Whose Words can we Trust?: PRiME's Modules for Teaching and Assessing Undergraduate Learning in Information Ethics

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Most undergraduate engineering programs in the United States face a common problem in designing curricula that develop students' professional responsibilities as well as their mathematical, scientific, and technical skills. As Thomas K. Grose explains,[1] ABET's EC 2000 standards, which require that graduates possess such skills as "an understanding of professional and ethical responsibility,"[2] pose particular challenges to engineering faculty, who typically resist the kind of course content associated with liberal arts. Grose also notes a complementary "hurdle" of humanities and social science professors' reluctance to form interdisciplinary teams with engineers.

At the University of Texas at Austin, however, humanities-trained faculty in the College of Engineering are joining forces to create teaching modules that could be used not only in their own communications courses, but also in technical classes by their engineer colleagues. Funded by the Chair of Free Enterprise, the Professional Responsibility Modules for Engineering (PRiME) project aims to facilitate the integration of such topics as Ownership of Information, Credibility of Sources, Teamwork, and Leadership into existing courses. These topics all fall under the umbrella of "Professional Responsibility," and it is envisaged that other topics, such as Environmental Responsibility, will be added later. This paper focuses on the development of PRiME's Ownership of Information and Credibility of Sources modules. These modules were designed in the fall of 2004 and will be tested in the spring of 2005.

The developers of PRiME—Hillary Hart, D'Arcy Randall, Christy Moore, Mark Carpenter, and Randi Voss—teach in different engineering departments, but they share a common undergraduate course, Engineering Communications, which is required throughout the College of Engineering. Different departments use the Engineering Communications course in different ways, but all versions are designed to address ABET Criteria d, f, g, h, i, and j -- the criteria concerned with professional non-technical skills. These classes train students in writing and presenting, and all require a research project.

Topics for the PRiME modules grew out of this common undergraduate course. Growing national concern over student cheating,[3] the impact of the Internet on student research,[4] and the tendency of engineering students at UT Austin to "place out" of freshman-level courses that teach research methods and academic integrity prompted PRiME developers to create two initial modules devoted to helping students learn to assess the credibility of sources and to avoid plagiarism. Learning to assess the credibility of sources is a crucial skill for undergraduate "millennials," who are accustomed to finding instant, and often dubious, information on the Internet. For engineering students, instances of plagiarism arise not only from academic

dishonesty but also from confusion over intellectual property on the Internet and proper methods of paraphrasing.

This paper describes the process by which these two modules were designed and developed during the fall semester of 2004 and then readied for testing in the developers' own classes in the spring semester of 2005. It covers website design, the creation of scenarios, and selection of educational material. The final section focuses on assessment techniques to be used formatively to revise the modules according to student and faculty feedback.

Design of Web-Based Modules

The first challenge of this project was to break down the content we wished to cover into smaller "lessons" that would make that subject "live" for students. We started by setting objectives for each subtopic and building a lesson to meet those objectives. For instance, for the Credibility of Sources module we knew we wanted to cover "how to evaluate" sources of information, especially web sources, as well as the whole issue of how to decide what information needs to be included in an engineering report and what doesn't. Thus, we decided to begin developing the Credibility module by creating two lessons, each of which would follow the same organizational pattern and could be taught separately or in tandem. As it happens, we also decided to break down the Ownership of Information module into two lessons.

The next challenge was to decide on an organizational format that could fit all the modules. In the summer of 2004, project leaders decided to use the model of Challenge Based Instruction as a way of framing and organizing the components of the Ethics modules. This model, as described in the National Academy Press book *How People Learn*,[5] has been adopted by VaNTH, an NSF engineering research center at Vanderbilt-Northwestern-Texas-Harvard/MIT that develops bioengineering educational technologies. The Biomedical Engineering Department at UT had already cast some of its ethics materials in the Challenge framework, which stresses interactive, group-oriented learning and student self-assessment. The six stages in the Challenge cycle are represented in Figure 1.

