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Embedding an Ethics Component in an Undergraduate Senior Project Class

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ABSTRACT

Technology-related ethics is a well-established requirement in Information Systems and Computer Science model curricula. However, exactly where and how these principles and skills should be taught is an open issue. This paper extends Cougar's use of scenarios in which the student must decide what he or she will do in an ethical situation to include the concept of creating an ethical team norm. It also broadens the scope of Martin's call to inject ethical issues throughout the different stages of the software development cycle in a project-driven capstone course with the inclusion of project management. The course requirement to deliver an information system while following a development methodology by the end of the quarter gave the students an opportunity to practice project management skills in a "live" environment. This paper discusses one university's success in using a framework that incorporates ethics into a team-based, project-driven senior capstone class.

BACKGROUND

Need For Ethics in the Curriculum

The need for computer science and technology-related ethics is well-established. As early as 1977, the National Science Foundation sponsored an ethics workshop where participants developed scenarios to facilitate technology-related ethics discussions (Athey, 1993). The Brookings Institution's Computer Ethics Institute has created Ten Commandments of Computer Ethics (Brookings Institute, 2003). As shown in Table 1, professional organizations have developed codes of ethics. Model curricula have been designed to include an ethics component. The ACM and IEEE-CS Computing Curricula 2001 includes among its advanced courses "Computers and Ethics" (CC2001 Report, 2001). The Curriculum Model 2000 of the Information Resource Management Association and Data Administration Managers Association recommend the study and application of methods for ethical analysis in several courses (Cohen, 2000). The Association for Computing Machinery (ACM), the Association for Information Systems (AIS) and the Association of Information Technology Professionals (AITP) jointly authored IS 2002, Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems, which called for embedding ethics in a variety of courses throughout the curriculum (Gorgone et al., 2002). This need for an ethical component in the CS and IS curricula is based, at least in part, on a belief that students lack sufficient grounding in ethics. In a study of 65 upper-class and graduate students, Athey (1993) found that "current students in high-tech majors have significantly different ethical opinions than older, more experienced experts." She concluded that students need to analyze and discuss technology-related ethical issues from a variety of angles, in order to prepare them for the issues that they will face in the workplace.

Table 1: Sampling of Professional Codes of Ethics

HKCS	Hong Kong Computer Society	Code of Ethics and Professional Conduct	www.hkcs.org.hk
BCS	British Computer Society	Code of Conduct	www.ccsr.cse.dmu.ac.uk
ACS	Australian Computer Society	Code of Ethics	www.acs.org.au
CIPS	Canadian Information Processing Society	Ethics and Standards of Conduct	http://www.cips.ca/about/ethics/
IMIS	Institute for the Management of Information Systems	Code of Ethics	www.imis.org.uk
ACM	Association for Computing Machinery	Code of Ethics and Professional Conduct	www.acm.org/constitution/code.html
IEEE	Institute of Electrical and Electronics Engineers	Code of Ethics	http://www.ieee.org/portal/index.jsp?pageID=corp_level1&path=about/whatis&file=code.xml&xsl=generic.xsl
Joint	ACM / IEEE CS	Software Engineering Code of Ethics and Professional Practice	www.acm.org/serving/se/code.htm

Content and Nature of Ethics Education

ProjectImpact CS, supported by the National Science Foundation, outlined the ethical and social principles and skills that computer science undergraduates should address. These are summarized in Table 2.

Exactly where the principles and skills in Table 2 should be taught is an open issue. Huff and Martin (1995) called for ethics to be taught throughout the curriculum, in addition to being taught in specific courses. They argued that integration insures repeated contact and a contextual grounding for the ethical issues, while specific courses insure sufficient coverage. Later, in a slight shift of opinion, Martin et al. (1996) listed three alternative implementation strategies: stand-alone courses, integration into existing courses, and incorporation within a project-driven capstone course. In such a capstone, the class forms project teams to

Table 2: Ethical and social principles and skills (Huff & Martin, 1995)

