

Strategies for Using Technology in the Teaching of Ethics

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ABSTRACT

Particularly with the advent of the World-Wide Web, the Internet has become an important tool in education, both in computer science and across the broader curriculum. This paper describes several strategies for integrating the use of the Internet into a course on computing ethics. Those strategies include using the Internet as a research tool, as a discussion medium, and as a publication channel. While some of those strategies have proved highly effective, others—particularly using the Internet for discussion—have been much more problematical. This paper outlines the problems that arise in each of these usage paradigms and describes how the course has evolved in an effort to address the shortcomings.

1. INTRODUCTION

In recent years, considerable attention has been focused on the need to integrate the study of ethics into the computer science curriculum. The increasing recognition of the importance of this topic is underscored by the appearance of several new textbooks on the social and ethical implications of computing [1, 3, 6, 8] as well as by the publication in *Communications of the ACM* of a series of articles emphasizing the need to include a strand on ethics and social responsibility within the undergraduate curriculum [7, 9, 14].

Since 1988–89, the Department of Computer Science at Stanford University has offered CS201 (Computers, Ethics, and Social Responsibility) as part of its undergraduate curriculum. All students majoring in the School of Engineering must take a course that meets the school’s technology and society requirement. In recent years, a increasing fraction of computer science majors have used CS201 to satisfy this requirement. As a result, enrollments have grown over the years, rising from 15 students in 1988–89 to 55 students in 1997–98.

In its early years, CS201 was taught jointly by my colleague Terry Winograd and Helen Nissenbaum from Stanford’s Philosophy Department. I took over the course in 1993–94. When I first taught the course, one of my goals was to increase its attractiveness to computer science majors—many of whom resist the idea of taking a course

that they regard as “fuzzy” and nontechnical. To this end, I wanted to bring more technology into the course. My hope was that computer science students, with their strong technical bias, would feel more at home with instructional methodologies that exploited computing technology in interesting ways. In particular, I tried to find opportunities to integrate the Internet into the pedagogy, both as a medium for class discussion and as a tool for student research.

The purpose of this paper is to describe my experience using the Internet in the context of CS201. Although the class now works quite well and uses technology in ways that seem quite effective, getting to this point was not as easy as I expected. Several of the assignments in CS201 have undergone considerable revision since I first taught the course, primarily because much of my early experience in the class was surprisingly negative. My experience convinces me that using Internet-based communication in a classroom setting requires considerable care, although the eventual results justify putting in the necessary time and energy.

2. THE CS201 SYLLABUS

Although the pace of technological change is so fast that I need to update my course reader each year, the list of topics and overall organization of the course has remained relatively constant since I first taught the course in 1993–94. The topics currently covered in the lectures and reading are shown in Figure 1.

Even though the course focuses primarily on ethical issues of computing, starting out with a historical

- Scientific ethics (the Manhattan Project)
- Classical ethical philosophy
- C. P. Snow’s “Two Cultures” essay
- Risks of computing technology
- Intellectual property
- The ethics of “hacking”
- Access to and control of the Internet
- Online communities
- Civil liberties and privacy in cyberspace
- Computers and the workplace
- Social issues in system design
- Computing and gender
- Utopian/dystopian visions of technology
- Codes of ethics

Figure 1. Topics covered in CS201

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ITiCSE '98 Dublin, Ireland

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discussion of scientific ethics has proven to be extremely effective, in part because the documentary film *The Day after Trinity* [2] brings to life so powerfully the moral and ethical issues that the Manhattan Project scientists had to face as they created the atomic bomb. The sections on classical ethics and C. P. Snow's "Two Cultures" essay [11] provide students with the intellectual framework they need to analyze the ethical issues raised in the rest of the course, which consists of a topical survey of various aspects of computing practice that raise interesting ethical issues.

3. ASSIGNMENTS IN CS201

In order to understand the material well enough to make it useful in their lives, students must do more than skim the reader or listen to lectures. The real, active learning experience comes from the assignments. When I designed my initial version of CS201, I decided to use the following assignments:

- A 5–7 page paper analyzing the causes and costs of a historical software failure
- A 5–7 page paper in which students apply classical ethical analysis to computing practice
- An oral debate on a controversial topic involving both computing and public policy
- An online forum about Internet policy
- A significant final project in which students undertake a comprehensive study of some aspect of computer science that raises significant ethical issues

Two of the assignments—the classical ethical analysis and the oral debate—do not involve modern computing technology in the structure of the assignment itself. The other three assignments, however, make it possible to integrate use of the Internet into the pedagogy of the course. The structure of these assignments and my experience with them are outlined in the individual sections that follow.

3.1 The Software Risks Paper

The first assignment in CS201—a paper in which students analyze the risks posed by a software failure—gives students the opportunity to use the Internet as a research tool. In this assignment, students select a historical incident in which a software failure caused significant damage, either in terms of physical injury or monetary loss. To find a topic, students rely most heavily on Peter Neumann's RISKS Forum and the associated online compendium of computing failures that Neumann maintains [10]. Although the formal requirement is simply that each paper must cite at least one electronic source, most students end up using the World-Wide Web and other Internet-based sources for the bulk of their research. This assignment, which does not use the Internet in any particularly novel way, has worked very well and has maintained the same form throughout the history of the course.

3.2 The Online Forum

In today's world, it is impossible to talk about the social implications of computing without talking about the Internet; as the Sun Microsystems slogan says, "the

network is the computer." It seemed to me that the Internet section of the course provided a perfect opportunity to use the technology as a medium for discussion as well as a subject of study. I therefore required students to participate in an online forum conducted over a ten-day period on the course newsgroup.