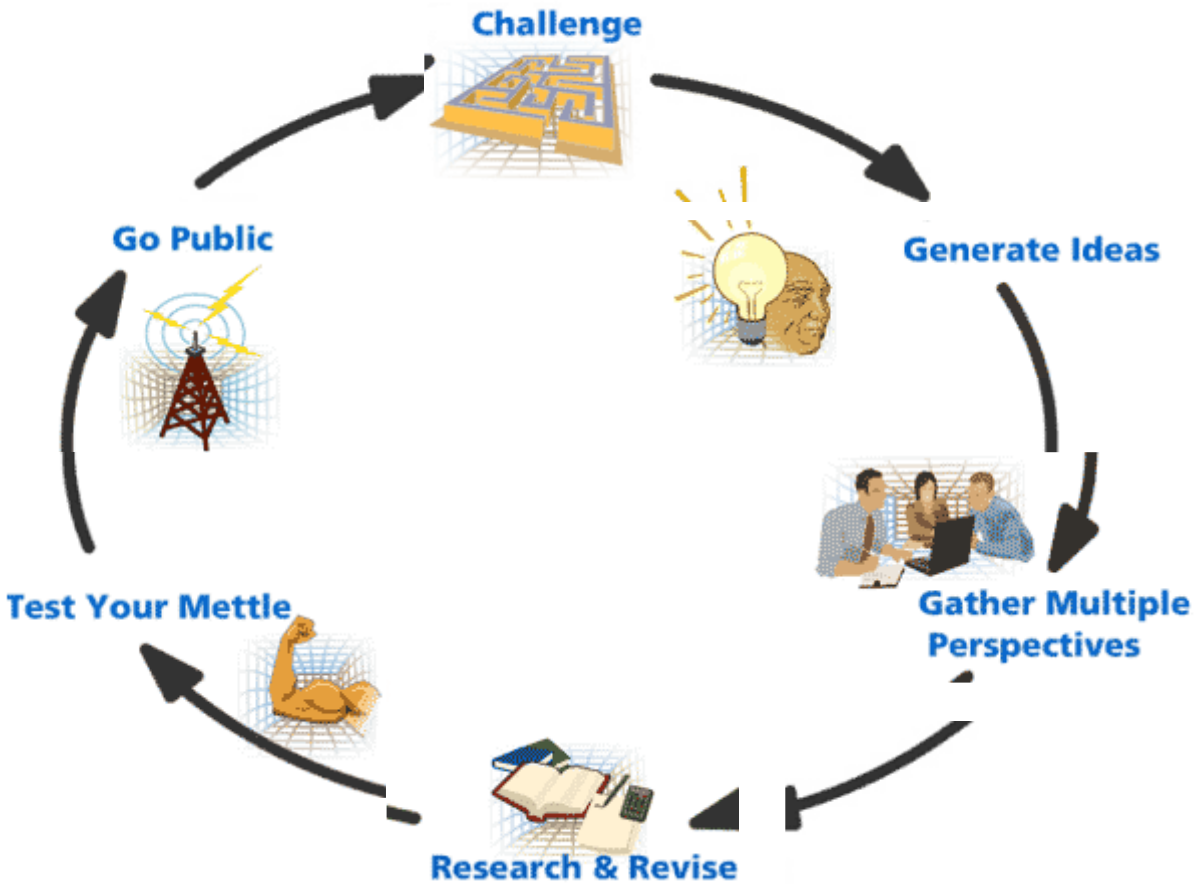

Figure 1. Stages of learning in ethics modules, based on Challenge-Based Instruction (Bransford, 2000). Developed by the Faculty Innovation Center at the College of Engineering, UT Austin.

How we interpreted these stages and developed materials for each lesson is discussed below. What we decided would be common to all modules was the flexibility, inherent in the model itself, to be recursive and non-linear rather than rigidly sequential. In other words, once the challenge had been given to students -- typically in the form of a complex scenario or case study in which ethical courses of action were not obvious or unilateral – the subsequent steps could be followed in any order or repeated. For instance, if students were not generating many ideas in the Generate Ideas stage, the instructor might want to return to the scenario given in the Challenge and change the way students responded – in class, perhaps, instead of simply online as an e-mail thread. For some lessons the path through these stages would branch in different directions, depending what the instructor felt would be most helpful to students.

Developing the lessons as web-based stages convinced us also to add an instructor-based "side" to all the modules. Since the goal of the project is to create an undergraduate curriculum in engineering ethics, we wanted to make the lessons as usable as possible for different styles of

instruction in very different courses. Thus, an Instructor's Guide will be available only to instructors and will include all the pedagogical suggestions we can make based on our own experience using the lessons and on the assessment of students and pilot faculty in the spring of 2005. Attempting to make the lessons as widely usable as possible led us also to devise for each module at least one lower-division and one upper-division lesson.

