

A Truly Interdisciplinary Course Grounded in Computer Science

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Abstract

We present a truly interdisciplinary version of a course in Information Technology, Ethics, and Society. A single offering of this course is taught by faculty from two unique disciplines, with one being a Computer Science faculty member from the School of Engineering and the other varying with time but always representing a separate school within our university. Most recently, full-time faculty from Philosophy and Mass Communications departments have represented the complementary half of the interdisciplinary nature of the course.

The course itself is open to all majors from across our entire university and requires no prior computing background of its enrolled students. Interestingly, our university requires all of our undergraduate students to complete at least one course designated as interdisciplinary before graduating. The primary goal of this course requirement is to engage students in an interdisciplinary approach to subject material; students are expected to see and explore the bridge between the disciplines involved in the course. This tends to challenge all students in the course, even if they are actively studying one of the directly involved disciplines.

As the course is open to students who may not have any computing (or engineering) background, one of the primary topics needs to be an introduction to various computing technologies - from both a utilization and a technical perspective. The course also includes coverage of ethics as it relates to information technology, making it pertinent as a practical course in applied ethics. Furthermore, the course covers legal ramifications of technology usage, thus also grounding students in the legal facets of technology usage and development.

The course has been offered regularly over the past few years at our institution, utilizing dedicated full-time faculty from both Computer Science and two other non-engineering departments. This paper outlines our course, including the background to the development of the course, basic topics covered by the course, teaching methodologies utilized in the classroom, and a discussion of the course's outcomes.

Key Words

Interdisciplinary Approaches, Education Methods

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Introduction

Over the years, many interdisciplinary courses that involve Computer Science have been offered by various institutions. In fact, Computer Science itself was often originally thought of as an interdisciplinary subject rather than an independent discipline of its own¹. Currently, some attempts have been made at making introductory information technology courses incorporate an interdisciplinary flair by incorporating ethics into their curriculum². Unfortunately, many incoming students no longer take such introductory courses, as they have either already had them in high school or avoid taking them altogether due to fear of the technical nature of the classes. In an effort to enroll some of these students, some institutions offer a second course in information technology for non-majors³ that includes topics in ethics. Other institutions attempt to build a non-introductory interdisciplinary course in Computer Science by incorporating business, science, or engineering concepts that have computing needs as a “bridge” to concepts in Computer Science⁴; unfortunately, these courses tend to exclude students outside of the “bridging” discipline (including Computer Science majors) and also do not cover ethical issues.

To help increase exposure to ethics, many institutions offer a course in Ethics of Computing that is intended for (or even required of) Computer Science majors⁵,

sometimes allowing non-majors to enroll simultaneously. This course is often (although not always) taught either by Computer Science faculty alone (where the emphasis is often on technical aspects with ethical side notes) or in the complete absence of Computer Science faculty (where the emphasis is on ethics with little technical grounding). Such approaches are certainly lacking a truly interdisciplinary perspective on the topic. Given this wide range of options, it is unclear how a course on computing, ethics, and society should be taught, or even who should teach such an offering⁶. In this paper we summarize a truly interdisciplinary version of such a course called *Information Technology and Society*. Instead of having faculty members from just one discipline teach the course, faculty members from at least two disciplines co-teach each offering of the class, making it truly interdisciplinary in nature.

Motivation

One of the requirements for all undergraduate students at Southern Illinois University - Edwardsville (SIUE) is to complete an *interdisciplinary studies* course. The only prerequisite for students to enroll in the course is to have at least Junior standing; no explicit course prerequisites are required. Each interdisciplinary studies course is taught by (at least) two faculty members from different departments within the university. In fact, these different faculty members are often from different schools within the university. The primary goal in this course is to ensure that students are exposed both to material found in multiple disciplines as well as to the interrelation between those disciplines. The Computer Science department worked with the Philosophy department to develop such an interdisciplinary studies course entitled *Information Technology and Society*, first offering the course in 2003. Since its inception, the course has been taught by three different members of the Computer Science department, two different members of the Philosophy Department, and two members of the Mass Communications Department. While the course has always included a Computer Science faculty member as one of the instructors, the other member of the interdisciplinary team has varied with time - which has made the course dynamic and interesting.

Course Content

The content of this interdisciplinary course can change between offerings, depending on the contributing academic departments. Even the emphasis of Computer Science concepts can change from semester to semester as different Computer Science faculty members teach the course. Nonetheless, there is a set of core material that is always covered in the

course, including introductory Computer Science concepts, Philosophical basics, and issues in Mass Communications.