	Ethical	*Social*
Principles	• Ethical claims can be discussed rationally • Ethical claims must be defended with reasons • Ethical choices cannot be avoided • Some easy ethical approaches are questionable	• Social context influences the design and use of technology • Power relations are central in all social interaction • Technology embodies value decisions made by designers • Empirical data is crucial to the design process
Skills	• Arguing from example, analogy, and counter-example • Identifying ethical principles and stake holders in concrete situations • Identifying and evaluating alternative courses of action • Applying ethical codes to concrete situations	• Identifying and interpreting the social context of a particular implementation • Identifying assumptions and values embedded in a particular design • Evaluation, by use of empirical data, a particular implementation of technology

address larger scale development projects. Martin et al. noted that ethical issues can arise in a senior practicum or project course in either of two ways: through the different stages of the software development cycle, or through general professional obligations. They suggested two strategies for involving students: asking them to write a one page paper about a particular approach, or asking them to write a social impact statement, similar to an environmental impact statement.

Couger (1989) described his experiences with three pedagogical approaches to the teaching of ethics to Information Systems students. The first approach, a lecture, followed by a requirement that students compare various codes of ethics, was seen by students as remote and uninteresting. The second approach, using practitioner literature to provide students with examples of how professionals dealt with various ethical situations, still failed to reach the majority of students. The third approach emphasized the use of scenarios in which the student must decide what he or she will do. This approach, which Couger called "personalization", involved students by requiring them to decide how to handle various situations, and to come to grips with how their individual response differed from the group norm and from the response of experts. Cougar believed that increased honesty, measured through reduced collusion and cheating in his course, was an indicator of the effectiveness of this third pedagogical approach, personalization. The personalized approach is also supported by Huff and Martin's principles and skills in Table 2. Implicit in this table is a recognition that students must not only be exposed to ethical principles, but that they must also be given the opportunity to develop the cognitive abilities needed to recognize and evaluate ethical dilemmas. Thus the table provides an argument that the teaching of ethics must, by its very nature, be an interactive, hands-on process.

A SUCCESSFUL IMPLEMENTATION

Framework for Incorporating Ethics into a Projects Class

The senior capstone course for the Bachelor of Science in E-Commerce Technology at DePaul University's School of Computer Science, Telecommunications and Information Systems integrates topics of social responsibility and ethics in the information age as they relate to the development of a complex Web information system. Students in this course have taken classes in systems analysis and design techniques, database technologies, and a minimum of six programming courses covering Java, Visual Basic, HTML, JavaScript, XML and ASP.Net.

The capstone course described here was taught in autumn 2002. The students were required to follow a system development methodology as well as practice project management skills to deliver a client-approved Web information system at the end of the quarter. The project was to develop a Website for the Illinois Coalition for Immigrant & Refugee Rights (ICIRR). ICIRR is dedicated to promoting the rights of immigrants and refugees to full and equal participation in the civic, cultural, social, and political life of our diverse society (ICIRR, 2003). To begin the requirements analysis, the executive director and communications coordinator of the ICIRR presented the unique characteristics of not-for-profit organizations and the ICIRR in particular. In conjunction with the ICIRR representatives, the students formulated a strategy statement for the Web information system. During a simplified Joint Application Development (JAD) session, the students presented the representatives with a system requirements document. Complete analysis and design documents, e.g. process descriptions, dataflow diagrams and entity relationship diagrams, were required. Throwaway prototypes were developed to demonstrate the students' understanding of the requirements. Usability tests were performed on the final iteration. The site was heavily populated with links and PDF documents. A test plan was implemented to assure ICIRR of quality of service. Students considered issues such as software piracy, privacy, information warfare, multi-cultural presentation and the Digital Divide as these issues related to the project. Table 3 uses project requirements to identify those points in the project development cycle where discussions of ethics and social responsibility were embedded. Each of these six points was used to provide the opportunity for students to consider their own individual ethical standards, and then to gather with their teammates to develop a team norm.

Table 3: Key points for ethical discussion during the project development process

Project Requirements	Social Responsibility/Ethics
1. Project Plan	Social responsibility in Project Management
2. Strategy Statement	Information Warfare, Security, Freedom of Speech and Digital Divide
3. System Requirements	Privacy and confidentiality
4. Usability Testing	Multi-cultural presentation
5. Test Plan	Quality and reliability of information
6. Functioning System	Software piracy

1. Project Plan

Social responsibility in IS/IT Project Management was discussed in the context of a stakeholder approach, wherein any group or individual who can affect or is affected by the achievement of the organization's objectives has a social responsibility to the organization, users and financial supporters. The role of the Project Manager was defined through duties and responsibilities owed to others:

- the client through time management, accurate reporting, clear communication and quality control;
- the project team as coordinator and evaluator;
- the future persons who will maintain or improve the programs by providing complete documentation and non-idiosyncratic code; and
- the users by providing a reliable and dependable Web information system.