Content of Modules

In selecting and writing the content for the modules, the PRiME developers initially drew from assignments we had already developed for our own classes. Our criteria for selection centered on the following questions: Do our students need to learn the material? Can the lessons within each module apply to more than one field of engineering? Are the lessons suitable for undergraduates? Could they be modified for teaching units of varying length and complexity? How much work would it take to update and maintain the website over several years? We also considered how we would assess the modules' success: Could we demonstrate that students learned the material? The following subsections elaborate on the content development of one lesson for each of the "Ownership of Information" and "Credibility of Sources" modules.

Ownership of Information: Copyright and Fair Use

The Ownership of Information module contains two lessons, one on Copyright and Fair Use and the other on Plagiarism and Fair Use. The two lessons are designed to complement one another, although some of their resources overlap. Designing the framework for this module and selecting its content challenged us because the literature on Copyright and Fair Use is voluminous, and the laws are changing, thus generating more arguments, lawsuits, and literature. For both academic and professional reasons, engineering students must learn the basics of Copyright and be aware of contemporary controversies concerning the way the laws are applied. After all, as professional engineers, their works may both benefit from the laws' protection and create new difficulties for the laws' interpretation. Both as students and as future professionals who will write reports and present their findings, they must also learn the definition of plagiarism and methods to avoid it.

The Copyright and Fair Use lesson is designed for either one long class period (1.5 hours), or a longer assignment combining homework and class discussions. It introduces the concept of Copyright through a story concerning a common practice in student life: downloading music from the Internet. The "Challenge" presents the story of the lawsuit filed in 2003 by the Recording Industry Association of America (RIAA) against 261 "major offenders" who downloaded music using a file-sharing service.[6] The suit was a public-relations debacle for the Recording Industry because one of the first people named in the suit was a 12-year-old girl, Brianna LaHara, an honors student from a housing project in NYC, who thought that the fee her mother had paid their file-sharing service also covered any necessary payment for downloading the songs.[7] Also named in the suit was 71-year-old Durwood Pickle from Richardson, Texas, whose grandchildren had downloaded songs onto his computer when they were visiting his house.

The lesson uses this story as a springboard to a short research project on Copyright. It begins with simple questions about why Brianna and Mr. Pickle were considered thieves, and how they

could have avoided the suit. Students are prompted to browse the websites on basic copyright from the U.S. government, Stanford, and the University of Texas at Austin. A short version of this lesson addresses the most important points: that creative individuals—musicians, writers, and engineers—produce "work" that is protected by copyright laws, and those laws also protect the "work" of industries that bring creative inventions to the public.

A longer version of the lesson exposes students to debates over how copyright laws on music downloading are interpreted. The point here is not necessarily to resolve those complex debates, but to recognize that they exist, and that technological advances made possible partly by engineers have often vast, unforeseen social consequences.

The story of the RIAA's suit against Brianna LaHara and Durwood Pickle carries two major advantages. It should provide an accessible introduction to a complex subject by appealing directly to student experience. This particular case study should also provoke a lively class discussion by presenting a distinction between the law as it stands today and students' common perceptions of justice. The main problem we foresee with the use of this story is that the articles will need to be updated frequently, and possibly replaced, and that even a "basic" unit in Copyright may demand more time than one or two class periods will allow.

Credibility of Sources: Evaluating Web Sites

The Credibility of Sources module offers training in evaluating sources in both academic and professional practice. In "Evaluating Web Sites, " students develop criteria for evaluating online sources for writing a research paper. Another lesson, "What to Report," examines a case study in which a young engineer considers whether to use hearsay evidence in an engineering report. Although the two lessons address problems from different stages of an engineer's training, they both aim to stimulate the critical judgment necessary for responsible professional practice.

Engineering students at UT, Austin often enter the program with Advanced Placement credit for the freshman Rhetoric and Composition course that teaches online research skills including how to judge the credibility of Internet sources. Consequently, unless the students acquired those skills elsewhere, they may initiate their research papers by surfing Google, riding on little more than common sense. Meanwhile, corporate websites feature sophisticated methods of presenting selective research to promote commercial interests. During the late 1990s, as library resources and academic research moved online, we grew alarmed by the numbers of student papers that, at worst, naively cited ".com" sources as evidence, or, more typically, did not sufficiently account for the sources' bias or conflict of interest. In response, we developed in-class exercises to raise the students' critical thinking skills (see one such exercise at http://www.ce.utexas.edu/prof/hart/333t/sources.cfm). The PRiME module's lesson "Evaluating Web Sites" develops out of such an exercise.

