A STUDY OF SOCIAL AND PROFESSIONAL ETHICS IN UNDERGRADUATE COMPUTER SCIENCE PROGRAMS: FACULTY PERSPECTIVES

by

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A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Educational Studies

(Instructional Technology)

Under the Supervision of Professor Charles Ansorge and

Assistant Professor Leen-Kiat Soh

Lincoln, Nebraska

August, 2007

UMI Number: 3255458

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

A STUDY OF SOCIAL AND PROFESSIONAL ETHICS IN

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University of Nebraska, 2007

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This study investigated how social and professional issues (computer ethics) are integrated into undergraduate computer science programs in the United States. Specifically, the study investigated nine research questions derived from a review of the computer science and ethics literature. (1) Are social and professional issues (computer ethics) being covered in undergraduate computer science curricula, (2) How do undergraduate computer science programs integrate social and professional issues into their curriculum, (3) Have faculty received any special training, (4) What are the perceptions of faculty concerning computer ethics, (5) How are decisions made, (6) What are the disciplines of those who teach computer ethics, (7) What pedagogy is used, (8) What topics are covered and what is the delivery method of these topics, and (9) What are the reasons for not covering computer ethics?

The study answered many questions and confirmed that (1) most universities and colleges do integrate computer ethics, (2) ethics is mainly integrated into other courses, (3) few schools provide any special ethics training for faculty, (4) Most faculty agree that ethics should be taught in computer science curricula, (5) most decisions concerning how

ethics are incorporated into the curriculum are made by committee, (6) computer science faculty teach ethics, (7) a variety of pedagogical instructional methods are utilized and (8) some required knowledge units in the 2001 computer science curricula are not fully covered, and (9) the major reason that schools do not teach ethics is because computer science faculty have not been trained.

ACKNOWLEDGMENTS

The undertaking of a dissertation is not accomplished without the support of many people. My first debt of gratitude goes to the chairs of my dissertation committee, Dr. Charles Ansorge and Dr. Leen-Kiat Soh, for their generous commitment, support and guidance. Your belief in my dissertation topic prompted me to follow my research interest and explore unknown territory. My gratitude also goes to my other dissertation committee members, Dr. James Walter and Dr. David Fowler for their helpful suggestions. A special thanks to Dr. David Brooks, who provided guidance and support through my doctoral course work. You challenged me to think differently about how students learn and how we should design interactive materials. A special thanks to Florence Appel for her advice and encouragement. I would like to acknowledge Florence Appel, Keith Miller, Tom Jewitt, Scott Sigman, Phil Heeler, and Mark Vellinga for their work as members of the survey focus group. Many significant mentors do make a difference!

To my husband, Kim Spradling, and my children, Ian and Sarah, thank you for your endless love, encouragement, and patience with me through this process. To my sister, Mary Lou Bomgaars, and my friend, Jody Strauch, thank you for your continuing support. To my parents, although not with me any more, thank you for sharing your work ethic with me for without it, this task would not have been possible.

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Chapter I

INTRODUCTION

The advent of the computer has impacted almost everyone in society today, whether it is a business, a government agency or the general public. It has changed the way that we complete our daily tasks at home and work, how we communicate with others, how our children are educated, how we buy and sell products, and how we are entertained (Quigley, 2005). In short, the computer has changed the very fabric of our society.

Ethical issues such as privacy protection, freedom of speech, intellectual property, crime, security, gender, ethnic and disability issues, pornography, codes of conduct and professional ethics certainly existed before computers, however, computers have changed the type of information that is saved, the speed in which information can be transmitted, and the way one may access information (Tavani, 2004). The introduction of the computer has complicated existing ethical dilemmas and has presented new ethical dilemmas.

Serious and popular news regularly highlight the role that computer ethics have played in cases such as the Challenger disaster, Y2K, Therac 25 Radiation Therapy System, Aegis radar system, the United States government vs. Microsoft monopoly case, Napster and Grokster, cases involving computer matching, data mining, the sale of electronic information, network security, computer viruses, spam, the digital divide, workplace and employee monitoring, electronic voting and identify theft, and recent legislation such as the Sarbanes-Oxley Act of 2002. The 2005 CSI/FBI Computer Crime and Security Survey (Gordon, Loeb, Lucyshun, & Richardson, 2005) estimates the 2005 losses to businesses (639 survey respondents) as $130 billion and states that this estimate may not largely represent the true losses because of implicit losses that are not reported, such as lost future sales of businesses. Further, the 2005 CSI/FBI report states that the impact of the Sarbanes-Oxley Act on information security has raised business interest in information security. These types of cases highlight that computer professionals are faced with questions that go beyond mathematical terms, and problem design and implementation.

Computer science faculty have been charged to help undergraduate computer science majors develop an awareness of social and ethical considerations in the context of computer science, that these topics are important topics in the field of computer science and should be evaluated in the context of computing technology as it is used and produced (Martin & Weltz, 1999). As future practitioners, computer science students must begin to grasp the responsibility that they will be asked to bear as professionals and the consequences of their actions. Thus, social and professional ethics education in undergraduate computer science programs is paramount to the enlightenment of computer science students on a variety of ethical topics.

A faculty study examined the status of social and professional ethics in the undergraduate computer science programs. The faculty study was used to document the status of social and professional ethics curriculum issues in undergraduate computer science programs in the United States and allow the researcher to look for trends, and make recommendations regarding what needs to be done to better integrate social and professional issues into the undergraduate computer science curriculum and train computer science faculty

1.1 Statement of Problem

While today's computing professionals frequently are confronted with questions requiring professional judgment that are not answered by the mathematical theory and computational techniques covered in their curriculum (Huff & Martin, 1995), many computing students view the computer as a tool that provides an intellectual challenge to them or as a test of their ability to solve logical problems (Granger et al., 1997) and have no awareness of the professional judgment that will be required of them. In other words, students must be educated to consider the user as well as the process of writing a computer program or designing a computer system to solve a problem.

Most computer professionals agree that undergraduate computing majors must develop a better awareness of the important role computer ethics will play in their information technology (IT) future. The prominence of social and professional ethics has been witnessed by the inclusion of social and professional standards in computer science accreditation since 1987 (Huff & Martin, 1995) and knowledge units in the *Computing Curricula 1991* report (ACM/IEEE-CS Joint Curriculum Task Force, 1991) and *Computing Curricula 2001: Computer Science* report (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002). The 1991 report highlights that students must be able to ask "serious questions about the social impact of computing and to evaluate proposed answers to those questions" (ACM/IEEE-CS Joint Curriculum Task Force, 1991, p. 12). Since 1991, a great deal of discussion has centered on what to expose and how to best expose students to these ethical issues within the computing field (Martin, Huff, Gotterbarn & Miller, 1996b). The main topics in the current computer ethics literature focus on the history of the computer, social and professional ethics concepts, perspectives and methodology, who should teach social and professional ethics, how training may take place for professors, how ethical content should be integrated into the computer science curriculum, what ethics content should be included into the computer science curriculum, and computer ethics pedagogy.

Many schools have embraced the inclusion of social and professional issues into the undergraduate computer science curriculum, while there are schools that have not. Regional studies regarding how social and professional issues have been dealt with in computer science programs have been conducted in Kentucky (Pullman, 1994) and California and other countries (Barroso & Melara, 2004). Pullman found that 70% of the survey respondents felt that incorporating computer ethics in the undergraduate curriculum was of great importance, while Barroso and Melara found that 82% of the survey respondents teach ethics. However, no national study of the status of social and professional issues in the undergraduate computer science programs in the United States has been conducted. Studies, such as this study, may not have been conducted in the past because of a general lack of interest by computer science educators in the topic of social and professional issues, or because of the difficulty in developing an accurate list of undergraduate computer science programs to survey. This type of study represents a major undertaking in which many researchers may not be interested.

1.2 Purpose of Study

The purpose of this study was to explore how social and professional issues (computer ethics) are integrated into undergraduate computer science programs in the United States.

1.3 Research Questions

1. Are social and professional issues integrated into the undergraduate computer science curricula?

2. How do undergraduate computer science programs integrate social and professional issues into their curriculum?

3. Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so, what type of training have they received?

4. What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum?

5. How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?

6. What is the practicing discipline of faculty that teach social and professional issues courses or modules?

7. What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?

8. What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?

9. What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?

1.4 Theoretical Perspective

Society's concern about ethics is not a new phenomenon, but has become more visible in the past decade. Professional organizations from doctors to engineers to accountants to computer scientists have focused more attention on defining ethical topics pertinent to their professions. Most professionals realize that their treatment of ethical issues may reflect poorly on their profession or cause harm to the general public and readily accept their responsibility in defining these ethical issues. The Association of Computing Machinery (ACM), which plays an important role in defining the content of the undergraduate computer science curriculum around the world, has incorporated ethical knowledge units into their standard curriculum (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002) and are searching for ways to help students develop an awareness of ethical topics. How and what should be taught as well as who should teach ethics are topics of discussion within the literature of the ACM professional organization.

Undergraduate computer science programs are attempting to integrate social and professional ethics into their computer science curricula. Considerable discussion has taken place on whether to integrate ethical content as either a separate course or whether to integrate ethical content across the curriculum. Students exposed to ethics in a separate course or a non-integrated approach may lack the ability to integrate ethics into their professional life (Greening, Kay, & Kummerfeld, 2004) and therefore the preferred method is to integrate ethical content across the computer science curriculum (Martin, 1999a, 1999b).

The majority (54%) of programs in California and other countries that teach ethics do so with a separate ethics course taught by experienced computer science faculty and use case studies (57%) as the main pedagogy to present ethics concepts (Barroso & Melara, 2004). While the preferred method for the decision to integrate ethical content is by committee (Martin, 1999a), no national study has been conducted to determine how schools are accomplishing this task.

In an effort to help faculty determine how to integrate computer ethics into the undergraduate computer science curriculum, some computer ethics training has been provided for computer science faculty. The Association of Computing Machinery (ACM) at their annual national conference has offered ethics workshops that cover a variety of topics and some ethics workshops were funded during the 1990's by the National Science Foundation. However, few national studies document how computer science faculty are receiving their ethics training and concerns exist that computer science faculty are not receiving appropriate ethics training.

1.5 Definition of Terms

Computer Crime. "A crime like any other crime, except that …the legal act must involve a computer system either as an object of a crime, an instrument used to commit a crime, or a repository of evidence related to a crime" (Kizza, 2003, p. 240).

Computer Ethics. "The analysis of the nature and social impact of computer technology and the corresponding formulation and justification of policies for the ethical use of such technology" (Kizza, 2003, p. 14).

Intellectual Property. "A wide scope of mechanisms that include copyright, patents, trademarks, protection of trade secrets, and .. personal identity rights (Kizza, 2003, p. 129).

Privacy. "The freedom from unauthorized intrusion" (Merriam-Webster Online Dictionary, 2005) or "a zone of inaccessibility that surrounds a person" (Quinn, 2004, p. 189).

Social and Professional Issues (SP). Ethical issues such as history of computing, social context of computing, methods and tools of analysis, professional and ethical responsibilities, risks and liabilities of computer-based systems, intellectual property, privacy, civil liberties, computer crime, economic issues in computing, and philosophical frameworks. (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002).

1.6 Delimitations and Limitations

The subjects in the faculty survey were limited to computer science faculty who teach in undergraduate computer science programs in the United States. The faculty survey utilized a stratified random sample of approximately 700 different computer science programs from the population of approximately 800 undergraduate computer science programs in the United States. The limitations of this study are generalizable to those faculty at undergraduate computer science programs in the United States who responded to the survey and are limited to the accuracy and honesty of the respondents.

1.7 Significance of Study

The faculty of undergraduate computer science programs in the United States will benefit from this study. Information gathered from this study answers many questions concerning how computer science programs that teach social and professional issues integrate these issues into the curriculum by either the use of a standalone course or modules in computer science courses, which social and professional issue topics are incorporated into the curriculum, how decisions are made to integrate the curriculum, whether programs provide ethics training for faculty, whether faculty believe the social and professional issues should be incorporated into the curriculum, what pedagogies are used to cover these issues, whether computer scientists, philosophers, or social scientists are teaching social and professional issues and why some computer sciences programs do not address social and professional issues. This information should provide new areas of discussion regarding the status of computer ethics education in undergraduate computer science programs in the United States.