2. Strategy Statement

The strategy statement required from the students included the purpose of the Web information system, the definition of the target audience and the technology to be employed. In addition, the specific challenges faced by the not-for-profit client were to be addressed. Readings and in-class discussions centered on information warfare, security and freedom of speech and how these concepts would be applied in the system.

Information warfare was defined as "operations that target or exploit information media in order to win some objective over an adversary" (Szewczak, 2000). According to the Journal of Business Strategy, the top trend in 2001 specifically targeted the acceleration of economic information warfare as a global threat against entire economies, commerce and enterprises (Anonymous, 2001). Classroom discussion broadened the definition to include segmented populations such as immigrants and refugees, the project's target audience. Security issues centered on theft of personal information, the risk to the target audience and the technical solutions that could be implemented to prevent such an occurrence. Web content and its restrictions based on "community standards" as defined by the 1996 Communication Decency Act versus Freedom of Speech as guaranteed by the Constitution were debated. The attack of September 11, 2001 and its effect on the American people was the impetus for these discussions. The ability to access information via the World Wide Web by the project target audience of immigrants and refugees led the discussion on the Digital Divide. It was verified by the client that the target audience would primarily access the site through public availability in locations such as libraries.

3. System Requirements

A social contract is not established if the consumer is unsure of the process followed by an online business in protecting personal information. Consent must be given to divulge information. These issues of privacy and confidentiality were discussed through business cases such as DoubleClick's plan to merge its consumer Web surfing database with its consumers' mail-order-catalog purchases database (Center for Democracy & Technology, 2000), RealJukeBox data capture about a consumer's musical selection without consent (Robinson, 1999), and US Bancorp US$3,000,000 settlement for having sold personal information to a direct marketer (Directnewsline, 1999). A key component of the Online Privacy Alliance is notice and disclosure (Online Privacy

Alliance, 2003). The inclusion of ICIRR's online privacy policy was a listed item in the project system requirements. The Federal Trade Commission's report on online privacy (Federal Trade Commission, 1999) was reviewed for compliance with respect to the ICIRR's Website.

4. Usability Testing

Since the Web is intrinsically a global medium, a visitor's culture will influence an optimal navigation experience (Luna et al., 2002). Cultural preferences such as font, date notation, currency, color sensitivity and use of images and symbols may impact what is deemed "user friendly" (Badre and Laskowski, 2001). An analysis of the project target audience was conducted in light of these considerations. Alternative navigation schemes, such as site maps, indexes, and search engines were considered. An additional requirement was to consider accessibility issues and test the Website at http://bobby.watchfire.com/bobby/html/en/index.jsp for ease of use by persons with disabilities: "Bobby is a comprehensive web accessibility software tool designed to help expose and repair barriers to accessibility and encourage compliance with existing accessibility guidelines. Bobby tests for compliance with government standards, including the U.S. Government's Section 508. It offers prioritized suggestions based on the Web Content Accessibility Guidelines provided by the World Wide Web Consortium's (W3C) Web Access Initiative."

5. Test Plan

The content of the Website students were developing was laden with links to legislative updates (HTML and PDF files), critical immigration and naturalization dates, and available resources. The students performed unit, link and system tests to ensure that all information was accurate and links were not broken. The target audience profile suggested a novice user who would become easily frustrated and a high potential of abandoning the site if this information was not readily accessible. The client stressed the need for quality assurance and reliability.

6. Functioning System

A system requirement in the students' project was to include a search feature. Many relied on Yahoo!, which provides the HTML code needed to add their search engine to a Website. The importance of citing the origin of this code led to a discussion of software piracy, both compiled applications, e.g. games, and "lifting" code from other Websites.

DISCUSSION

The approach taken in this course followed Martin et al.'s implementation strategy of incorporating ethical issues through the different stages of the software development cycle. This class extended the model to include project management. Throughout their major field coursework, students were not exposed to the challenges of working with "real clients" on "live projects" nor with the unpredictability and risk associated within this project environment. Project management was required to assign responsibility and authority for achievement of the client's goals while working within the course requirement of following a development methodology when building an information system. The resolution of conflicting user requirements and containing scope creep were the biggest challenges for the project leader and team, far more significant than any technical challenge.

