So I think that one thing that this class has helped is you've got a whole bunch of stuff and what's relevant to this person, what's relevant to this person and how do I portray it directly to them.*

Summary

Practicing Omega is a new and innovative approach to helping students achieve the ABET Criteria 3(g), "the ability to communicate effectively." In a technical writing course, student participated in a virtual workplace crafted to simulate real work situations and ethical dilemmas.

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The Omega simulation forced students to initiate and structure their own learning. They developed and demonstrated the Competencies of communication and initiative, as evidenced by qualitative assessment (focus groups) and their performance in the course. These Competencies are directly linked to the ABET communication outcome.

Future possibilities

We plan to continue using the Omega in future offerings of the technical writing course for students in the Agricultural and Biosystems Engineering Learning Community. However, our experience has opened our eyes to a number of future possibilities. The Omega format, with different virtual companies, could be used in many different settings:

- any course which addresses Outcomes linked to the Communication competency,
- our capstone design course, where students are part of an engineering team,
- other simulation settings tailored directly to engineering practice,
- reverse engineering of the design process – applied to the “process” rather than the device,
- exposing high school students to the profession of engineering,
- creating multi-locational (local, national, international) engineering education and experiences through the internet.

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