1.8 Methodology

A web-based survey was administered to 700 undergraduate computer science programs as part of a stratified random sample of 797 undergraduate computer science programs in the United States. The survey's purpose was to determine how social and professional issues (computer ethics) are integrated into undergraduate computer science curricula in the United States. There were 251 survey responses or a 36% response rate. This dissertation describes the demographics of the respondents and presents a content analysis of the responses concerning how undergraduate computer science programs integrate social and professional issues into their curricula, namely by either the use of a standalone course or modules in computer science courses in which social and professional issue topics are incorporated into the curricula.

1.9 Contributions

The *Computing Curricula 2001: Computer Science* report outlines the inclusion of social and professional issues in the computer science curricula. However, no previous study has documented a comprehensive look at whether schools are following the report guidelines and recommendations. This research study contributes to the literature by documenting the current status of social and professional issues in the undergraduate computer science curricula.

1.10 Overview of Remaining Chapter

This dissertation contains five additional chapters. Chapter II contains a review of the literature which highlights computer ethics history, concepts, perspectives and methodology, who teaches ethics, the integration of ethical content into the computer science curricula, the decision making process, faculty training, pedagogy, and ethics content. Chapter III discusses the research methodology chosen for the faculty survey. Nine research questions were chosen for this study. Chapter IV highlights the research results for the nine research questions. Chapter V discusses the research results. Chapter VI provides recommendations and conclusions.

Chapter II

REVIEW OF LITERATURE

2.1 Overview

Computers are pervasive in our world today. Computer hardware and software are growing in use in almost every industry with entertainment, trucking, medical professions, government, banking, education, being just several examples. The Internet, build upon computer technology, has dramatically changed our everyday lives, and new uses of computers are providing opportunities to develop new forms of communication that are changing the way we work and our leisure time.

Computers have dramatically changed our lives, profoundly affected how we live our lives, and how others interact with us on a daily basis. With profound changes to a society comes a responsibility to examine the benefits and risks of computer technology and the ethical issues surrounding computer technology. This chapter examines the history of computer ethics, computer ethics concepts, perspectives and methodology, who teaches ethics, the integration of ethical content into the computer science curricula, how ethical content decisions are made, how faculty are trained to teach ethical content, computer ethics pedagogy, and computer ethics content in the computer science curricula.

2.2 Computer Ethics History

Norbert Wiener first discussed information processing entities in his 1950 book, *The Human Use of Human Beings*, and noted that computerized automata would bring an ethical challenge to humanity (Bynum, 2000). Wiener posed several questions that dealt with the social and ethical consequences of introducing computing machines into society, how to ethically integrate technology into society and what were the responsibilities of technology professionals, and therefore he is often considered to be the founder of computer ethics as a field of scholarly research (Bynum, 2000). However, “the very term computer ethics did not come into common usage until the mid 1970's when Walter Maner began using it in his writings, his conference presentations and his university courses” (Bynum, 2000, p. 10).

The trend to incorporate computer ethics into the undergraduate computing curriculum extends back to the 1987 Computer Science Accreditation curriculum standards (Huff & Martin, 1995). These ethical curriculum standards were expanded in 1991 when the *Computing Curricula 1991* report made “a strong case for including social analysis and ethical issues within the computer science curriculum” (Martin et al., 1996a, p. 2). The most recent report, *Computing Curricula 2001: Computer Science*, a joint undertaking of the Computer Society of the Institute for Electrical Electronic Engineers (IEEE-CS) and the Association of Computing Machinery (ACM), includes curricular guidelines for undergraduate programs in computing and incorporates a subject area, Social and Professional Issues (SP), which includes a variety of issues: from the history of computing to professional and ethical responsibilities (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002). Ten knowledge units were included in the 2001 report. Seven of these knowledge units (history of computing, social context of computing, methods and tools of analysis, professional and ethical responsibilities, risks and liabilities of computer-based systems, intellectual property, privacy and civil liberties) are considered core coverage. Three knowledge units (computer crime, economic issues in computing, philosophical frameworks) are considered elective coverage.

The *Computing Curricula* 2001: Computer Science (2002, p. 152) report quotes the *Computing Curricula 1991* which outlines the need for ethics education:

> "Undergraduates also need to understand the basic, cultural, social, legal, and ethical issues inherent in the discipline of computing. They should understand where the discipline has been, where it is, and where it is heading. They should understand their roles in this process, as well as appreciate the philosophical questions, technical problems, and aesthetic values that play an important part in the development of the discipline".

The 2001 report set in motion the direction of the coverage of social and professional issues in undergraduate computer science curricula.

2.3 Computer Ethics Concepts, Perspectives and Methodology

Most scholars and computer professionals will acknowledge that the use of computer technology has impacted our moral, legal, and social systems. The debate still continues as to whether computer technology has presented any unique moral problems and therefore deserves the status of a separate discipline. In other words, there is great debate among scholars regarding the nature of computer ethics.

"Ethics as a field of study is a multi-level discipline consisting of (a) metaethics, (b) normative ethics and (c) applied ethics" (Marturano, 2002, p. 72). Metaethics attempts to provide the semantics of a variety of theories that are used to explain ethics terminology. Hospers states that normative ethics deals with fundamental issues such as "what ends are good, what acts are right, what policies are just, and for what actions a person should be held responsible" (as cited in Marturano, 2002, p. 72). Applied ethics deals with the application of normative ethics and applies to both professional and individual moral dilemmas.

Deborah Johnson suggests that "computer ethics has followed computer technology in its evolution, and for the same reason computer ethics as a separate discipline will disappear in the near future" (as cited in Marturano, 2002, p. 71), while Tavani suggests that computer ethics may be "best understood as a 'new species' of (existing) generic moral problems" (2002a, p. 48). Walter Maner (1996) proposes that computer ethics is a unique discipline that has generated an entirely new set of ethical issues that did not and could not have existed before the invention of computer technology and therefore deserves a distinction from other forms of ethics. Himma (2004) argues that problems in computer ethics are not unique in a variety of senses, encompassing meta-ethical, ethical or epistemic, but that computer ethics should be treated as a separate subdiscipline of applied ethics because individuals who acquire a comprehensive understanding of the technical issues are more likely to produce quality ethical arguments that address the problems.

Floridi and Sanders (2002) summarize five different approaches that have emerged in the foundation of computer ethics: No Approach (NA), Professional Approach (PA), Radical Approach (RA), Conservative Approach (CA) and Innovative Approach (IA). NA presents the viewpoint that computer ethics problems represent unsolvable dilemmas with no conceptual foundation and therefore tend to be dealt with by using a "pop ethics" approach of unsystematic and heterogeneous stories that are largely negative and not neutral. PA's goals are to appeal to the social responsibility of computer professionals and tend to approach ethics issues from a pedagogical viewpoint, namely the emphasis is placed on professional standards, responsibilities and obligations, and does not adequately address other issues such as privacy, security, reliability, access, etc.

RA proponents believe that computer ethics exists as a unique field of study, but opponents argue that by overemphasizing the uniqueness of computer ethics, the risk is to move computer ethics away from the realm of metaethical theories. CA utilizes classic macroethics but recognizes that these theories may need to be adapted and extended, however, CA also incorporates microethics, which is "practical, field-dependent, applied and professional ethics" (Floridi & Sanders, 2002, p. 5). CA does not provide explicit methodology and often relies on common-sense, case-based analysis which does not provide a clear understanding of what is new in computer ethics issues.

IA introduces a new macroethical perspective, Information Ethics (IE), which may be "understood as the theoretical foundation of applied CE, is a non-standard, environmental macroethics, patient-oriented and ontocentric, based on the concepts of information object/infosphere/entropy rather than life/ecosystem/pain" (Floridi & Sanders, 2002, p. 7). Information Ethics directs the focus on something more fundamental than life, namely information and rather than focusing on pain, the focus addresses entropy (i.e. chaos and disorganization). IE proponents argue that because any form of being is encompassed in information, it represents an ontocentric theory.

The approval or disapproval of any information process is based upon how it affects the information entity. In other words, any actions toward the infosphere may be judged upon how the action improves or impoverishes the infosphere. Floridi and

Sanders suggest that the innovative approach of information ethics will lead to the shaping of a new ethical view.

Many scholars and professionals who agree that computer ethics should be classified as a branch of applied ethics may proceed from three different viewpoints: professional ethics, philosophical ethics, or descriptive ethics (Tavani, 2004). Donald Gotterbarn suggests that professional ethics may be understood as issues or moral responsibilities that affect computer professionals and should not encompass broader moral and social implications of technology (as cited in Tavani, 2004). Philosophical ethics is concerned with broader concerns that affect all of society, even those individuals that have never used a computer. Descriptive ethics describes sociological aspects of moral issues, such as race, gender, and social class, and asserts that other ethical questions will become clearer if other descriptive aspects of the issue are known.

The standard model used in applied ethics is to (a) identify the ethical problem, (b) clarify and analyze the problem in conceptual and factual terms, and (c) apply moral principles to the problem (Brey, 2000). Moor (1998, 1985), however, suggests that the standard approach to applied ethics is not appropriate and additional steps in the analysis must be added to account for questions that will address "policy vacuums" and "conceptual muddles" which result because computer technology is "logically malleable."

An alternative, multi-level, interdisciplinary approach, "disclosive computer ethics," is provided as an alternative to Moor's model and the standard model used in applied ethics (Brey, 2000). Brey's disclosive model incorporates three levels of analysis: disclosure level, theoretical level and application level. The disclosure level is the initial level and addresses embedded moral values that may be present in the design of a computer system. At the theoretical level, moral theories are developed, while at the application level, moral theory is applied to the analysis that takes place at the disclosure level. Brey also suggests that disclosive computer ethics should focus on "four key values: justice, autonomy, democracy, and privacy" (Brey, 2000, p. 16).

Tavani (2004) builds upon Brey's model and suggests the following guide be used for identification, analysis, and, deliberation.

Step 1. Identify a practice involving cybertechnology or a feature in that technology that is controversial from a moral perspective.

- 1a. Disclose any hidden (or opaque) features or issues that have moral implications.
- 1b. If the issue is descriptive, assess the sociological implications for relevant social institutions and sociodemographic groups.
- 1c. If there are no ethical/normative issues, stop.
- 1d. If the ethical issue is professional in nature, assess it in terms of existing codes of conduct/ethics for relevant professional associations.
- 1e. If one or more ethical issues remain, go to Step 2.

Step 2. Analyze the ethical issue by clarifying concepts and situating it in a context.

- 2a. If a policy vacuum exists, go to Step 2b, otherwise go to Step 3.
- 2b. Clear up any conceptual muddles involving the policy vacuum and go to Step 3.

Step 3. Deliberate on the ethical issue. The deliberation process requires two stages:

3a. Apply one or more ethical theories to the analysis of the moral issues and then go to Step 3b.

3b. Justify the position you reached by evaluating it against the rules of logic/critical thinking (Tavani, 2004, p. 23-24).

While the faculty study does not address specific questions concerning whether computer science educators view computer ethics as a separate discipline within ethics or as special area within applied ethics, the study does allow one to gather insights into the views of the importance of the inclusion of social and professional issues in undergraduate computer science programs. With this background regarding computer concepts, perspectives and methodologies, the next question to answer is "who should teach computer ethics to computer science undergraduates?"

2.4 Who Teaches Ethics

There has been a great deal of debate (Gotterbarn, 1994; Johnson, 1994; Martin, 1994; Tavani, 2004) regarding who should teach computer ethics courses. The question usually focuses around whether philosophers, social scientists, or computer scientists are best prepared to teach computer ethics. Each scholar's opinion regarding who should teach computer ethics is heavily influenced by each scholar's perspective of computer ethics.

Deborah Johnson (1994) in a landmark article entitled "Who Should Teach Computer Ethics and Computers & Society?" suggests that philosophers are best equipped to teach computer ethics courses, and that ethical issues regarding computer technology are really ethical issues, not computer ethics issues. Johnson’s viewpoint is that philosophers are best qualified to examine ethical issues, identify moral issues, and evaluate the courses of action because they are educated in ethical theory and nothing in the education of computer scientists fully prepares them for these activities. It would be best for philosophers to teach courses in computer ethics and then have ethical issues introduced within the technical content of computer science courses by computer scientists. Johnson, however, does point out that one drawback to this approach may be that computer science students may place more validity on a course taught by computer scientists than philosophers, and may view this course as a course separate from their discipline.