Computer Science Topics

While there is no guarantee of enrolled student backgrounds in information technology, it is nonetheless possible to introduce a wide range of Computer Science concepts in the course. Typically, the first Computer Science oriented lecture involves a brief “history of computing”, ranging from the abacus through Babbage's Engine, the ENIAC, and finally ending up at today's laptop computers, cellphones and PDA's. This tends to lead naturally to an introduction to what constitutes a computer program and resulting software. With this grounding, the course can explore many specializations within Computer Science, always taking care to ensure that the concepts can be related to societal issues. A good example of this is the concept of encryption; this can be introduced by looking at a cryptogram puzzle found in today's newspaper (or an on-line equivalent therein). The importance of encryption can also be emphasized with historical perspectives like the ancient Roman military or the German Enigma machine from WWII. Students can also be introduced to the flaws in these systems (i.e. public key issues) and the current practice of utilizing public/private keys to avoid these flaws. Although the actual implementation details of such encryption schemes are beyond the scope of the class, lessons in their use and their effectiveness have been successful. Surprisingly, many of these concepts were new to Computer Science students as well as to others who use encryption on a daily basis in environments like secure web surfing.

Since so much of what makes up today's information technology field is network based, it is important to include a discussion of how computer networks function. This can be introduced by asking students to pass messages around the classroom, with each student acting as a router. Very quickly, students run into congestion problems and routing decisions - issues at the heart of contemporary research in networking. Furthermore, students tie into the need for encrypting data sent through networks when they realize that their fellow classmates (routers) can read every message that they encounter.

Many other technical concepts can be introduced in such a course, including a basic overview of graphical image formats, steganography, viruses, open source software concepts, etc... In fact, the only real constraint is to ensure that the material covered has some societal impact or ethical issue that could be tied in with material from other colleagues co-teaching the course; that is, the material should form a supporting portion of the course's interdisciplinary “bridge”.

Philosophy Topics

An introduction to ethics is included in the course, in order to give students grounds from which to make sense of the societal issues that are raised through use of information technology in today's world. While there are certainly philosophical topics outside of ethics that would be relevant, such as whether a computer could be capable of genuine thought, ethical issues are most relevant to the students' needs and interests. The first step is to introduce the students to the major schools of ethical theory by giving a basic introduction to deontological, teleological, and virtue ethics. Following this, an overview of the positions of specific influential ethicists is presented, including Aristotle, Immanuel Kant and John Stuart Mill. General ethical questions are raised at this point regarding the permissible uses of government authority, the extent of human rights, and what individuals owe to one another.

Discussion of issues in applied ethics is utilized to enhance the topics raised by the lecturer from the Computer Science department. Moral ramifications and controversies arising from the technologies and procedures being described are discussed, including issues involving privacy and personal information, freedom of speech, intellectual property rights and professional ethics. Specific questions that are particularly liable to be addressed include “to what degree should a government be able to monitor Internet activity in the home?”, “to what degree should an employer be able to monitor Internet activity in the workplace?”, “to what degree should businesses be permitted to share information about individuals, particularly medical information?”, “is there a moral duty to provide Internet access to the poor?”, “is Internet piracy wrong? is it analogous to theft?”, “Should there be special restrictions as to what may be accessed from schools or public libraries and if so, what should those restrictions be?”

Mass Communications Topics

For many non-computer science students, computers remain primarily a tool of communication. Therefore, it is essential that this course discuss prevalent computing concepts and technologies in this context. Two very important and interrelated topics covered in the course are privacy concerns and surveillance issues. These are certainly familiar topics to most students, primarily due to repeated media exposure to the debates surrounding controversial legislative actions and government practices after September 11. Coverage of these topics, however, should extend beyond current debates and practices by including a brief historical examination of major developments, landmark legislative acts and court decisions. A related issue presented in the course is privacy/surveillance at the work place -what rights employees enjoy (or do not enjoy), what surveillance practices are in place, and what rationalizations and arguments have been proposed (e.g. hostile work environment theory). Most students tend to respond well to such topics. In end-of-semester course evaluations, many students indicated they did

not pay attention or were not aware of many issues before this class, and they have learned to look at those issues very differently.

Freedom of speech is navigating into new terrains in the on-line world. So there is an extensive discussion of First Amendment issues in relation to information technologies - which would be incomplete without the exploration of the latest legislative acts since the mid-1990s. We encourage students to engage in debating issues such as whether computer code constitutes free speech. A natural extension of this discussion is the development and implementation of filtering software and its legality in different contexts.

