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.

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 1: Sampling of Professional Codes of Ethics

<table>
<thead>
<tr>
<th>Organization</th>
<th>Code of Ethics and Professional Conduct</th>
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<tbody>
<tr>
<td>HKCS</td>
<td><a href="http://www.hkcs.org.hk">www.hkcs.org.hk</a></td>
</tr>
<tr>
<td>BCS British Computer Society</td>
<td><a href="http://www.esr.esdmu.ac.uk">www.esr.esdmu.ac.uk</a></td>
</tr>
<tr>
<td>ACS Australian Computer Society</td>
<td><a href="http://www.acs.org.au">www.acs.org.au</a></td>
</tr>
<tr>
<td>CIPS Canadian Information Processing Society</td>
<td><a href="http://www.cips.ca/about/ethics/">http://www.cips.ca/about/ethics/</a></td>
</tr>
<tr>
<td>IMS Institute for the Management of Information Systems</td>
<td><a href="http://www.ims.org.uk">www.ims.org.uk</a></td>
</tr>
<tr>
<td>ACM Association for Computing Machinery</td>
<td><a href="http://www.acm.org/constituents/code.html">www.acm.org/constituents/code.html</a></td>
</tr>
<tr>
<td>IEEE Institute of Electrical and Electronic Engineers</td>
<td><a href="http://www.ieee.org/portal/index.jsp?pageId=corp_level1&amp;path=about/whatisk&amp;file=code.tmldaskell=/generic.xsl">http://www.ieee.org/portal/index.jsp?pageId=corp_level1&amp;path=about/whatisk&amp;file=code.tmldaskell=/generic.xsl</a></td>
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<table>
<thead>
<tr>
<th>Principles</th>
<th>Social</th>
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<tbody>
<tr>
<td>• Ethical claims can be discussed rationally</td>
<td>• Social context influences the design and use of technology</td>
</tr>
<tr>
<td>• Ethical claims must be defended with reasons</td>
<td>• Power relations are central in all social interaction</td>
</tr>
<tr>
<td>• Ethical choices cannot be avoided</td>
<td>• Technology embodies value decisions made by designers</td>
</tr>
<tr>
<td>• Some easy ethical approaches are questionable</td>
<td>• Empirical data is crucial to the design process</td>
</tr>
</tbody>
</table>

| Skills | |
|--------| |
| • Arguing from example, analogy, and counter-example | • Identifying and interpreting the social context of a particular design |
| • Identifying ethical principles and stake holders in concrete situations | • Identifying assumptions and values embedded in a particular design |
| • Identifying and evaluating alternative courses of action | • Evaluation, by use of empirical data, a particular implementation of technology |
| • Applying ethical codes to concrete situations | |

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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.

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-idiiosyncratic 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

<table>
<thead>
<tr>
<th>Project Requirements</th>
<th>Social Responsibility/Ethics</th>
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<tbody>
<tr>
<td>1. Project Plan</td>
<td>Social responsibility in Project Management</td>
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<tr>
<td>3. System Requirements</td>
<td>Privacy and confidentiality</td>
</tr>
<tr>
<td>4. Usability Testing</td>
<td>Multi-cultural presentation</td>
</tr>
<tr>
<td>5. Test Plan</td>
<td>Quality and reliability of information</td>
</tr>
<tr>
<td>6. Functioning System</td>
<td>Software piracy</td>
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</tbody>
</table>

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

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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

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