Diane Martin (1994) in response to Johnson's comments, raises another question, , "Who should design such courses and decide what topics should be taught" (Martin, 1994, p. 7). Martin proposes that computer scientists should take the lead in defining, developing and incorporating ethical issues and standards into the computer science curriculum. Philosophers should participate in this discussion. However, the responsibility of incorporating ethics in the computer science curriculum lies with the computer science community.

Donald Gotterbarn (1994), in response to Johnson's article, comments that computer scientists are capable of learning ethical theories and strategies given the proper training in ethical issues and he questions whether philosophers have adequate training to understand issues of responsibility for computing professionals. Gotterbarn, agreeing with Johnson, believes that students tend to think that courses taught by someone outside of their discipline are less important than courses taught within their discipline.

What may appear to be a "turf battle" is not. Herman Tavani (2002b) points out that computer scientists such as David and Webster agree with Johnson, while Floridi, a philosopher, points out that some philosophers may not be enthusiastic about teaching computer ethics because of their views regarding the legitimacy of the computer ethics field. Tavani suggests that using Brey's multi-level interdisciplinary model of "disclosive computer ethics" to teach computer ethics allows the instructor to take important design features of computer technology into account and is well suited for computer science instructors. Moor's approach toward computer ethics of a " team effort involving people from many disciplines working together to consider what the computer technology does, what the consequences are likely to be, how it should best be conceived, and what the new policies should become" (as cited in Tavani, 2002b, p. 38) should also be considered. Tavani further mentions that Grodzinsky, a computer scientist, and Moor, a philosopher, are among a growing number of computer ethics instructors that support the movement toward computer scientists and philosophers working together to define and implement computer ethics knowledge areas.

Barroso and Melara (2004) in their study of California universities and other countries found that computer ethics is mostly taught by professionals from the information science fields rather than the field of philosophy. A review of the literature found no national studies regarding who actually teaches computer ethics courses at most colleges and universities in the United States. The faculty study provides insights into whether computer scientists, philosophers or social scientists are teaching computer ethics.

2.5 Integration of Ethical Content into Computer Science Curricula

Realizations concerning the importance of ethical and social context in computer technology were acknowledged in the *Computing Curricula 1991* (ACM/IEEE-CS Joint Curriculum Task Force, 1991) with the inclusion of a foundational principle of social, ethical and professional context of computer science. However, many felt the *Computing Curricula 1991* fell short in providing sufficient detail and guidelines about how to implement this knowledge unit into the curriculum (Huff & Martin, 1995; Martin & Weltz, 1999). To address the need for a more rigorous approach, a group of 25 experts including philosophers, social scientists, ethicists and computer scientists with expertise in computer science curriculum accreditation issues were brought together in 1994 through the ImpactCS Project, funded by the National Science Foundation (Huff & Martin, 1995). The primary purpose of the ImpactCS Project was "to define the core content and methodology for integrating social impact and ethics topics across the computer science curriculum" (ImpactCS, 1998).

Computer ethics courses taught previously attempted to make students aware of ethical issues but were not based upon theoretical principles of moral education (Martin & Weltz, 1999).

> Research has demonstrated that two major theories of moral education can provide a useful pedagogical foundation for teaching ethics and social responsibility in computer science. They are Values Clarification developed in the late 1960's by Raths, Harmin, and Simon and Kohlberg's Cognitive Development of Moral Reasoning approach developed in the early 1970's (Martin & Weltz, 1999, p. 7).

Values clarification "helps people to clarify and understand their own value systems" (Martin & Weltz, 1999, p. 7) and may provide a useful beginning point for ethics discussions. Kohlberg's Cognitive Development of Moral Reasoning includes six stages of moral reasoning and was based upon Piaget's earlier cognitive development theory. Kohlberg's work demonstrated that individuals move from one stage to another stage as a result of unresolved conflict and that his research has implications for computer ethics education, namely that students are only able to advance one stage at a time and that each stage must be fully realized before a student may move to the next stage. Martin and Weltz (1999, p. 7) point out that these two theories "provide a strong rational for developing a staged and integrated progression to any curriculum dealing with ethics and social responsibility."

Students should be guided through "three stages of development in their ethical thinking and sense of social responsibility related to becoming a computer professional: (1) awareness of the issues, (2) evaluation and decision-making, and (3) responsible action" (Martin & Weltz, 1999, p. 8). The goal of integration may be accomplished by "(1) an early introduction, (2) continued discussion in most courses, (3) integration of topics within the courses, and (4) maximum coverage with minimum overlap" (Martin & Weltz, 1999, p. 8) .

An early introduction to social and professional ethics in the computer science curriculum should focus on issues that are relevant to students as computer users and may be introduced with topics such as privacy, e-mail or software copyright issues. Students should be introduced to the

> principles and skills of ethical and social analysis as well as an introduction to some of the major issues related to computing so that students can begin to move from the awareness stage to the ability to evaluate and make decisions about such issues (Martin & Weltz, 1999, p. 10).

Real world cases are suggested as a means to allow students to become aware of the effects of ethical decisions relating to computer technology.

Because computer ethics impacts all topics within computer science, ethics topics such as privacy, developer responsibility in software design and security naturally lend themselves to ethical discussions of social responsibility and should be included in most computer science courses. The challenge in this area is to "look beyond mere fact or programming skill to the end application" (Martin & Weltz, 1999, p. 9) such as how a particular algorithm may impact various situations such as life and death or how the privacy of information in a database may impact individuals (Appel, 2005).

Ethical and social responsibility should not be treated as extra topics in the computer science curriculum (Martin & Weltz, 1999). The key is to develop an integrated approach that allows students to develop the necessary background, an understanding of tools of analysis and to develop skills in introductory courses so that they are able to utilize these tools and skills in advanced courses. This approach provides the only way to assist students in realizing that ethical issues are central to technical issues in computing.

Maximum coverage with minimum overlap requires careful planning across the computer science curriculum, provides a balance between certain issues that need to be covered and current events, and allows for the flexibility to incorporate new topics. The danger to an informal approach rather than a carefully planned integration may result in an informal coverage of topics that may be repeated in courses leading to student boredom, while other topics may never be covered (Martin & Weltz, 1999).

An interdisciplinary approach is important to the integration of ethical and social issues into the computer science curriculum and should include a conceptual approach that integrates the disciplines of philosophical ethics, social science, and computer science (Huff & Martin, 1995; Martin & Weltz, 1999). To achieve the integration of these disciplines, several of the Impact CS Project participants outline how these three areas intersect and define an "intellectual space" of three dimensions: levels of social analysis, topics of ethical analysis, and computer technology. Levels of social analysis include: individuals, communities and groups, organizations, cultures, institutions, nations, and global vs. local. Topics of ethical analysis are outlined as: individual and professional responsibility, quality of life, use of power, risks and reliability, property rights, privacy, equity and access, and honesty and deception. Each particular technology is associated with different areas of concern that would involve social and ethical issues, while some technological issues may address all areas of these dimensions (Huff & Martin, 1995; Martin & Weltz, 1999).

The Social and Professional Issues section of the *Computing Curricula 2001: Computer Science* report was developed and based upon the research and careful study of the ImpactCS Project. The report states that social and professional knowledge areas should be covered through "one required course along with short modules in other courses" (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2001, p. 152). The report covers delivery issues such as whether a stand-alone course should be introduced at the lower level (freshman or sophomore), at the upper level (junior or senior), or as a capstone course for seniors, or whether components of these ethics topics should be integrated in a variety of courses.

Positive factors for offering a course at the lower level allow the introduction of methods and tools of analysis before analyzing ethical issues in technical areas and do provide some opportunity to introduce professional and ethical issues to students who may leave a program early to enter the workforce. Several problems in offering a lower level course, namely that lower level students may not have the technical knowledge and the intellectual maturity to perform an in-depth ethical analysis or understand the background and issues involved, are also addressed (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2001).

The integration of ethics within the computer science curriculum has emerged as the predominant method for spreading ethical content across the curriculum, and that appending ethics to existing content units may produce a "domino effect" from which students may perceive that ethics is not integrated into their profession. This domino effect may produce an effect that is more detrimental to ethics professional education than the inclusion of no ethics at all from which students may begin to view ethics as an afterthought to professional practice (Greening, Kay & Kummerfel, 2004).

While a scaffolding approach toward computer ethics education appears to be well grounded and supported, there is no one approach that is used in computer science programs. This study is the first national survey to gather information regarding how universities and colleges actually integrate computer ethics across the curriculum.

2.6 Decision Making Process

Curriculum changes may come from both external and/or internal forces. The *Computing Curricula 2001: Computer Science* report or the ABET accreditation standards are examples of external forces, while internal forces may come from a dean, a department chair, a group of faculty or one faculty member interested in adopting a change based upon research findings or a personal or moral belief. A change in accreditation standards may have a greater influence and more creditability than an individual or a group of faculty.

Changing curriculum at most universities is a lengthy and sometimes difficult process. Significant changes will often require approval of the department faculty, a college dean, a faculty senate, university administration, and a governing board, while other small changes may only involve a group of faculty. Implementing social and professional issues into the computer science curriculum will meet with more success if a solid plan is devised that includes the voices of all computer science faculty in the department. In fact, a steering committee of experts in ethics, social impact and curriculum design developed the ImpactCS Project (1998) standards.

A major question is how to approach getting faculty to want to change their curriculum. A change stage model developed by Lewis (as cited in Pierce & Henry, 1996) outlines three stages, "unfreezing," getting people to recognize that there is a need for change, "change," getting people to try new techniques and behaviors, and "refreezing," finding a way to incorporate new techniques and behaviors.

Pierce and Henry (1996, p. 2) introduced a change model (Figure 1) with seven phases of implementation, which incorporates Lewis' model and the models of other researchers. While many authors report on what they have done to integrate social and professional issues into the computer science curriculum, most do not provide details about whether the process included all departmental faculty, a small committee of faculty or if one individual completed the work. The results of the faculty survey serve as a key step which may alert faculty to necessary changes in the integration of computer ethics in undergraduate computer science programs and thereby begin the unfreezing process in the change model. Recommendations from the faculty survey should address what changes need to take place, if any and provide a better basis for faculty to accept these recommendations.

2.7 Faculty Training

Most faculty teaching in undergraduate computer science programs do not have a background in ethics. Johnson (1994) argued that nothing in the background of computer scientists prepared them to teach ethics. Gottenbarn (1994) responded to Johnson that computer science instructors would need training in ethical theory. The question is how computer science faculty will be trained to teach computer ethics.

Several methods may be used to accomplish the goal of training computer science faculty. Coercion by a department chair or dean is often effective (Small, 1995). Offering formal training through workshops at regional and national conference, online distance learning modules, and summer workshops funded by the National Science Foundation (NSF) should provide some enhancements for faculty (Martin & Weltz, 1999).

Unfreezing   Change   Refreezing

|-----------------|---------------------------------|--

Initiation → Adoption → Adaptation → Acceptance → Use → Measurement → Incorporation

Figure 1. Pierce and Henry Model of Implementation

However, as faculty are drawn into the training process, it should encompass a classroom setting with an environment where faculty are able to interact with other faculty, and materials that provide a framework for learning, objectives or goals an content which can be incorporated into computer ethics courses or course modules. Computer science faculty should consider pairing with faculty from other disciplines such as philosophy, humanities and social sciences to develop ethics training materials, but computer science faculty should take the lead in running the workshops.

Several NSF funded workshops were offered during the 1990's. For instance, the annual Special Interest Group on Computer Science Education (SIGCSE) conference typically offers workshops on ethics topics, and several professional organizations have regularly sponsored conferences that deal solely with ethics topics. Still, there is a need for further ethics training for computer science faculty and the faculty survey demonstrates a need for further training.

2.8 Computer Ethics Pedagogy Used

There are many pedagogical approaches used to teach social and professional issues in the computer science curriculum, such as case studies, faculty lectures, discussion groups, papers written by students, ethic's videos, critiquing magazine or newspaper articles on computer ethics, and student class presentations. Barroso and Malara's (2004) study of computer science and engineering faculty at California universities and other countries found that survey respondents used case studies (80.9%), lectures by instructors (79.4%), student written papers (67.6%), small group discussions (66.2%), in-depth study of selected issues (64.8%), clippings (53.5%), student presentations on topics chosen by students (43.7%) and video tapes (21.1%). Other approaches reported were student reports on interviews with professionals, novels or plays, audio tapes, web use in class, simulation games, and internships in ethics. Pulliam's (1994) study of computer science faculty in Kentucky found that 55% of the survey respondents used case studies as well as other methods such as lectures by instructors, written reports on research, group projects and report, and oral reports on research. The results of pedagogy questions included in the faculty survey provides some documentation of the pedagogies used to teach computer ethics.