Another equally important topic is intellectual property (e.g. copyright and patent) rights in the networked era. Students need to have a good understanding of what is protected by current (domestic and international) laws and how infringements can occur. There are numerous Napster-like cases that can serve as material for discussion. Additionally, there is also a fair amount of attention to computer crimes. Since it is necessary to mention existing laws and codes, a great deal of effort is made to make them relevant to information technology in general and to students in particular. We also try to provide a local perspective on things by examining pertinent state and local laws on related issues. In order to offer an alternative view to the hegemonic perspective of the establishment, the course also touches upon the sociocultural and political aspects of the hacker culture and the open source software campaign. Popular participation from Youtube to E-Bay has been a defining feature of new information and communication technologies. Therefore, we also spend some time in encouraging students to think about the implications for political involvement and democracy.

Current Topics

Issues related to the impact of information technology on society are constantly being discussed by today's news media, giving the course ample amounts of contemporary material for class discussion. One recent example of such is a discussion as to whether or not there is such a thing as "addiction to information technology". Many other events warrant inclusion also, such as computer system failures at airports, "new" virus releases, e-mail scams, federal and international government infringements on access to the Internet, and so on. However, one must take care to expose students to both sides of the issue discussed, as many media articles have a political bias to them. This can be overcome by utilizing several articles supporting various perspectives on the same issue.

Reading Materials

As one might expect, choosing appropriate readings for such a course proves challenging. Finding a textbook that covers computing ethics alone leaves a plethora of choices⁷. Fortunately, in our case, the list was culled by removing books requiring a technical background, as many students in the class do not possess such skills. However, the task is made more difficult since the course also incorporates a discussion of societal impacts and philosophical issues. After a long search, we settled on *A Gift of Fire* by Sara Baase⁸, which introduces Philosophical viewpoints, discusses Computer Science concepts without great technical detail, and outlines basic issues in Mass Communications. However, in the context of our course, this text lacks significant depth in Philosophy and Mass Communications. The dynamically changing nature of faculty assigned to the course adds to the difficulty in choosing appropriate texts covering disciplines outside of Computer Science; instead scholarly works covering more detailed material can be given as supplemental handouts. For example, supplemental handouts on topics such as RFID, privacy, and resulting societal issues⁹ can also be utilized to discuss more technical Computer Science Concepts as well as their impact on society.

Challenges Faced

Offering an interdisciplinary class of this nature faces significant challenges. One challenge faced with this interdisciplinary course is that students enrolled in the class come from diverse backgrounds. Some students have grown up in affluent environments where they have been exposed to computing since pre-school, while others were lucky to see a single (often obsolete) computer by the time they graduated from high school. While it is true that most of today's students have grown up in an environment where cell phones, DVD players, and other artifacts of the information technology age are commonplace, typically several students enrolled in the class come from socio-economic backgrounds where they simply have not grown accustomed to having (and thus using) such technology.

Since the class is one of a pool of possible required courses from which the entire university undergraduate population chooses, students with various academic specializations take the class. Thus, there is no guaranteed background of any sort to students in the class. Certainly, there is no guarantee that the students know how to program; a few do not even know how to use a word processor or are literally afraid of

using computers. Beyond that, there is no guarantee of a mathematical background to students in the class (some students have delayed taking basic algebra until late in their college careers, while others have already completed differential equations or discrete mathematics), nor is there a guarantee that students have completed a technical class in some other discipline (such as a laboratory science course). There are even a few students in the class whom, by credit hour count, are juniors but have yet to declare a major.

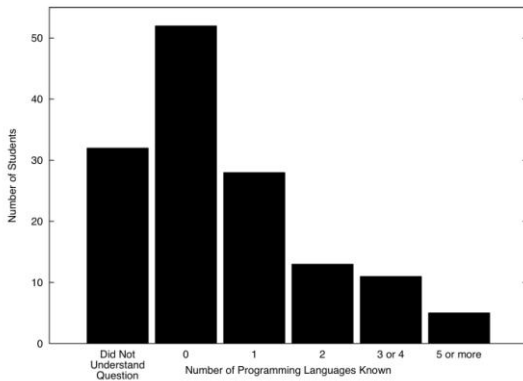
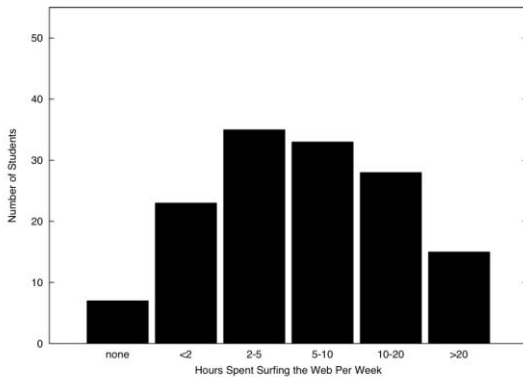