The "Challenge" presents a fictional scenario in which a student pair, "Gloria" and "Matt," have been assigned to find "seven credible sources showing a variety of viewpoints" on the safety of genetically modified crops. The sources may draw from various media. "Gloria" finds three sources that appear credible: a National Public Radio broadcast,[8] Gary Comstock's book *Vexing Nature*: *On the Ethical Case Against Biotechnology*,[9] and a University of Washington website on

science controversies.[10] "Matt" appropriates a bibliography of online sources from an old student paper, and his contribution consists of three Monsanto sites with a subtle corporate identification (Biotech Knowledge; Biotechnology—Good to Grow; Explorations),[11,12,13] and a site sponsored by an organization whose aim is "To show Monsanto's crimes against humanity and the environment" (Monsanto Sucks).[14] At the close of the scenario, the audience is asked to evaluate "Gloria" and "Matt's" online sources.

"Generate Ideas" gives the links for the sources and a matrix for evaluation. Students are be given 5-10 minutes to review and rank the sources on a scale of 1-5, with 5 being the highest in credibility. This section of the assignment can initiate a discussion on the credibility of the conventional domains: .com, .edu, .org, and .gov. Students are also asked to articulate the distinction between "bias" and "conflict of interest"; in our experience, they often confuse the two concepts.

We were surprised at the number, quality, and complexity of resources available to help evaluate web sites. "Gather Multiple Perspectives" lists several sites. For classes able to investigate the issue in greater depth, we include a PowerPoint presentation summarizing B. J. Fogg's *Persuasive Technology: Using Computers to Change What We Think and Do*.[15] In this section, students create a Source Credibility Checklist for their own use. They may either choose an existing list that serves their needs or make adaptations to the lists. When they move on to the "Revise and Rewrite" section, they return to their original Matrix and review their rankings using their new Checklist.

The "Test Your Mettle" section presents a second list of another controversial science and engineering topic: drilling for oil and gas in Alaska's North Slope. This list presents a larger challenge than the one on genetic modification because some of the sources raise questions about the objectivity of ".gov" sites, which are generally considered to be one of the most credible domains. The topic of drilling in Alaska may, indeed, suit our criteria for inclusion more closely than that of genetic modification because the drilling debate potentially engages all fields on engineering, with the exception of aerospace.

The lesson concludes with a "Go Public" assignment that asks students to choose a topic related to their particular course and make a 5-minute presentation evaluating some of the online sources concerning that topic. In our classes, this presentation will feed into the series of assignments leading up to our research paper.

Assessment

The goals of PRiME are to create modules that are transportable across Engineering disciplines and that help the departments meet the non-technical ABET criteria. Therefore, in our Spring 2005 formative assessment, we will have two faculty members from different departments assessing each lesson: one assessment will be made by the primary writer, and a second by a PRiME colleague who needs similar material for his or her course. Altogether, PRiME faculty will be testing nine lessons in five modules. In addition to the Ownership of Information and Evaluating Sources modules partially described above, we will be testing modules on

Professional Responsibility, Leadership Ethics, and Ethics in Teamwork. The assessment will be carried out by the participating faculty, the Program Coordinator, and Teaching Assistants.

For its formative assessment, PRiME will be using three tools: an on-line survey, internal assessments built into the modules, and a focus group. The online survey will be linked to the last stage of the cycle ("Go Public"), so it will be integrated with each lesson and be completed in class. The online survey will gather data on the lessons' usability and the quality of the material. Students will report on such details as the ease of navigation, the clarity of instructions, and technical difficulties with links and submissions. The quality assessment will be correlated with the lesson's stated objectives, which will be linked to ABET program outcomes.

The online assessment results will be gathered and analyzed using a software tool developed by the Faculty Innovation Center at the UT College of Engineering. This web-based survey tool, Consensus, provides capabilities not found in other, off-the-shelf survey tools; it is very flexible and generates many different reports from the data collected.