2.9 Computer Ethics Content in the Computer Science Curricula

2.9.1 Introduction

The *Computing Curricula 2001: Computer Science* report includes 10 social and professional knowledge units. The units include seven core knowledge units that require 17 hours; history of computing (1 hour), social context of computing (3 hours), methods and tools of analysis (2 hours), professional and ethical responsibilities (3 hours), risks and liabilities of computer-based systems (2 hours), intellectual property (3 hours) and privacy and civil liberties (2 hours). Elective knowledge units include computer crime, economic issues in computing, and philosophical frameworks. A discussion follows concerning the content of each of the knowledge units.

2.9.2 History of Computing

Students aged 18 to 20 have little knowledge of computer history as a discipline and therefore should be introduced to electronic computers first built in the 1940's and contrast this with the punch card era of the late 1980's so that students come to understand how major corporations such as IBM and SperryRand came into existence (Little, 2003). By introducing students to computers of the “1950s” and “1960s”, students will realize that computing became a major product that had few malicious attacks. Timesharing and anonymous computing are associated with the "1970s", while the "1980s" saw the introduction of personal computers that eventually became major work tools. The decades after the "1980s" led to networking, the Internet, and other implications. Little suggests that in order for students to understand cases from history, they need to understand the various stages of the development in computing.

The introduction of four technological phases of computer history are suggested by Tavani (2004): Phase 1 (1950s and 1960s) in which huge mainframe computers are connected as stand-alone machines and privacy issues began to emerge; Phase 2 (1970s and 1980s) in which a variety of computers and communication devices converged allowing the exchange of information and new problems dealing with privacy and computer crime; Phase 3 (1990 to the present) in which the Internet era increased significantly leading to new web technologies and additional ethics such as free speech, anonymity, jurisdiction, and the debate over the private versus public character of personal information; and Phase 4 (present) in which convergent technologies have led to a view of computing as a new kind of medium rather than being thought of as a conventional computer technology.

Many computer science educators do not consider the history of computing an important topic for inclusion in the undergraduate computer science curriculum. This study will determine to what extent the coverage of history is integrated into the undergraduate computer science curriculum.

2.9.3 Social Context of Computing

The social context of computing includes topics such as an introduction to social issues of computing and as they relate directly to networked communications, the Internet, gender-related issues, and international issues. The social context of computing should encompass issues related to three areas: "socio-demographic groups (involving social class, race, and gender), social and political institutions (such as education and government), and social sectors (such as the work place)" (Tavani, 2004, p. 259). In addition, social issues should also encompass the concept of on-line communities, how the Internet facilitates or threatens democracy, personal-identity issues as well as a host of other issues dealing with artificial intelligence and nanotechnology.

Of particular interest in this area is the debate about gender ethics. Problems involving gender typically are focused on issues dealing with problems that relate to the low number of women in computing and men and women's moral development (Adam, 2000). Adam argues that gender issues are often researched in the form of gathering data via techniques based upon student survey, and therefore larger issues are missed. Data should be gathered through empirical observation and interviews, which may then be tested against ethical theories. Gender bias should carefully be examined in relation to design and development decisions in educational software and video game software. Research suggests that the design of educational software is male-biased and includes embedded stereotypes (Tavani, 2004). The design of software, which carries social values, may contribute to influences on career choices, so software designers should strive to eliminate gender bias (Huff, 2002).

International issues are another area of interest among scholars. Globalization issues will continue to increase as the computer industry increases off-shore programming and forms more multi-national IT companies (Gabbert, 2003). The international scope of a comprehensive curriculum should emphasize that technology issues enable globalization, globalization drives technology in the form of development teams, which are now distributed around the world, and social issues must be framed in terms of social, economic, political, and legal issues. Students must be sensitized to computer compatibility issues in relationship to different countries, cultures, and legal systems (Lee, 2002).

2.9.4 Methods and Tools of Analysis

Methods and tools of analysis should include information on how to make and evaluate ethical arguments, how to identify and evaluate ethical choices, understand the social context of design, identify assumptions and values (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2001). Tavani's (2004) modified version of the standard approach to solving ethics issues for applied ethics, previously introduced, is one form of analysis that deserves coverage. Students should learn to argue from example, analogy, and counter-example (Martin, Huff, Gotterbarn & Killer, 1996a, 1996b). Cases may be used to help students understand what has happened to individuals and society as result of a particular case (Little, 2003). Little suggests three types of cases are useful in this analysis: (a) problem event cases, and biography cases and policy issue cases that relate to a variety of issues, such as history, and (b) basic rights such as privacy, free speech, intellectual property, and law or (c) assessments relating to technology.

One approach toward cases is to require students to first list all the relevant facts, second to identify the stakeholders in the case, and third to isolate the major ethical issues in the case (Harjinder, 1999). Students must come to understand that "ethical choices are not made with absolute certainty" (Harjinder, 1999, p. 36) and those ethical decisions are made based upon a rational approach that applies principles and involves examining all of the alternative options. If technical issues are best understood in their social content, then providing students with a set of guidelines for facilitating the discussion of technical issues will allow students to develop a better understanding of how to make ethical decisions.

2.9.5 Professional and Ethical Responsibilities

Computing Curricula 2001: Computer Science ((IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002) incorporates professional and ethical responsibility topics such as community values, professionalism, professional credentialing, the role of professionals, ethical dissent and whistle-blowing, codes of ethics, harassment and discrimination, and policies for the work place. Students need to have some understanding that as they enter the computer profession they are joining a professional community in which the public will place some trust. By studying the ACM Code of Ethics and Professional Conduct, students are able to observe that this code of ethics provides guidance and advice regarding how they may address ethical situations as a professional and what is expected regarding their professional attitude and behavior.

Students also need to be informed that as computer professionals they may become involved in four basic types of relationship: (1) employer-employee, (2) client-professional, (3) society-professional, and (4) professional-professional (Johnson, 2001).

Conflicts will arise between an employee's responsibility to these different groups such as weighing the responsibility that employees should be loyal to their employer and the responsibility a professional has to inform society of illegal or immoral acts by their employer, which may harm the general public. While there may not be clear answers to these situations, students should be made aware of these relationships so they are able to distinguish them and make ethical decisions regarding the precedence of these relationships. The topic of whistle-blowing addresses many of these relationships. Cases, such as the Star Wars project and the Space Shuttle Challenger accident should be included in this discussion.

Greening et al. (2004) offer the following observations regarding the importance of including professional ethics in the computer science curriculum. First, there are distinct differences between the ethical judgments made by students and professionals and so the topic of professional ethics will help bridge the gap. Second, having a sound understanding of professional ethics does offer students an employment advantage. Third, students that lack an understanding of professional ethics may be exploited by employers and asked to perform or participate in unethical or illegal activities of which they are not fully aware.

2.9.6 Risks and Liabilities of Computer-based Systems

Historical examples of software risks, implications of software complexity, and risk assessment and management are topics included in the risks and liabilities knowledge area. Two content areas in the computer science curriculum that lend themselves to risk analysis are the software development cycle and computer security. There are many historical cases, such as the Therac 25 case or the Aegis radar system case that may be used to illustrate software risks and the complexity of software.

Risk analysis in relation to the software development cycle most often includes issues such as scheduling, budgeting and reliability with much of the attention paid to the cost-effectiveness of software or the technical details of software development (Gotterbarn & Clear, 2004). This type of risk analysis tends to be quantitative in nature and often results in failure. Using this limited definition of risk analysis, software may satisfy the conditions of scheduling, budgeting and reliability, but failures may still arise. Gotterbarn and Clear suggest that two additional elements must be woven into the risk analysis process. First, by expanding the identification of stakeholders beyond the developer and the customer, other people may be found to be significantly affected by a system. Second, risk analysis must be expanded to incorporate not only a detailed plan of the technical skills but also include a detailed analysis of the social, ethical and professional aspects of the system. These two new elements require a qualitative approach to risk analysis that rely on textual descriptions of the risks. Both approaches, quantitative and qualitative, are necessary and complement each other.

Computer security may be viewed from two viewpoints, system security and data security. System security refers to a computer system's vulnerability to outside attacks in the form of viruses, worms, etc. and will be discussed in the computer security knowledge area. Data security refers to the vulnerability of unauthorized access to data, which may be sensitive data or may be altered as part of the access (Tavani, 2004). Computer security and risk analysis decisions should not only be market driven, but should also take into account security policies that involve public safety. "Schneider believes that risk can be understood and assessed in terms of the net result of the impacts of five elements: assets, threats, vulnerabilities, impact, and safeguards" (as cited in Tavani, 2004, p. 170).

2.9.7 Intellectual Property

Foundations of intellectual property, copyrights, patents and trade secrets, software piracy, software patents, international issues concerning intellectual property are included in the intellectual property knowledge area of the *Computing Curricula 2001: Computer Science* report. While it is important for computer science undergraduates to understand current laws and norms involved in the protection of intellectual property, it is also essential for students to develop some understanding of the various philosophical theories that support the foundation of legal protection schemes (Tavani, 2004).

Three theories of intellectual property (labor, utilitarian, and personality) have emerged. Labor theory provides a rationale of granting rights to a person based upon his labor, while utilitarian theory provides a rationale of granting property rights based upon maximizing the greatest number of people in a society. Personality theory, which is the basis for many laws in Europe, provides the rationale that property is an extension of the creator's personality. An alternative framework regarding information is emerging for analyzing intellectual property right claims (Tavani, 2004). This alternative framework gets to the issue of whether software should be free (Stallman, 1992) or information, including software, wants to be shared (Tavani, 2004). A large movement regarding "open source" software is based upon the concept that information wants to be shared. The open source movement often claims inventions that were never copyrighted or patented, such as HTTP by Tim Berners-Lee or the mouse by Doug Engelbart, led to new technologies and industries, which were able to expand in ways that would not have been possible if these technological contributions were patented or copyrighted. The "open source" software movement has led to the development of new businesses that make money by supporting open source code.

The sharing of MP3 files and DVDs has also gained much attention in relation to intellectual property, ordinary computer users and companies (Napster, Gnutella, Groskter and KaZaA). These companies provide the means, either centralized or decentralized, for private individuals to distribute copyrighted material. The No Electronic Theft (NET) Act (1997) deems it unlawful for "the reproduction or distribution, including by electronic means... 1 or more copyrighted works, which have a total retail value of more than $1,000." Many students are frequent users of these web sites and therefore should be made aware of the legal ramifications regarding their own personal use and how this could be viewed from the perspective of the recording industry. The greatest challenge for computer science instructors is to educate computer science students so that they, as ordinary users and future computer professionals, begin to develop an understanding of issues that will respect the rights of the software industry and yet allow for the sharing of information. Intellectual property topics, such as copyright, piracy, plagiarism and author’s rights were ranked of high importance in the Barroso and Melara (2004) study of faculty.

2.9.8 Privacy and Civil Liberties

The privacy and civil liberties knowledge area of the *Computing Curricula 2001: Computer Science* (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002) report includes the ethical and legal basis for privacy protection, privacy implications of massive database systems, technological strategies for privacy protection, freedom of expression in cyberspace, international and intercultural implications. Privacy covers a wide range of social practices and domains and is not a simple concept.

Privacy remains an important issue in respect to individuals and electronic commerce (Acquiti, 2004; Johnson, 2001) and receives more media attention that any other ethical issue (Tavani, 2004). Design issues, such as the collection, storage and transmission of data, significantly impact the privacy of individuals (Johnson, 2001; Tavani, 2004; Appel, 2005). It is no surprise then that Microsoft began an initiative, Trustworthy Computing, which trains employees how to write more secure, reliable software with the intent to protect the privacy of their customers (Brechner, 2003). Students need to understand that individuals, cultures, and nations differ greatly in their privacy expectations. While privacy legislation in the United States has been a piecemeal approach (Johnson, 2004), European nations have been more aggressive than Western nations regarding data-protection principles and have implemented the EU Directive on Data Protection which is designed to protect the flow of data to countries (Tavani, 2004).