As each project requirement was reviewed, a lecture on the ethical concept was given followed by discussion of cases that were applicable and finally integrated in the project. Following Cougar's approach that emphasized the use of scenarios in which the student must decide what he or she will do and Martin et al.'s strategy for involving students by writing a one-page paper, each student answered the question individually. Each team was then instructed to reach consensus on the answer as an extension of Cougar's "personalization" approach and Martin's strategic use of writing. For example, after a lecture on social responsibility in project management, the students were asked to individually commit to paper a two or three paragraph answer to the following question:

Your e-commerce senior project class requires three-member groups to develop a Web information system. You have been chosen Team Leader for your project group. The instructor makes it very clear that points will be deducted for late submission and extra credit points will be awarded for early submission of the project deliverables. If plagiarism, in this case software piracy, is detected, the entire group will get a failing grade for the course. Coding will be done during the lab section of the course in the 7th floor e-commerce software lab. As you know, this lab is shared by e-commerce upper-level undergraduate and graduate students. You discover one of your team members has copied a piece of copyrighted software onto a lab system to carry out his/her share of the project without the other member's knowledge. You call a team meeting to discuss the situation. One member thinks that the software should be removed because he/she is worried that another student in the class will report to the instructor that your group has copied pirated software into a lab system which will result in a failing grade for the course. The member who copied the software refuses to uninstall the product. His/her reason is that the software is able to speed up their work such that the whole project can be finished earlier to earn the extra credit. As leader of the group, what do you do?

The students were instructed to be completely honest in answering the question since it had no impact on their grade and was for discussion purposes. They were also to provide the line of reasoning in their answer formulation. Student teams then met to construct an answer that became a guideline for team behavior. As the teams emerged with an agreed-upon method of operating, they entered Tuckman's "norming" phase (Tuckman, 1965). The result was team members were able to reconcile their own initial opinions with the greater ethical context of the team.

Anecdotal evidence from faculty at the authors' university identifies a recent increase in the rate of plagiarism of computer code. The availability and ease of copying code from the World Wide Web has increased these occurrences as seen by the proliferation of plagiarism cases. There were no known instances of plagiarism in this course which can be used as an indicator of the effectiveness of this approach. Unfortunately, the successful integration of ethics within this course occurred at the conclusion of the students' college career. It is the authors' opinion that an advantage to using the Huff and Martin (1995) suggestion of introducing these concepts throughout the curriculum may have the desired effect of reducing plagiarism in early programming classes.

CONCLUSION AND FUTURE RESEARCH

Students in this capstone course integrated system development methodology and project management skills while infusing ethical discussions and decisions in the construction of a Web information system for a not-for-profit association. The students found the challenges of managing the development of a complex system was not with technology but with "people" issues, e.g. conflicting user requirements and scope creep. Ethical scenarios were provided within each development phase to foster discussion and allowed each student to reflect on their own personal code of conduct. Each student's personal code of conduct became a contributing factor to building team norms. Developing norms gave team members an opportunity to express what was important to them and discover what was important to their teammates. This built trust and discipline between team members. In the cited example, the students developed a team norm against plagiarism.

A discussion of ethics should be introduced as early as possible in the computer science and technology-related curricula and should be continued throughout the entire curriculum. Each ethical question examined should involve the student through the use of scenarios that will affect both their present collegial and future professional work. The culmination of applied ethics can be integrated in a team-based, project-driven senior capstone. Future research plans include administering a questionnaire describing scenarios that require ethical decisions at the beginning of the course and then administering the same questionnaire at the end of the class. Other plans include introducing ethical discussions in earlier courses to determine the effect on class behavior, e.g. reduction in the instances of plagiarism.

REFERENCES

Anonymous (2001, Nov/Dec). The top trends in the future of security. *Journal of Business Strategy*, 22:6, 4.

ACM / IEEE CS (2003). *Software Engineering Code of Ethics and Professional Practice*. Retrieved September 25, 2003 from www.acm.org/serving/se/code.htm.

Association for Computing Machinery (2003). *Code of ethics and professional conduct*. Retrieved September 25, 2003 from http://acm.org/constitution/code.html.

