ETHICS AND THE PROFESSOR CHEMICAL COMPANY

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INTRODUCTION

The University of Nebraska at Kearney (UNK) is a 4-year branch campus of the University of Nebraska – Lincoln, specializing in degrees in education, industrial distribution, and health sciences. Student enrollments in the mid 1990s approached 10,000. From 1995 to 2001, UNK experienced a decline in student credit hour production, which finally stabilized at 6500. We are currently experiencing an upswing in enrollment.

Students are attracted to UNK for the undergraduate experience in a rural setting. While some programs do offer Masters of Science in Education and Masters of Science degrees, the majority of the departments within the four colleges that make up the university only offer Bachelor of Science and Bachelor of Arts degrees. In fact, the University has identified priority programs within the college due to their ability to attract students, their strength of program, and the success of their majors. The Department of Chemistry is one of the priority programs at UNK. The faculty in the department have contributed to the success of the program by working closely with the students. In addition, the department’s mission to educate chemistry students using state-of-the-art laboratory instrumentation has been touted as a strength of the department.

Because all of the chemistry majors must complete at least two semesters of undergraduate research, the implementation and practice of a professional code of ethics is of importance to the faculty of the department. In July of 2002, I had the opportunity to attend the Ethics Across the Curriculum (EAC) workshop at the Illinois Institute of Technology sponsored by the National Science Foundation. Based on the material I gathered at that workshop, I have implemented discussion of professional ethics early in the career of chemistry students.
GENERAL CHEMISTRY

The most obvious course to begin using professional ethics is the first course in the major. In Chemistry, this course is General Chemistry. General Chemistry is a two-semester course that introduces the basics behind the different fields within our curriculum. This course covers topics ranging from Organic Chemistry (synthesis and structure of molecules) to Analytical Chemistry (measurement of amounts of molecules) to Physical Chemistry (properties of molecules). The course requires students to have a fairly strong background in algebra and some working knowledge of trigonometry and geometry. In fact, students wishing to enroll in General Chemistry at the University of Nebraska at Kearney must have a suitable ACT Math score, a passing grade in College Algebra, or a minimum score of 25 on the ACS Toledo Exam (a basic chemistry skills placement exam).

The General Chemistry course is designed to pique the curiosity of students from a widely diverse population. In fact, given that only 70% are freshmen and that the course satisfies a general studies requirement, the range of abilities and capabilities of the students in this course is very diverse. These factors, the diverse population, the diverse math skills, and the wide variety of topics in the course, make teaching the course difficult.

INTEGRATING ETHICS

However, integrating a program to introduce professional ethics seems to fit well into the course. And, while there are many different methods to conduct this integration, I chose to utilize a web-based approach.

Students in the course are divided into groups of three. The three students meet together outside of class to elect a team leader and develop a personal relationship with the other members of their team. Each team is then instructed to “form” a chemical company by pronouncing the team leader as the CEO, developing a name for the company, a logo, and a company slogan. Points are awarded for successful completion of this task.

The students are then instructed to develop a web-based presence on the UNK campus server. Access to this server for this course is easy after a brief introduction from the campus instructional technology committee members. This website is used to display the company name, the
Developing a successful website relies on the students’ ability to find chemical information in the library relating to the properties of the compound, the structure of the compound, its reactivity, etc. This also requires that the students use the information from the lecture to develop a well-rounded website that is very detailed.

The website serves as the site for the students to report their answers to a series of homework assignments related to their chemical company. These assignments require the students to answer typical chemistry questions, but have an additional component relating to the code of professional ethics for chemists. The ACS Code of Ethics is a professional code of ethics developed using standard professional codes. This code, while not overly detailed, is coherent in its coverage of the major issues common in professions.

To make the chemical company theme work well with a class of students, I added my own chemical company. This company, known as the Professor Chemical Company, Inc. was added to be the competition with the students in the class. PCC also has a web-based presence on the same server and is updated weekly with new information about topics in the course, answers to homework assignments, and other information pertaining to the assignments. In fact, during one week of the course, the information on the website for PCC was purposely incorrect to test the students’ ability to find and report the mistake (see the ACS Code of Ethics).

Every two weeks during the course, the students receive an ethics-related homework problem in the form of a Case Study. This problem is distributed by Blackboard and by handout in class. The students, then, have one week to address the problem and formulate a response in the form of a modification to their website. Chemical Companies that do not post their response by the deadline are penalized the full credit for the website. (To date, not one group has failed to meet the deadline.)