"A good theory of privacy has at least three components: an account of the concept of privacy, an account of the justification for privacy, and an account of the management of privacy" (Tavani & Moor, 2001, p. 6). Scholars often provide a theoretical basis for privacy regarding its instrumental value, a value that is good because it leads to something good, and its intrinsic value, a value that is good in itself. Privacy for one of many reasons is instrumental because it offers protection from harm (Moor, 1997) and it shares a special relationship that is necessary for democracy (Johnson, 2001). Privacy may be viewed as intrinsic because it represents "the risk of an intrinsic loss of freedom" (Spinello, 2000, p. 103), or because there is a connection between privacy and autonomy (Johnson, 2001). Moor (1997) includes a core list of values that are related to privacy which are life, happiness, freedom, knowledge, ability, resources, and security. Tavani and Moor (2001) suggest privacy has two distinct components: protection from access and information gathering (a justification) and individual control of personal information (a justification and management).

Privacy in respect to personal information and technology should be examined from the viewpoint of the amount of information retained, the transmission speed of information, the duration of retained information, and the kind of information retained, and are significant in relation to data-gathering often without the consent or knowledge of the individual, data-exchange between computer databases and data-mining of large databases (Tavani, 2004). Cybertechnology allows what Moor (1997) describes as "the greasing of information," the collection and manipulation of information in ways that most people do not expect. For this reason, privacy topics of interest should include a discussion of Internet cookies, data and workplace surveillance, search engines, and privacy-enhancing technologies (PETs), a new technology that plays a role in allowing individuals to control the amount of information they disclose online and what information they want to release (Tavani & Moor, 2001; Tavani, 2004).

The Internet has many democratic characteristics: it offers many-to-many communication that is unmediated, unfiltered, and uninstitutionalized, it provides access to a diversity of sources, it provides opportunities for new associations to form, and it gives more power to the less powerful (Johnson, 2001). However, the Internet also provides an opportunity for social fragmentation to occur such as individuals who isolate themselves or entrench themselves into their own prejudices (Johnson, 2001, Tavani, 2004). Discussions regarding the current status, or future direction of the form, of the Internet are certainly relevant ethical topics. Faculty ranked privacy topics highest in importance in the Barroso and Melara study (2004) of California universities and other countries.

2.9.9 Computer Crime

History and examples of computer crime, cracking or hacking and its effects, viruses, worms, and Trojan horses, and crime prevention strategies are included in the computer crime elective knowledge area. Computer crimes may take place within a computer system by trusted persons or may take place in cyberspace. Cybercrimes such as hate crimes, fraud, gambling, drug trafficking, viruses, worms, cyberstalking, industrial espionage, cyberterroism, and denial of service attacks may be explored to illustrate the social and financial costs of cybercrime.

Hackers may gain unauthorized access to a computer system, release a computer virus or worm, take control of a web site or make a denial of service attack on a web site. Johnson (2001) points out that some computer enthusiasts make a distinction between hackers and crackers, with the definition of a cracker as someone who engages in illegal activities and a hacker as someone who does not. The distinction between the two has not taken hold. While hackers espouse that "information should be free," they provide a useful service, and do not harm real people, the very idea of hacking is contrary to privacy (Tavani, 2004).

While the types of computer crime and cybercrime may easily be addressed in a lower-level course, crime prevention strategies may be best addressed in technical courses dealing with network security, database systems design and software engineering. Spafford suggests that measures to reduce the vulnerability of a threat to a computer system should not be viewed as an "add-on" but should be embedded in the design of a system (as cited in Tavani, 2004). In relation to computer security, prevention may take the form of firewalls, antivirus software, or encryption devices. Computer crimes, while an elective topic, were ranked high in importance on by faculty in the Barroso and Melara study (2004). Additionally, students seem to enjoy discussing computer crime topics.

2.9.10 Economic Issues in Computing

Economic issues in computing surround the elective knowledge areas of the implications of monopolies, the effect of skilled labor supply and quality in computing products, pricing strategies in the computing environment and concepts that address equity in the access of computing. The term "digital divide" commonly refers to the widening gap that is created by those who have access to computing and those who do not and is usually discussed in the context of computing as it relates to education, ethnicity, disability, age, jobs and job skills, and international economic issues (Johnson, 2001; Kizza, 2003; Tavani, 2004). While some legal and economic solutions are offered in the form of universal access service policies and E-rates, there are no clear cut solutions to the digital divide issue.

Business pricing is often based upon supply and demand. If suppliers have no constraints, their object is to receive the highest price that produces the most profit. However, market demand often impacts the price of the supplier and may often cause the supplier to lower the price. In many industries, levels of pricing may be based upon such factors as negotiation between the supplier and buyer, or government regulations.

Merriam-Webster's Online Dictionary defines a monopoly as the exclusive ownership through legal privilege, command of supply, or concerted action. The issue of monopoly came to the forefront in a case between the United States government and the state of New York versus Microsoft Corporation when Microsoft was charged with monopoly power in the PC operating industry. While the case was eventually settled and certain restrictions were placed on Microsoft, many considered it a victory for Microsoft ("Judge approves Microsoft antitrust settlement", 2002). Microsoft was also fined $600 million dollars by the European Union ("Microsoft hit by record EU fine", 2004) and paid the fine in July of 2005 but is appealing the decision (“Microsoft pays EU in full”, 2005), so the monopoly issue with Microsoft is still in the forefront. While exposure to the topics of pricing strategies and monopolies are not mandatory topics, some knowledge of these topics adds to a student's market savvy.

2.9.11 Philosophical Frameworks

Philosophical frameworks, particularly utilitarianism and deontological theories, problems of ethical relativism, scientific ethics in historical perspective and differences in scientific and philosophical approaches are elective philosophical frameworks knowledge areas. Utilitarianism is an ethical theory that claims behavior is driven by its consequences, while deontological theories are based upon the internal character of the act (Tavani, 2004). Ethical relativism does not accept the existence of universal moral norms but rather believes that morals should be interpreted in the context of society, culture or the individual (Kizza, 2003). A problem with the ethical relativism philosophy is that just because an individual or members of a particular cultural group believes something is right or wrong does not make it right or wrong. Ethical relativism does not stand on any moral principles. The contradiction of the morality of slavery is a perfect counter-argument to ethical relativism.

The scientific method has been adopted by the discipline of computer science and for this reason, it is important that students have exposure to hypothesis formulation, experimental design, hypothesis testing, and data analysis (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2001). Twenty to thirty years ago science and technology literature was filled with claims about the value-neutrality of their research. However, research scientists and technologists are influenced by social factors that result in embedded values in technology, such as user-friendliness, and efficiency (Johnson, 2001). Scientific ethics are often based upon utilitarian

theories which result in the prime ethic of the autonomous search for advances, which are just as value-laden as other groups, such as environmentalists promoting nature before profit or economic left-wingers promoting public risk before corporate profit (Munro, 2000). Philosophical theories are based upon a set of moral rules in a specific context, which are then justified against a set of violations. While some philosophical theories may rank benefits and harms differently, they are nevertheless tested over time. Undergraduate students advancing to graduate programs need to develop an awareness of embedded values that may take place in the scientific community so that as they research technology advances they begin to weigh various philosophical theories to examine their research. Most computer science faculty do not have a philosophy background and may not feel comfortable covering the topic of various philosophical frameworks.

Chapter III

METHODOLOGY

3.1 Introduction

The methodologies for conducting the faculty survey are described in this chapter. The faculty survey was used to determine the status of social and professional issues in undergraduate computer science programs. Methodology issues such as the research questions, population and sampling plan, survey instrument, variables and measures, survey procedures, reliability and validity issues, ethical issues, and the analysis plan for the survey are discussed.

3.2 Faculty Survey

An online survey was used to determine the status of social and professional issues in the undergraduate computer science programs in the United States.

3.3 Research Questions

1. Are social and professional issues integrated into the undergraduate computer science curricula?

Null Hypothesis: For the general population of schools, there is no relationship between size of school and the social and professional issues integrated into the undergraduate computer science curricula.

2. How do undergraduate computer science programs integrate social and professional issues into their curriculum?

Null Hypothesis: For the general population of schools, there is no relationship between size of school and how social and professional issues are integrated in undergraduate computer science programs.

3. Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so what type of training have they received?

Null Hypothesis: For the general population of schools, there is no relationship between size of school and training to teach social and professional issues.

4. What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum?

Null Hypothesis: For the general population of schools, there is no correlation between the size of school and computer science faculty opinions about incorporating social and professional issues into the undergraduate computer science curriculum.

5. How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?

6. What is the practicing discipline of faculty that teach social and professional issues courses or modules?

7. What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?

8. What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?

9. What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?

3.4 Population and Sampling Plan

A list of 1,400 universities and colleges that offer computer science majors was purchased from Market Data Retrieval (MDR), a company that provides marketing information and services for the education market. Each entry on the list included the university or college name, the location (city and state) of the university or college, the approximate enrollment of the university or college, and the name of the department chair. While MDR assured that the list contained only computer science programs, a review of the list revealed that the list included other types of majors, such as Computer Information Systems and Information Technology majors, which would not be appropriate members of the population. Therefore, each university or college on the list was examined to determine the appropriateness of their inclusion in the population in an effort to obtain an accurate list of the "true" or known population. Determining the known population will affect the validity of research generalizations to the specified population.

The web site for each university and college on the list was reviewed to collect three types of information. First, an effort was made to verify that the university or college offered an undergraduate computer science major. Approximately 600 universities and colleges did not offer a computer science major, but rather some other type of computer related major. These 600 universities and colleges were removed from the population because they did not meet the criteria for the population leaving a population of approximately 800 universities and colleges that offer undergraduate computer science majors. Second, an effort was made to verify that the current department chair's name was accurate. Third, the e-mail address of the current department chair was collected so that each chair could become the contact person for the faculty survey. The known population, or a sampling frame, identified through this process consists of 797 faculty chairs from undergraduate computer science programs in the United States.

The sampling frame of 797 faculty chairs was used to draw an unbiased random sample and provided the opportunity for every member of a known population an equal chance of being included in the sample population (Gravetter & Wallnau, 2004). In an effort to reduce the possibility that the sample may turn out to be unrepresentative of the population, a stratified random sample was used to determine the final sample (Huck, 2000). The sampling frame was divided into five groups or strata based upon the university or college enrollments, which "should increase the homogeneity within each stratum and increase the heterogeneity between strata" (Tilley, 2005, p. 6). The use of strata allows for stratified random sampling which should provide more precision and reduce the sampling error (Scheaffer, Mendenhall & Ott, 1979). The population by enrollment strata is shown in Table 1.

Table 1
Strata (subgroups) of the Population

University or College Enrollment	Number of Schools	Percentage of Schools by Category
Under 1,000	35	4%
1,001 – 5,000	345	43%
5,001 – 10,000	173	22%
10,001 – 20,000	136	17%
Over 20,000	108	14%
Total	797	100%

An overall sample size of 700 universities and schools was chosen from the known population of 797 schools in an effort to increase power. Cohen (1977) suggests a sample size of approximately 600 participants for a chi-square test with a small effect and 12 degrees of freedom, a power of .80 and an alpha of .01. However, the sample size was increased to 700 schools because no additional costs were associated with increasing the sample size and rates of return were anticipated to be low.

A stratified random sample of 700 schools was drawn from the known population of 797 schools using percentages from each strata of the known population, yielding an overall sample shown in Table 2.

Table 2.
Strata (subgroups) for Stratified Random Sampling

University or College Enrollment	Number of Schools	Percentage of Schools by Category
Under 1,000	31	4%
Under 5,000	303	43%
5,000 – 10,000	152	22%
10,001 – 20,000	119	17%
Over 20,000	95	14%
Total	700	100%

3.5 Survey Instrument

A survey is usually conducted when a researcher wants to estimate some unknown characteristic (Czaja & Blair, 2005), the distribution of characteristics of a population (Dillman, 2000) or to collect information about objective and verifiable facts (Fowler, 1995). The goal in designing the survey instrument should be to collect high quality information that is pertinent to the research goals and produce high response rates (Dillman, 2000). Questions should be written in a manner that "every potential respondent will interpret in the same way, be able to respond to accurately, and be willing to answer" (Dillman, 2000, p. 32).