Athey, S. (1993, May). A comparison of experts' and high tech students' ethical beliefs in computer-related situations. *Journal of Business Ethics*, 12:5, 359-370.

Australian Computer Society (2003). *Code of ethics*. Retrieved September 25, 2003 from www.acs.org.au

Badre, A. & Laskowski, S. *The cultural context of web genres: content vs. style*. Retrieved September 25, 2003 from ftp://ftp.cc.gatech.edu/pub/gvu/tr/2001/01-01.pdf.

Bobby (2003). Retrieved September 25, 2003 from http://bobby.watchfire.com/bobby/html/en/index.jsp.

British Computer Society (2003). *Code of conduct*. Retrieved September 25, 2003 from www.ccsr.cse.dmu.ac.uk.

Brookings Institute (2003). *Ten commandments of computer ethics*. Retrieved September 25, 2003 from http://www.brook.edu/ITS/CEI/CEI_HP.HTM.

Canadian Information Processing Society (2003). *Code of ethics & standards of conduct*. Retrieved September 25, 2003 from http://www.cips.ca/about/ethics/.

CC2001 Report (2001). *Computing curricula 2001 computer science volume*. Retrieved September 25, 2003 from http://acm.org/sigcse/cc2001.

Center for Democracy & Technology (2000, Mar 2). *Doubleclick puts hold on tying personal info to online habits*. Retrieved September 25, 2003 from http://www.cdt.org/action/doubleclick.shtml.

Cohen, E. (ed) (2000). *Curriculum model 2000 of the information resource management association and the data administration managers association*. Retrieved September 25, 2003 from http://gise.org/IRMA-DAMA-2000.pdf.

Couger, J. D. (1989, June). Preparing IS students to deal with ethical issues. *MIS Quarterly*, 13:2, 211-218.

Directnewsline (1999, Jul 1). *Direct Marketing Business Intelligence*. Retrieved September 25, 2003 from http://www.directmag.com/ar/marketing_directnewsline/.

Federal Trade Commission (1999, Apr 30). *Online Privacy*. Retrieved September 25, 2003 from http://www3.ftc.gov/reports/privacy3/priv-23.htm.

Gorgone, J. T., Davis, G. B., Valacich, J. S., Topi, H., Feinstein, D. L., & Longenecker, Jr., H. E. (2002). *IS 2002: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems*. Retrieved September 25, 2003 from http://www.acm.org/education/curricula.html#IS2002.

Hong Kong Computer Society (2003). *Code of ethics and professional conduct*. Retrieved September 25, 2003 from www.hkcs.org.hk.

Huff, C. & Martin, C. D. (1995, Dec). Computing consequences: a framework for teaching ethical computing. *Communications of the ACM*, 38:12, 75-84.

Illinois Coalition for Immigrant & Refugee Rights (2003). Retrieved September 25, 2003 from http://www.icirr.org/info.asp.

Institute for the Management of Information Systems (2003). *Code of ethics*. Retrieved September 25, 2003 from www.imis.org.uk.

Institute of Electrical and Electronics Engineers (2003). *Code of ethics*. Retrieved September 25, 2003 from http://www.ieee.org/portal/index.jsp?pageID=corp_level1&path=about/whatis&file=code.xml&xsl=generic.xsl

Luna, D., Peracchio, L. A., & de Juan, M. D. (2002, Fall). Cross-cultural and cognitive aspects of Web site navigation. *Academy of Marketing Science Journal*, 30:4, 397-410.

Martin, C. D., Huff, C., Gotterbarn, D., & Miller, K. (1996, Dec). Implementing a tenth strand in the CS curriculum. *Communications of the ACM*, 39:12, 75-84.

Online Privacy Alliance (2003). Retrieved September 25, 2003 from http://www.privacyalliance.org/resources/OPA_brochure.pdf.

Robinson, S. (1999, Nov 1). *CD software is said to monitor users' listening habits*. Retrieved September 25 from http://www.nytimes.com/library/tech/99/11/biztech/articles/01real.html.

Szewczak, E. (2000, Jan-Mar). Information warfare and security. *Journal of End User Computing*, 12:1, 44.

Tuckman, B. W. (1965). Developmental Sequence in Small Groups. *Psychological Bulletin*, 63:6, 384-399.