During the second week of the assignment, the students are required to visit the other chemical companies and determine the other types of responses to the case study. This information is gathered for an in-class discussion at the end of the second week. This method of integrating ethics into the classroom clearly uses little time within the lecture portion of the course and requires the students to spend time outside of the course in pursuit of chemical information. Moreover, and perhaps
more to the point, these homework assignments prepare the students to understand professional ethics as they apply to a 'real-world' situation.

I was actually hesitant to make the grade for these assignments worth more than 5% of the course. After seeing the effort the students applied to these problems, I think that 5% of the total course grade is adequate. As a side note, it is still amazing to me to see that the students will work an extra hour for a single point in a 1000 point course.

For example, here is a typical webpage for the Bart and Susan Chemical Company. The first thing you'll note is the students' ability to find and present humor in everything they do – if given the opportunity to be creative. In any case, this company has developed a webpage to describe the molecule ammonia. The web page goes into detail describing the process by which ammonia is made (although the equation is slightly incorrect in that it isn't balanced) and they provide some useful details about the structure and properties of ammonia.

**Typical Integration of Ethics**

A typical case study used in these homework problems is presented here. This problem seems to be well-received by the students. It begins…

"PCC, Inc., a specialty chemical manufacturer, recently opened a facility on scenic Dry Creek one-half of a mile north of the Kearney County Feeders operation. PCC has just begun manufacturing a compound known as perchloroethylene (PCE).

"Your company, established in the area, makes its living by manufacturing and selling PCE.

"At the Backlot Bar last Friday night, John, one of your well-respected research chemists, overheard a hushed conversation between PCC chemists. He has entered your offices to report what he heard. He mentions that the PCC chemists appeared to be discussing an accidental spill of PCE that happened last month near the Kearney County Feeders. Apparently, there was some concern about it leaching into Dry Creek. John was unable to hear more about the spill and you’ve heard nothing about it from any other source.

"Until PCC, Inc., came to Nebraska, your company was the only manufacturer of PCE in the state. PCC, Inc. has grabbed a large portion of your business since they’ve begun making this
compound. In fact, your company is spending a lot of time trying to find an alternative product to manufacture in order to save the company and the jobs of its employees.

“The Bottom Line… What would you, as the company’s leaders, do given this information?”

The students are also presented with a series of possible responses to this case study, and they are presented with a related homework assignment. Specifically, the students could…

- Report the spill to the EPA or to the Nebraska Department of Environmental Quality.
- Confront PCC about the knowledge of the spill and demand they clean it up.
- Leak information about the spill to the Press.
- Discount the information because John didn’t know enough to even prove that a spill occurred.
- Other.

The students typically formulate acceptable answers to this problem. The amount of work that they spend in the formation of their answer is clear indication that they take the problem seriously and that they spend time discussing the answer for the company. The typical response is to notify the EPA, the NDEQ, and confront PCC to determine more information. While some approach the answer in a diplomatic manner, by confronting PCC, Inc. first and then reporting the information to the EPA and the NDEQ, the overwhelming response is in agreement with the ACS Professional Code of Ethics. The specific code requires all chemists to protect the environment and quickly notify authorities in the event of a chemical release.

Other Case Studies

Other case studies have been used in this manner on a wide variety of General Chemistry Topics. These studies range from stealing ideas from confidential files, to improper advertising, to irreproducibility in chemical analyses. Each of these case studies has an answer that is completely supported by the ACS Professional Code of Ethics. Specifically, the issues surrounding the release of preliminary data for verification, the
respect for fellow chemists, and the advancement of chemical awareness are issues addressed in the case studies.

**SUMMARY**

Student responses to the case studies are generally excellent. In fact, over 90% of the student websites successfully identify the Professional Code that is being violated and offer a suitable solution to the dilemma. The other 10% of the student responses, while misidentifying the violated code, still offer responses that provide an adequate solution to the dilemma in the case study.

Students also remark during the assessment of the course that they enjoy the additional projects. This most likely stems from the low point values placed on their completion (they don't lose many points if they make a mistake) and from their ability to act, think, and produce something using their creativity.

Some of the exams during the semester have also included a question relating to the ACS code. The questions are typically answered well, with average scores on the questions in the 78-84% range.

Integrating professional ethics into beginning level courses might imply that a lot of lecture time be lost to the discussion of the specific issues within a topic. However, this is not the case. Through the use of websites and a team-based approach to answering questions of ethics, the topic can be covered in great detail. In addition, instead of distracting from the students’ out-of-class study time, it enhances their studying since the problems are based on current topics.

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**NOTE**

1 Presented at the Thirteenth Annual Meeting of the Association for Practical & Professional Ethics, February 26-29, 2004, in Cincinnati, Ohio.