A variety of themes surfaced, after considerable review of the computer science and computer ethics literature, concerning the topic of integrating social and professional issues into the undergraduate computer science program. Themes such as: (a) the coverage of social and professional issues (computer ethics) in undergraduate computer science curricula, (b) the delivery method, (c) whether computer ethics is taught by computer scientists or philosophers, (d) computer ethics training, (e) the decision making process, (f) pedagogy, (g) computer ethics topics are covered, (h) reasons for not covering computer ethics and (i) the perceptions of faculty concerning computer ethics. The researcher developed survey questions based upon these major themes, with guidance from the literature. A web survey was conducted to identify answers to questions which reflect the various themes related to the topic of the integration of social and professional issues in the undergraduate computer science curriculum. The faculty survey appears in Appendix A.

3.6 Variables and Measures

Variables used in the faculty survey were used to seek relationships between variables. Four variables are grouped by common characteristics and nine variables are grouped by computer ethics themes. Variables grouped by common characteristics include school size, number of majors, region, and professional title. Variables grouped by computer ethics themes include ethics covered, ethics delivery, special training, ethics perception, decisions made, who teaches, pedagogy, topics covered, and reasons for not teaching.

3.7 Survey Procedures

Web or Internet surveys are noted to be more cost effective than mail surveys, increase the speed of the collection of data, are easier to use, have a higher response rate (Cobanoglu, Warde & Moreo, 2000) and allow complex skip patterns of survey questions. Computer science faculty frequently use e-mail and the Internet and therefore it was expected that they may be more likely to respond to a web survey than a mail survey.

The faculty survey was conducted using a web survey and web survey tool (SurveyMonkey.com), which allowed the researcher to design and customize online surveys and to collect and analyze results in real-time. SurveyMonkey includes features such as unlimited number of questions, skip logic that allows one to customize the path for the respondent, customizable survey features, data encryption, the ability to download all data to a local computer in an Excel spreadsheet or into a statistical package and allows the account holder to share survey results with survey respondents.

Participants were contacted initially by an e-mail which directed them to an address for a web site containing the faculty survey. The replies from the survey were recorded in a SurveyMonkey.com database. Information from this database was downloaded to a statistical package, Statistical Package for the Social Sciences (SPSS), for analysis. Five e-mails were sent to faculty invited to participate in the study. The first e-mail contact (Appendix C) was made a few days before the study began in an effort to verify e-mail addresses and inform the possible participants of the importance of the study. The second e-mail contact (Appendix D) contained the invitation to participate in the study, a link to the web survey and specific information about the purpose of the study. The third e-mail contact (Appendix E) was sent a week after the study began to remind the non-responders of the study. Two weeks after the study began, the fourth e-mail contact (Appendix F) was sent to invite non-respondents to participate in the study. The fifth e-mail contact (Appendix G) was sent four weeks after the study began and reminded non-responders that the study would be closing soon. A short thank you message was displayed after the survey respondent completed the survey.

Computer science faculty have demonstrated little interest in the topic of social and professional ethics in undergraduate computer science curricula and therefore, the expected response rate for the faculty survey was between 10% and 30%. Cobanoglu, Warde and Moreo (2000) compared mail, fax and web-based survey methods of hospitality professors and found that the web survey had a significantly higher response rate (44%) than the mail survey (26%) or fax survey (17%) and that the response pattern for web survey respondents was quicker than mail survey respondents. Other researchers (Cazja & Blair, 2005; Trouteaud, 2004) have examined factors, such as the length of the survey and the e-mail subject header. Several researchers (Cazja & Blair, 2005, Dillman, 2000) readily admit that the knowledge base on how to increase the response rate of web-based surveys is behind the knowledge base of mail surveys. Based upon the research of Cobanoglu et al. (2000) and Trouteaud (2004) on response patterns, it was expected that response patters would be highest after the first and second invitation to participate in the faculty web-based survey.

3.8 Reliability and Validity Issues

Survey questions are valid if they measure the factors or constructs of interest and the survey respondents interpret the questions as it were intended (Czaja & Blair, 2005).

Wallen and Fraenkel (2001) report that the validation of a survey instrument is the process of collecting evidence to support inferences that a researcher makes on the data collected. The rigor with which the study is conducted also contributes to the internal validity of the study and extends to the survey design, the care used in conducting the study and the decisions that were made regarding what and what not to include in the study ("Validity", 2005).

While there are many types of validity, face, and content-related validity are most pertinent to the faculty survey. Face validity addresses how a survey instrument is designed or how it attempts to gather the data ("Validity", 2005; Kitchenham & Pfleeger, 2002c). Content-related validity refers to the characteristics of the content included in the survey instrument and the specifications or qualifications that the research used to formulate the content (Kitchenham & Pfleeger, 2002c; Wallen & Fraenkel, 2001).

External validity is important when a researcher wants to generalize research results from the study findings to the general population (Cook & Campbell, 1979 as cited in Pattern, 2004). Sample bias is a serious threat to external validity so by using stratified random sampling from a well-defined population sample bias will be reduced.

The faculty survey, which was administered as a web survey, was designed after consulting several survey design textbooks and websites, such as Dillman, Wallen and Fraenkel, Czaja and Blair and "Validity," that emphasize issues associated with measurement error, coverage error and sampling error. Each type of error that may affect validity is addressed below.

<u>Measurement error.</u> Dillman defines measurement error as "The result of poor question wording or questions being presented in such as way that inaccurate or

uninterpretable answers are obtained" (Dillman, 2000, p. 11). The researcher wrote the questions included in the faculty survey after reviewing current computer ethics issues. Detail was paid to the wording of questions, possible responses, grouping of questions and the order of questions presented in the faculty survey. Focus groups of experts in the field of computer ethics and non-experts, computer science faculty who do not incorporate computer ethics into their computer science curriculum, were asked to participate in the focus group.

Coverage error. Measures were taken to assure that all undergraduate computer science programs in the United States were included in the population by visiting each web site of the list of 1400 universities and colleges. The computer science curriculum was reviewed at each university or college department web site in an effort to determine if they in fact offer an undergraduate computer science major.

Sampling error. The researcher contacted each department chair included in the sample prior to conducting the actual survey in an effort to gain the name of the appropriate member of each computer science department to respond to the survey. In the letter sent to universities and college it was noted that this was a national survey which has not been undertaken previously and that participation would allow their voice to be heard. Additionally, the sample size of 700 universities and colleges helped to reduce the sampling error.

The focus group for the faculty survey consisted of six computer science educators. Each focus group member's suggestions were reviewed for the appropriateness of his comments and then incorporated whenever possible into the faculty survey.

Reliability is often referred to as the consistency of the data collected (Pattern, 2004). This is usually accomplished by a test and retest of a survey, which then allows one to examine if the same distribution occurs over a period of time (Kitchemham & Pfleeger, 2002c). While a test and retest of the survey will not be possible given the time needed to administer the survey, the faculty survey was reviewed by a focus group of six computer science faculty, of which some were computer ethics experts and some were not. The pilot group was asked to provide feedback on wording of the questions, the appropriateness of these questions, the order of the questions, and the length of time to complete the survey. The responses of the pilot group were reviewed to look for any inconsistencies in their answers. The survey was also piloted with a group of computer science students and computer science faculty once the survey was stored on the SurveyMonkey.com web site to ensure that the survey worked appropriately.

Another factor that affects data reliability is non-response bias (Grossnickle & Raskin, 2000). This type of bias occurs when people, selected to participate in the survey, do not respond because they refuse to participate or may not be contacted. When this type of sampling error occurs, certain types of survey respondents may be underrepresented. Non-response bias is difficult to control.

3.9 Ethical Issues

While scientific research provides new information and contributes to the research community, the research may pose ethical situations. The Belmont Report (1979) established three basic ethical principles for research that involve humans, respect for persons, beneficence and justice. The "respect for persons" principle addresses the idea that while people are considered to be self-determinant, there are people with diminished autonomy that are entitled to protection. The "beneficence" reminds researchers to minimize harms and maximize benefits. The principle of "justice" encourages researchers to treat people fairly and share equitably the burdens and benefits of research.

Guided by these principles, the following steps were taken: (1) The researcher secured all necessary Internal Review Board (IRB) approval for the survey and e-mail letters used to contact the faculty in the sample. (2) Participation in the study was voluntary. (3) Survey responses were kept confidential and the data were protected on the SurveyMonkey.com web site and on the researcher's computer. (4) The purpose and benefits of the survey, contact information, and a description of confidentiality was provided in the contact e-mail that introduced the study. (5) The survey was designed to avoid any embarrassing questions. (6) The research targeted an appropriate population that would benefit from the study.

The survey results were stored in a secure database at the SurveyMonkey.com web site and later stored on the researchers computer which is password protected. The survey data will be stored for a period of at least five years so that any future studies may be compared to these data.

3.10 Analysis Plan

The data were collected from the SurveyMonkey.com web site and then imported into a statistical package, Statistical Package for the Social Sciences (SPSS), for analysis. Descriptive statistics for the independent variables were summarized. Survey results were measured by the categories previously described. A family-wise alpha of .001 used for all tests and a simple sequentially rejective multiple test procedure was used to ensure a small probability of rejecting any true hypotheses (Holm, 1979). Table 3 summarizes the tests that were performed.

Table 3

Summary of Data Sources, Types and Measures Applied by Research Question (Faculty Survey)

Research Question #	Date Source	Response Type	Data Type	Analysis Plan
1	Faculty Survey Responses	Categories	Nominal	Chi-square test of independence
2	Faculty Survey Responses	Categories	Nominal	Chi-square test of independence
3	Faculty Survey Responses	Categories	Nominal	Chi-square test of independence
4	Faculty Survey Responses	Likert Scale	Ordinal	Spearman Correlation
5, 6, 7, 8, 9	Faculty Survey Responses	Categories	Nominal	Frequencies, Percentages

Chapter IV

RESULTS

4.1 Introduction

A web-based survey was administered to a stratified random sample of undergraduate computer science programs in the United States with the purpose of exploring how social and professional issues (computer ethics) are integrated into undergraduate computer science curricula in the United States. The investigator collected data regarding whether social and professional issues were taught in undergraduate computer science curricula, the delivery method, who teaches computer ethics social and professional issues, how faculty receive ethics training, how decisions are made regarding the placement of ethics in the curricula, the pedagogies, what topics are covered, what are the reasons for not covering computer ethics, and the perceptions of faculty concerning computer ethics. The investigator also examined the data collected for trends and differences among the overall student enrollment, numbers of computer science majors, accreditation, hours of coverage, and region of the country.

4.2 Population and Sample

The population eligible for inclusion in this study consisted of 797 undergraduate schools in the United States that offered a computer science major. The list of 797 schools was developed from a list of 1,400 universities and colleges that offered undergraduate computer science programs, which was purchased from Market Data Retrieval (MDR), a company that provides marketing information and services for the education market. An exhaustive review of the list revealed that it included 600 other technology related majors, such as Computer Information Systems and Information

Technology majors. Therefore, 600 universities and colleges were removed from the population, because they did not meet the computer science program criteria for the population, leaving a population of 797 universities and colleges that offer undergraduate computer science majors. This left a known population which consisted of N = 797 faculty chairs from undergraduate computer science programs in the United States.

A sample size of n = 700 was selected from the population and then divided into strata (subgroups) according to the size of institution. This stratified random sample ensured that subgroups were represented in the correct proportions. A total of 700 e-mails were sent to department chairs asking them to respond with the name of the appropriate person to whom the survey should be e-mailed. Approximately 125 e-mails or 18% were returned with an e-mail address of the correct person to whom the study should be directed at the particular institutions. Six colleges or universities were removed from the list of 700 colleges or universities because of bad e-mail addresses, leaving 694 e-mail addresses. A total of 694 e-mails with a survey link and password were sent to the stratified randomly selected faculty and 258 survey responses were received. One response was rejected because the survey participant did not answer any questions and six of the survey responses were excluded because of missing data. This provided 251 usable surveys for the study and a response rate of 36%. Table 4 identifies the proportionate stratified random sample results.

Table 4

Proportionate Stratified Random Sample Results from a Population Divided into University or College Strata

University or College Enrollment	Number of Schools (Population)	Proportion of Schools by Category	Number of Schools (Strata Sample Size)	Usable Survey Responses	Proportion of Survey Responses by Category
Under 1,000	35	4%	31	12	4%
1,001 - 5,000	345	43%	303	112	45%
5,000 – 10,000	173	22%	152	52	21%
10,001 – 20,000	136	17%	119	42	17%
Over 20,000	108	14%	95	33	13%
Total	797	100%	700	251	100%

4.3 Demographics of Respondents

The 251 survey respondents from various regions of the country, large and small colleges or universities, were represented by 119 (47.4%) chairs of a department containing a computer science or computer science and engineering major, 101 (40.2%) faculty in a department containing a computer science or computer science and engineering major, 18 (7.2%) chairs of the computer science curriculum committee, 12 (4.8%) as an other category, which included college deans, adjunct professors, program director, etc., and one survey respondent who did not indicate his position. The respondents were represented by college or university size (Table 4), by the number of computer science majors (Table 5), from a variety of regions in the United States (Table 6), and from accredited and non accredited institutions (Table 7).