In its original form, the online forum assignment was not a success. As the statistics in section 4 indicate, the online forum—which involved greater use of technology than any of the other assignments—was the least well received by the students. There were several problems that led to the general sense of dissatisfaction:

- *Grades were based on individual postings.* In the first year, I assigned grades for the online forum by maintaining a log of all postings and evaluating each student's contribution to the debate as a whole. Some students reacted by posting articles on every thread to make sure that they hadn't missed any critical topic. Others reported that they felt constrained in their postings, wanting to make sure that each message was polished before sending it out.
- *Students suffered from information overload.* Partly because of the grading pressure, postings to the newsgroup quickly got out of hand. Over the ten days of the forum, 175 messages were sent to the newsgroup, representing over half a megabyte of text. Students reported that they could not keep up with the discussion.
- *There was no closure to the discussion.* At the beginning of the online forum exercise, I expressed the hope that students would try to find consensus on the question that was posed. In fact, the discussion continued to range further afield, with students devoting most of their postings to arguing out relatively small points that were in many ways tangential.

Because of the low ratings for this assignment in its first year, I changed it drastically over the next two years. The first change I made was to schedule an in-class discussion at the conclusion of the online forum. The face-to-face discussion was much more effective at producing a sense of closure. At the end of the class discussion, one student remarked that more had been accomplished in the preceding 50 minutes than in the entire ten days of the online forum.

The second change was to remove the grading pressure from the online postings. In the current version of the assignment, the grade is based on a paper that students write after completing the online forum exercise. In that paper, students must cite at least one of their own postings, which forces them to take part in the forum without having things get out of hand. This change reduced both the grading pressure and the problem of information overload. Both the number of postings and the total volume declined by approximately 50 percent.

3.3 The Final Project

In my initial conception of the course, I did not envision the final project as one that incorporated the Internet in any substantive way beyond its value as a research tool. In 1993–94, the World-Wide Web was not a mature technology, and few students had any experience

constructing web pages of their own. The final project assignment was therefore relatively traditional, requiring a 10-15 page paper. This assignment proved frustrating to students who felt that it put too much of a load at the end of the quarter when they had implementation projects due in their other, more technically oriented courses.

By 1995–96, students had so much more experience with the World-Wide Web that I was encouraged to change the final assignment to a group project in which the deliverables were a web site and an oral presentation at a day-long mini-conference. The intention was not to reduce the amount of work. On the contrary, most students spend far more time on the final project today than they did on the papers in the original course design. The point was to increase their sense of accomplishment, both by introducing collaborative learning and by having them produce a “published” product, in the sense that their projects would be available on the web.

The web-based projects have proven to be quite successful. One of the CS201 student projects from my 1994–95 course, an extremely well-researched study of the use of computers by the apartheid regime in South Africa, was selected as the winning entry in MIT’s 1997 Ethics of Science/Engineering Web Contest. Another was selected for inclusion in a forthcoming book. Moreover, the web pages from past years continue to serve as a resource for other Internet users. Professor Don Gotterbarn of East Tennessee State University, who has written extensively on computing ethics and education, made the following comments in an e-mail message:

To give [my students] a clear idea of the kinds of things that would be good, I referred them to a CS201 web page and the projects that are there. Truthfully, I was so impressed by some of the projects I saw that I thought it would be both fun and educational to have them do similar types of things.

In a similar vein, a high-school student exploring the web recently sent me the following note:

First of all—nice projects, I will try to read as many of them as possible during my free time—this thing is like a jackpot for all dedicated computer science students.

Projects from 1995-96	Projects from 1997-98
Autonomous weapons	The changing nature of work
Liability law and software development	Pricing proposals for the Internet
Use of the Internet by terrorist organizations	Pricing of the Internet: An analytical overview
Computer addiction	The effects of technology on interpersonal skills
Computers in the classroom	Optical media and intellectual property issues
The danger of corporate monopolies	Microsoft vs. the Department of Justice
Applying local/national laws to global networks	The effect of computers on the gender gap in education
The use of public-key encryption systems	The ethics of “spam”
The Clipper Chip	The Internet and domain names
Electronic monitoring in the workplace	Barriers to access based on race and class
Vulnerability of computerized vote-counting systems	Databases in cyberspace: Maintaining individual privacy rights
	Defamation and the Internet

All project web pages are available from the course home page at <http://cse.stanford.edu/classes/cs201>

Figure 2. CS201 Projects

At the end of the quarter, I distribute an informal survey in which I ask students to evaluate each CS201 assignment using the following scale:

useless		helped some		very helpful
1	2	3	4	5

The overall class rating at the end of the table is taken from the course evaluations conducted by the School of Engineering and are expressed as a percentile against other courses in the school.

Assignment	1993-94	1995-96
Paper #1 (software risks)	3.73	3.79
Paper #2 (ethical analysis)	3.63	3.43
Oral classroom debate	4.04	4.27
Online debate	3.33	3.75
Final paper/project	3.68	4.04
Class rating (percentile)	62	89

Figure 3. Evaluation of assignments

The list of projects from the past two offerings of the course is shown in Figure 2, along with the web page for the site.

4. EVALUATION AND CONCLUSIONS

At the end of the course in 1993–94 and again in 1995–96, I conducted a survey in which I asked students to evaluate the utility of each assignment. The results of that survey are shown in Figure 3.

As the data in the table make clear, student satisfaction with both the online debate and the final project increased substantially after the changes were introduced. This improvement was also reflected in the overall course evaluations, which between these years rose from the 62nd to the 89th percentile relative to other courses in the School of Engineering.

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