Figure 1: Student IT Usage

Figure 2: Student CS Background

In order to understand the backgrounds of students taking the course, two recent offerings of the class have included a survey given during the first day of class. Some of the results from this survey are shown in Figure 1, which shows the results of asking enrolled students how long they surf the web for during a typical week. These results indicate that enrolled students

generally do use information technology, but with a varying degree of regularity. Figure 2 shows the results of asking students how many programming languages they know. The results here clearly show the disparity among students in the class - while some have a strong footing in Computer Science (i.e. knew several programming languages), some students in the class did not even know what a programming language is. Interestingly, many students in the class considered the ability to build web pages to be computer programming - so the results of the survey may be artificially inflated.

Nonetheless, there is typically a wide range of disciplines that take the course. In a typical semester, there are budding Engineers, Philosophers, business administrators, art historians, writers, and Computer Scientists present in the classroom. While it is certainly a challenge to

simultaneously engage all of these students, this academic diversity can also lend itself to a vibrant classroom, as discussed in the following section.

Teaching Methodologies

Since the largest challenge faced in the class is ensuring that all of the students in the class are being reached, various teaching methodologies have been employed. While traditional

instruction such as lectures and exams are utilized, such items do not necessarily embrace the interdisciplinary goal of the course - namely to engage students in thinking about the interrelationship of the material found in the course. In order to do so, we engaged students in both group exercises and individual writing assignments.

In order to “forcibly” expose students to differing viewpoints and areas of expertise, a variant on case based analysis¹⁰ has been utilized. The class was broken down into discussion groups of about 6 students each. These groups were given a somewhat controversial topic (i.e. case) related to material that had just been lectured on and were then asked to discuss and form an opinion based on the case. After about 10 or 15 minutes of discussion, each group nominated a presenter who gave a brief summary of their group’s opinion and their justification of that opinion. Discussed topics in this format included a debate on whether or not open source software is a good idea, if neo-Luddites actually have a valid point, and so on. Such discussions gave the faculty involved valuable feedback, including a clear indication of how well students grasped lectured material. Students, including Computer Science and other technically oriented

majors, also got to hear points of view from others outside of their own discipline and comfort zone. The discussion groups often utilized the technically oriented students to help clarify details, while at the same time exposing those students to some individuals who truly disliked technology - a first for many such students.

While these group exercises aided many students, they tended to quieten the soft-spoken (or under-prepared) student. Thus, other methodologies need to be employed to ensure that such students do not “fall into the cracks”. The topics discussed in the class lend themselves well to writing opinion papers, where each student is asked to form an opinion and then justify it using facts discussed in texts, lectures, or other research material. Each such written assignment was intended to incorporate the interdisciplinary aspects of the course by encouraging students to incorporate aspects from the technical, philosophical, and societal impacts discussed in class, as well as ideas from their own disciplines. Examples of such include having students justify a stance on RFID and privacy from a philosophical stance of their choosing or asking students to apply a technology discussed in class to a brand new application of their choosing while being sure to discuss applicable societal impacts such as copyrights and patents.

Conclusion and Student Feedback

We have presented a truly interdisciplinary course with foundations in Computer Science, intended to cover topics on how Information Technology impacts society. Unlike other courses that cover this material, this course has faculty dedicated from both Computer Science and other disciplines, as opposed to just one of these disciplines. It is also open to enrollment from the entire student body, regardless of student background or major, as it has no course prerequisites. Furthermore, the course serves as an introduction to ethics in computing that is suitable for anyone in the information technology field.

Interestingly, students seemed to grasp both the concepts presented by each discipline, along with the interdisciplinary nature of the course, which is one of the primary goals of the course. This can be seen in student comments on the course, such as:

“I felt as though I had a relatively good understanding of the ethics issues going into the class but learned a great deal more than I had planned”

“Bringing both concepts together to form one complete concept was helpful in the learning process”

“This course covers very important material and should be required of every student”

As one might expect, the course is constantly evolving. While students have given positive feedback on the interaction of the basic course components, there is always room for improvement; more class discussions and in-class activities are planned for future offerings, including activities such as panel discussions or “mock trials”. The course content is also constantly being modified to cover topics currently in the news, such as specific privacy issues related to information technology and how they impact students in the class.

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