Table 5

Survey Respondents - Demographic Breakdown by Number of Computer Science Majors

	f	%
Under 100	149	59.3
101 to 300	76	30.3
301 to 500	18	7.2
Above 500	8	3.1
Total	251	100.0

Table 6
Survey Respondents - Demographic Breakdown by Region of the United States

	f	%
Pacific region (Alaska, California, Hawaii, Oregon, Washington)	22	8.8
Mountains region (Arizona, Colorado, Montana, New Mexico, Nevada, Utah, Wyoming)	11	4.4
West North Central region (Iowa, Kansas, Minnesota, Missouri, North Dakota, Nebraska, South Dakota)	40	15.9
East North Central region (Illinois, Indiana, Michigan, Ohio, Wisconsin)	42	16.7
West South Central region (Arkansas, Louisianan, Oklahoma, Texas)	22	8.8
East South Central region (Alabama, Kentucky, Mississippi, Tennessee)	20	8.0
South Atlantic region (Washington, DC, Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia)	39	15.5
Middle Atlantic region (New Jersey, New York, Pennsylvania)	37	14.7
New England region (Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont)	18	7.2
Total	251	100.0

Table 7
Survey Respondents - Demographic Breakdown by Accredited versus Non-Accredited Schools

	f	%
Non-Accredited	143	57.0
Accredited	75	29.9
Not Reported	33	13.1
Total	251	100.0

4.4 Statistical Analysis, Bonferroni Correction and Effect Size

Note: The faculty survey contained 41 questions upon which the intention was to perform chi-square tests. A "family-wise" alpha of .05 was sought so a Bonferroni adjusted alpha of .001 or .05 alpha / 41 questions was used (Holm, 1979). In decreasing the alpha level from .05 to .001, it is more difficult obtain any significant results. In other words the tests are more conservative and thereby decrease the chance of committing a Type I error. Generally, the Pearson chi-square test of independence was used to analyze the data. In the cases of chi-square, where the assumption of a minimum of five subjects per cell was not met, categories were regrouped into broader, yet meaningful categories, where possible. When a Pearson chi-square test of independence is significant, a modified phi-coefficient (ø) will be calculated using the Cramer's V formula as reported in Gravetter and Wallnau (2004). Effect sizes of small, medium or large will be determined using Cohen's guidelines (1988).

4.5 Research Question One

Are social and professional issues integrated into the undergraduate computer science curricula? Null Hypothesis: For the general population of schools, there is no relationship between size of school and the social and professional issues integrated into the undergraduate computer science curricula.

Survey respondents were asked if their department's undergraduate computer curriculum included any social and professional ethics issues. Of the 251 responses to this question, 31 (12.45%) indicated that they do not include any ethics in their computer science curricula, while 220 (87.6%) answered that they do include ethics. The number of universities or colleges that include or exclude social and professional ethics by overall enrollment is presented in Table 8. No Pearson chi-square analysis could be performed because several cells had an expected count less than 5. Overall enrollment was collapsed into two groups (0 – 5,000 and above 5,000) to avoid cells with fewer than 5, but the Pearson chi-square test of independence comparing ethics inclusion or exclusion by overall enrollment was not significant with ($\chi^2(1, n=251) = 1.062$, $p = 0.303$, $ø = 0.00002$).

Table 8

Ethics Inclusion Reported by Overall Enrollment

	Overall Enrollment					
Ethics Inclusion	Under 1,000	1,001 – 5,000	5,001 – 10,000	10,001 – 20,000	Over 20,000	Total
No	0	18	4	3	6	31
Yes	12	94	48	39	27	220
Total	12	112	52	42	33	251

The number of institutions that include or exclude social and professional ethics reported by the number of computer science majors is presented in Table 9. No Pearson chi-square analysis could be performed because several cells had an expected count less than 5. The number of computer science majors was collapsed into two groups (0 – 300 and above 300) to avoid cells fewer than 5, but the Pearson chi-square test of independence comparing ethics inclusion or exclusion by the number of computer science majors was not significant with ($\chi^2(1, n=251) = 0.247$, $p = 0.619$, ø = 0.000001).

Table 9

Ethics Inclusion Reported by Number of Computer Science Majors

	Number of Computer Science Majors				
Ethics Inclusion	Under 100	101 - 300	301 – 500	Above 500	Total
No	24	3	4	0	31
Yes	125	73	14	8	220
Total	149	76	18	8	251

Survey respondents were also asked to identify the number of hours (classroom) that social and professional issues were covered in the undergraduate computer science curricula. Table 10 records the hours (classroom) ethics is covered for the 220 colleges or universities indicating they include ethics coverage in their curricula. Note: Two respondents did not provide information regarding the number of hours of ethics coverage.

Table 10

Social and Professional Ethics Hours (Classroom) of Coverage

	F	%
1-4	43	19.7
5-8	46	21.1
9-12	21	9.6
13-16	26	11.9
Above 16	82	37.6
Total	218	100.0

Survey respondents were also asked whether they required ethics coverage in their undergraduate computer science curricula. Of the 220 that include ethics, 173 (78.6%) require ethics coverage, 46 (20.9%) do not require ethics coverage, and 1 (.5%) did not answer this question. The Pearson chi-square test of independence could not be calculated for required ethics coverage by the number of computer science majors because several cells had an expected count fewer than 5. However, when the number of majors was regrouped into two groups (under 100, 100 or above), there was a significant relationship between whether a school required ethics coverage and the number of computer science majors as shown in Table 11 with ($\chi^2(1, n=219) = 10.67$, $p < 0.001$, ø = 0.22).

Table 11

Ethics Inclusion Reported by Number of Computer Science Majors (2 Groups)

	Number of Computer Science Majors		
Ethics Required	Less 100	100 or Above	Total
No	36	10	46
Yes	89	84	173
Total	125	94	219

Survey respondents were also asked whether they were accredited. Seventy-five (34.1%) reported that they were accredited, 143 (65.0%) reported they were not accredited and two (.9%) did not respond to this question. The Pearson chi-square test of independence could not be calculated for accredited by the size of school enrollment because several cells had an expected count fewer than 5. However, when the size of college or university enrollment was regrouped into two groups (0 – 5,000 and above 5,000), a significant relationship between accredited institutions and the size of college or university enrollment was found as shown in Table 12 with ($\chi^2(1, n=218) = 39.85$, $p < 0.001$, ø = 0.42).

Table 12
Accredited Reported by Overall Enrollment (2 Groups)

	Overall Enrollment		
Accredited	0 – 5,000	Above 5,000	Total
No	91	52	143
Yes	14	61	75
Total	105	113	218

The Pearson chi-square test of independence could not be calculated for accredited by the number of computer science majors because several cells had an expected count fewer than 5. However, when the number of majors was regrouped into two groups (under 100, 100 or above), there was a significant relationship between accredited institutions and the size of college or university enrollment as shown in Table 13 with ($\chi^2(1, n=218) = 61.69$, $p < 0.001$, ø = 0.053).

Table 13
Accredited Reported by Number of Computer Science Majors (2 Groups)

	Number of Computer Science Majors		
Accredited	Less 100	100 or Above	Total
No	108	35	143
Yes	15	60	75
Total	123	95	218

There was a significant relationship between accredited institutions and whether ethics was required as shown in Table 14 with ($\chi^2(1, n=217) = 20.294$, $p < 0.001$, ø = 0.31).

Table 14

Accredited by Ethics Required

	Ethics Required		
Accredited	No	Yes	Total
No	43	99	142
Yes	3	72	75
Total	46	171	217

Survey respondents were also asked what their reasons were for incorporating social and professional ethics into their undergraduate computer science curricula and were allowed to select multiple answers. Table 15 summarizes the responses for 220 survey respondents.

Table 15

Reasons For Incorporating Ethics Into Computer Science Curricula (Multiple Answers)

	f	%
CAC/ABET requires coverage	106	48.2
ACM recommends coverage	137	62.3
We believe that social and professional ethics should be incorporated into the undergraduate computer science curricula	200	90.9
Other	29	13.2

Of the 29 survey respondents who listed "Other" as their reason for incorporating social and professional ethics, 7 (3.2%) listed religion reasons, 5 (2.3%) listed a general education or university requirement, 4 (1.8%) listed strong support from alumni and industry, 4 (1.8%) listed that ethics was an integral topic throughout their curricula, 1 (.005%) listed that ethics was important to their military academy curricula, and the 9 (4.1%) remaining comments ranged from specific models used for the curriculum to explanations of how ethics is incorporated into their curriculum.

Of the 220 respondents for this question, 66 (30%) selected one answer, 64 (29.1%) selected two answers, 82 (37.3%) selected three answers, and 8 (3.6%) selected four answers to this question. Of the survey respondents who selected two answers, 39 (17.7%) selected that ACM recommends coverage, and that they believe that social and professional ethics should be incorporated into the undergraduate computer science curricula. Of the survey respondents who selected three answers, 69 (30.9%) selected that CAC/ABET requires coverage, ACM recommends coverage and that they believe that social and professional ethics should be incorporated into the undergraduate curricula.

4.6 Research Question Two

How do undergraduate computer science programs integrate social and professional issues into their curriculum? Null Hypothesis: For the general population of college or universities, there is no relationship between size of school and how social and professional issues are integrated in undergraduate computer science programs.

Survey respondents were asked how they integrate social and professional issues into their curricula. Of the 220 survey respondents, 52 (23.6%) responded that they teach a standalone course, 91 (41.1%) responded that their social and professional issues content is integrated into other courses, 60 (27.3%) responded that they use a standalone course and integrate these issues into other courses, and 17 (7.7%) responded that they use "Other" means. Of the 17 responses in the "Other" category, 8 (3.7%) offer an ethics component in another course, 6 (2.7%) offer a course that is taught by another department.

The Pearson chi-square test of independence could not be calculated for how colleges or universities integrate social and professional issues by the overall student enrollment because several cells had an expected count fewer than 5. However, there was a relationship between how schools integrate social and professional issues by number of computer science majors regrouped into two groups (less than 100 and 100 and above) as shown in Table 16 with ($\chi^2(3, n=220) = 18.61$, $p < 0.001$, ø = 0.17).

Table 16
Delivery by Number of Computer Science Majors (2 Groups)

	Number of Computer Science Majors		
Delivery	Less 100	100 or Above	Total
Standalone Course	24	28	52
Content Integrated Into Other Courses	67	24	91
Standalone Course and Integrated	25	35	60
Other	9	8	17
Total	125	95	220

Also, a relationship was found between how colleges and universities integrate social and professional issues by hours of coverage regrouped into two groups (1 – 12 and 13 and above) as shown in Table 17 with ($\chi^2(3, n=218) = 30.12$, $p < 0.001$, ø = 0.21).

Table 17
Delivery by Hours of Coverage (2 Groups)

	Hours Of Coverage		
Delivery	1 -12	13 and Above	Total
Standalone Course	21	31	52
Content Integrated Into Other Courses	65	25	90
Standalone Course and Integrated	18	41	59
Other	6	11	17
Total	110	108	218

Survey respondents were asked at what level their standalone course was offered. Of the 112 survey respondents who offered a standalone course, 20 (17.9%) offer the standalone course as a lower-level course (freshman or sophomore), 88 (78.6%) as an upper-level course (sophomore, junior, senior), and 4 (3.6%) with no level of standing.

4.7 Research Question Three

Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so what type of training have they received? Null Hypothesis: For the general population of schools, there is no relationship between size of school and training to teach social and professional issues.

Survey respondents were asked whether their department, school, or college provided training for faculty that teach social and professional ethics. Of the 219 who responded to this question, 169 (77.2) responded "No," while 50 (22.8%) responded "Yes."