A second level or internal assessment is already built into the modules, through the use of the Challenge cycle. Students respond to one set of questions at the early "Generate Ideas" stage; later, after a significant amount of research and reading, they return to the same set of questions. In the "Copyright and Fair Use" lesson described above, for instance, students test their initial understanding of Copyright law shortly after reading the case study concerning the RIAA lawsuit. Later, after reading more on both the lawsuit and Copyright law, and holding a class discussion, they return to the same question with, we hope, a more accurate and deeper understanding of the issues involved. Thus, both students and faculty can gauge how much the students have learned through the lesson, and what adjustments or clarifications need to be made.

Our third assessment tool will be a series of student focus groups drawn from each class. The focus groups will work with a Teaching Assistant, rather than the faculty member teaching the class, in order to reduce bias and to promote frank responses. Through the focus groups, we plan to gather qualitative information on the content and locate the lacunae in the cycles in order to round out our formative assessment.

Conclusion

The PRiME project's modules on information ethics will be piloted and assessed in the spring of 2005, so an update to this paper will be provided at the June 2005 ASEE conference. The aim of the project is not simply to offer more web-based materials on engineering ethics but to demonstrate how these materials may be integrated into any engineering course. By breaking down each lesson into clearly delineated stages and by creating an Instructor Guide for all lessons, the project team aims to make it easy for engineering faculty to include at least some ethics material and discussion in their courses. Since assessment tools are built into the lessons, faculty will be able to judge for themselves how effective the modules are at improving student awareness of the complexities of professional responsibility and at preparing students to deal with them ethically. The ultimate goal is to provide both pedagogical guidance and off-the-shelf

ease of use, such that faculty in all disciplines concerned with professional responsibility in any higher education setting may use the materials and integrate them into the curriculum.

After the first four PRiME modules are assessed and revised, the project will develop modules on other topics as determined by UT engineering faculty. In the second year of the project, technical faculty will provide much of the material for modules on topics such as Design Ethics, Global and Social Responsibility, Safety, and Environmental Responsibility, with PRiME faculty coordinating the Challenge-Based-Instructional design and the pedagogical guidance built in to each lesson. By using proven educational strategies such as those outlined in *How People Learn* – providing learner-centered, assessment-centered, and community-centered environments – the PRiME team hopes to make a quantum leap in the effectiveness of teaching engineering ethics.

Bibliography

1. Grose, Thomas K. "Opening a New Book." *ASEE Prism Online.* February, 2004. http://www.prism-magazine.org/feb04/new_book.cfm. (Accessed January 5, 2005)

2. ABET. "Criteria for Accrediting Engineering Programs." 2004-2005. http://www.abet.org/criteria.html (Accessed January 4, 2005).

3. Selingo, Jeffrey. "The Cheating Culture." *Prism*.8 September, 2004: 24-30.

4. McCabe, Donald L. and Gary Pavela. "Ten [Updated] Principles of Academic Integrity." *Change.* May/June, 2004: 10-15.

5. Bransford, John. *How People Learn: Brain, Mind, Experience, and School.* Washington, D.C. National Academy Press, 2000.

6. Bridis, Ted. "Music Group Filed 261 Lawsuits Against Internet Users." *The Associated Press State & Local Wire.* September 9, 2004.

7. Shangha, Soni and Furman, Phyllis. "Sued for a Song." *Daily News* (New York). September 9, 2003, p. 3.

8. Joyce, Christopher. "Genes from Engineered Grass Spread Far." *Morning Edition.* National Public Radio. September 21, 2004. http://www.npr.org/templates/story/story.php?storyId=3928527 (Accessed January 5, 2005).

9. Comstock, Gary. *Vexing Nature: On the Ethical Case Against Agriculture Biotechnology.* Kluwer Academic Publishers, 2000.

10. Science Controversies On-Line Partnerships in Education. (2000-2005). http://scope.educ.washington.edu/ (Accessed January 5, 2005).

11. *Biotech Knowledge*. (Jan. 3, 2005). Monsanto. http://www.biotechknowledge.com (Accessed January 3, 2005).

12. *Biotech Good to Grow.* (January, 2005). Monsanto. http://biotechgoodtogrow.com (Accessed January 3, 2005).

13. *Explorations.* (2004) Monsanto. http://212.100.230.153 (Accessed January 5, 2005).

14. Monsanto Sucks. http://monsantosucks.com (Accessed January 5, 2005).

15. Fogg, B. J. *Persuasive Technology: Using Computers to Change What We Think and Do.* San Francisco: Morgan Kaufmann Publishers, 2002

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