Of the 50 who responded "Yes" to this question, 49 responded to a follow-up question regarding the circumstances of the training. Two (4.1%) responded that faculty training was mandatory and the majority of faculty embraced the training, one (2.0%) responded that faculty training was mandatory and the majority of faculty were resistant to the training, 22 (44.9%) responded that faculty training was not required, but the majority of faculty were receptive to receive some type of training, 11 (22.4%) responded that faculty training was not required, but the majority of faculty were not interested in receiving any training, and 13 (26.5%) responded to an "Other" category. "Other" responses ranged from NSF workshops, limited funding, professional conferences or seminars, and training by faculty who already teach the ethics course.

The 49 survey respondents who answered “Yes” to the training question were also asked to identify the circumstances surrounding the training. Table 18 summarizes the responses. The “Other” responses included several descriptions of NSF workshops or conferences for which the department provided funding, a description that resources were limited for training or that faculty training was provided as ethics across the curriculum, but most faculty did not take part in the training.

Table 18
Circumstances Surrounding Faculty Training

	f	%
Faculty training was mandatory and the majority of the faculty embraced the training	2	4.1
Faculty training was mandatory and the majority of the faculty were resistant to the training	1	2.0
Faculty training was not required but the majority of the faculty were receptive to receiving some type of training	22	44.9
Faculty training was not required and the majority of the faculty were not interested in receiving any training	11	22.4
Other	13	26.5
Total	49	100.0

Survey respondents who answered “Yes” to the question about training were also asked to identify how training was provided. Table 19 summaries the responses.

Table 19
How Ethics Training Was Provided (Multiple Answers)

	f	%
Faculty are responsible for their own training	26	53.1
Training from within the university or college	16	32.7
Training from outside the university or college	15	30.6
1-3 hour workshop	7	14.3
3-6 hour workshop	1	2.0
6-9 hour workshop	5	10.2
Other	15	30.6

"Other" responses ranged from NSF workshops to weekend or weeklong workshops, monthly sessions, seminars, professional conferences, or attending a class taught by someone else.

The Pearson chi-square test of independence could not be calculated for whether training was or was not provided by overall school enrollment, number of majors, hours of coverage or accredited because several cells had an expected count fewer than 5. However, a relationship was found between whether training was or was not provided by whether ethics was required or not required at a school as shown in Table 20 with ($\chi^2(1, n=218) = 11.40$, $p < 0.001$, $ø = 0.23$).

Table 20
Training Provided by Ethics Required

	Ethics Required		
Training Provided	No	Yes	Total
No	44	124	168
Yes	2	48	50
Total	46	172	218

4.8 Research Question Four

What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum? Null Hypothesis: For the general population of schools, there is no correlation between the size of school and computer science faculty opinions about incorporating social and professional issues into the undergraduate computer science curriculum.

Survey respondents were asked to what extent they agreed with the statement, "Social and professional ethics topics should be incorporated into the undergraduate computer science curriculum." The responses, as shown in Table 21, demonstrate a strong support for the inclusion of ethics in the computer science curriculum.

Table 21
Social and Professional Ethics Topics Should Be Incorporated Into The Undergraduate Computer Science Curriculum

	f	%
Completely Agree	186	74.1
Generally Agree	56	22.3
Undecided	5	2.0
Generally Disagree	0	0.0
Completely Disagree	4	1.6
No opinion	0	0.0
Total	251	100.0

Table 22 summarizes the cross tabulations of should ethics be incorporated by whether schools include or exclude ethics. Levels of agreement with "Should Incorporate Ethics" were ranked by faculty on a six-point scale ranging from completely agree (1) to no opinion (6), while "Include Ethics" was ranked either no (1) or yes (2). A correlation between "Should Include Ethics" and "Include Ethics" was statistically related, (Spearman *rho* = -0.420, n = 251, p < 0.01, two tails). Table 23 summarizes the cross tabulations of should ethics be incorporated by the number of computer science majors. Number of Computer Science Majors was ranked one a four-point scale from under 100 (1) to above 500 (4). A correlation between "Should Incorporate Ethics" and "Number of Computer Science Majors" was statistically related, (Spearman *rho* = -0.270, n = 251, p < 0.01, two tails).

Table 22
Social and Professional Ethics Topics Should Be Incorporated Into The Undergraduate Computer Science Curriculum by Schools Including Ethics

	Include Ethics		
Should Incorporate Ethics	No	Yes	Total
Completely Agree	9	177	186
Generally Agree	14	42	56
Undecided	4	1	5
Generally Disagree	0	0	0
Completely Disagree	4	0	4
No opinion	0	0	0
Total	31	220	251

Table 23
Social and Professional Ethics Topics Should Be Incorporated Into The Undergraduate Computer Science Curriculum by The Number of Computer Science Majors

	Number of Computer Science Majors				
Should Incorporate Ethics	Under 100	101-300	301-500	Above 500	Total
Completely Agree	95	69	16	6	186
Generally Agree	46	6	2	2	56
Undecided	4	1	0	0	5
Generally Disagree	0	0	0	0	0
Completely Disagree	4	0	0	0	4
No opinion	0	0	0	0	0
Total	149	76	18	8	251

4.9 Research Question Five

How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?

Survey respondents were asked who made the decision concerning how to incorporate social and professional ethics content into the undergraduate computer science curriculum. Table 24 summarizes the responses. Several of the “Other” responses indicated that the decision was made by “consensus of the entire faculty”.

Table 24

How Decisions Made To Incorporate Ethics Into Computer Science Curricula

	f	%
Committee of faculty	87	39.5
Individual decisions	51	23.2
Committee of faculty and individual decisions	73	33.2
Other	9	4.1
Total	220	100.0

A cross tabulation of the how decisions were made by accredited or non-accredited schools provided the information reported in Table 25, which shows that most accredited schools make decisions by either a committee of faculty, or a committee of faculty and individual decisions (88%) and for non-accredited schools either a committee of faculty, or a committee of faculty and individual decisions are equally often responsible for the decisions (65%).

Table 25

How Decisions Made By Accredited

	Accredited		
How Decisions Made	No	Yes	Total
Committee of faculty	45	41	86
Individual decisions	46	4	50
Committee of faculty and individual decisions	48	25	73
Other	4	5	9
Total	143	75	218

A cross tabulation of the how decisions were made by whether a school does or does not require ethics be provided the information reported in Table 26, which shows that most accredited schools make decisions by either a committee of faculty, or a committee of faculty and individual decisions. There was a significant relationship between how decisions were made by whether ethics was required or not required at a school with ($\chi^2(1, n=219) = 63.915, p < .001$, ø = 0.54).

Table 26
How Decisions Made By Ethics Required

How Decisions Made	Ethics Required No	Ethics Required Yes	Total
Committee of faculty	9	78	87
Individual decisions	31	20	51
Committee of faculty and individual decisions	6	67	73
Other	0	8	8
Total	46	173	219

4.10 Research Question Six

What is the practicing discipline of faculty who teach social and professional issues courses or modules?

Survey respondents were asked who teaches the social and professional issues incorporated into the undergraduate computer science curriculum. Table 27 summaries their responses. The 14 "Other" responses consisted of business, sociology, or humanities faculty.

Table 27
Who Teaches Ethics

	f	%
Philosophy faculty	9	4.5
Computer Science faculty	186	84.5
Teach of CS and other disciplines	10	4.5
Other	14	6.5
Total	220	100.0

4.11 Research Question Seven

What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?

Survey respondents were asked how their department introduced social and professional ethics into the undergraduate computer science curriculum. Table 28 summarizes the possible responses of the 219 respondents to this question. Respondents were asked to select all pedagogies that applied. Journaling, student written ethics vignettes, reflection papers, debates, interactive demonstrations, telling stories, guest speakers, essays, newspaper articles, or codes of ethics made up most of the 24 Other responses.

Table 28
Pedagogies (Multiple Answers)

	f	%
Lectures	194	77.3
Group Discussion	192	76.5
Case Studies	151	60.2
Readings	166	66.1
Presentations	122	48.6
Research Papers	110	43.6
Exams or quizzes	109	43.4
Videotapes	43	17.1
Other	24	9.6

4.12 Research Question Eight

What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?

Survey respondents were asked about their coverage of social and professional issues related to each of the 10 social and professional knowledge units to determine whether the knowledge unit was covered, not covered, or partially covered. Respondents who answered cover or cover portions of the content for a knowledge unit were asked where the particular knowledge unit was covered (standalone course, course content in other courses, or stand alone course and course content in other courses).Tables 29 through 48 reveal the responses. Table 49 provides a summary of the Social and Professional Knowledge Units Coverage. Figure 2 provides a comparison of the Social and Professional Knowledge Units Coverage. Table 50 provides a summary of the Social and Professional Knowledge Units Delivery. Figure 3 provides a comparison of the Social and Professional Knowledge Units Delivery responses.

Table 29
History of Computing Coverage

	f	%
Cover	55	25.0
Do not cover	43	19.5
Cover Portions of the content	111	50.5
Not sure	11	5.0
Total	220	100.0

The history of computing topic includes: Prehistory – the world before 1946; Pioneers of computing; History of computer hardware, software, networking

Table 30
How Integrated - History of Computing Coverage

	f	%
Standalone course	7	4.2
Content in other courses	140	84.8
Standalone course and content in other courses	15	9.1
Not sure	3	1.8
Total	165	100.0

Table 31
Social Context of Computing Coverage

	f	%
Cover	99	45.2
Do not cover	18	8.2
Cover Portions of the content	97	44.3
Not sure	5	2.3
Total	219	100.0

The social context of computing topic includes: introduction to the social implications of computing; Social implications of networked communication; Growth of, control of, and access to the Internet; Gender-related issues; International issues

Table 32

How Integrated – Social Context of Computing Coverage

	f	%
Standalone course	43	21.9
Content in other courses	115	58.7
Standalone course and content in other courses	35	17.9
Not sure	3	1.5
Total	196	100.0

Table 33

Methods and Tools of Analysis Coverage

	f	%
Cover	84	38.2
Do not cover	41	18.6
Cover Portions of the content	81	36.8
Not sure	14	6.4
Total	220	100.0

The methods and tools of analysis topic includes: Making and evaluating ethical arguments; Identifying and evaluating ethical choices; Understanding the social context of design; Identifying assumptions and values

Table 34

How Integrated – Methods and Tools of Analysis Coverage

	f	%
Standalone course	58	35.4
Content in other courses	72	43.9
Standalone course and content in other courses	29	17.7
Not sure	5	3.0
Total	164	100.0

Table 35

Professional and Ethical Responsibilities Coverage

	f	%
Cover	106	48.2
Do not cover	8	3.6
Cover Portions of the content	99	45.0
Not sure	7	3.2
Total	220	100.0

The professional and ethical responsibilities topic includes: Community values and the laws by which we live; The nature of professionalism; Various forms of professional credentialing and the advantages and disadvantages; The role of the professional in public policy; Maintaining awareness of consequences; Ethical dissent and whistle-blowing; Codes of ethics, conduct, and practice (IEEE, ACM, SE, AITP, etc.); Dealing with harassment and discrimination; “Acceptable use” policies for computing in the workplace

Table 36
How Integrated – Professional and Ethical Responsibilities Coverage

	f	%
Standalone course	53	26.1
Content in other courses	104	51.2
Standalone course and content in other courses	43	21.2
Not sure	3	1.5
Total	203	100.0

Table 37
Risks and Liabilities of Computer-Based Systems Coverage

	f	%
Cover	98	44.5
Do not cover	23	10.5
Cover Portions of the content	92	41.8
Not sure	7	3.2
Total	220	100.0

The risks and liabilities of computer-based systems topic includes: Historical examples of software risks; Implications of software complexity; Risk assessment and management

Table 38
How Integrated – Risks and Liabilities of Computer-Based Systems Coverage

	f	%
Standalone course	35	18.5
Content in other courses	103	54.5
Standalone course and content in other courses	50	26.5
Not sure	1	.5
Total	189	100.0

Table 39
Intellectual Property Coverage

	f	%
Cover	118	53.6
Do not cover	21	9.5
Cover Portions of the content	76	34.5
Not sure	5	2.3
Total	220	100.0

The intellectual property topic includes: Foundations of intellectual property; Copyrights, patents, and trade secrets; Software piracy; Software patents; Transnational issues concerning intellectual property

Table 40
How Integrated – Intellectual Property Coverage

	f	%
Standalone course	57	29.4
Content in other courses	106	54.6
Standalone course and content in other courses	30	15.5
Not sure	1	.5
Total	194	100.0

Table 41
Privacy and Civil Liberties Coverage

	f	%
Cover	104	47.3
Do not cover	19	8.6
Cover Portions of the content	88	40.0
Not sure	9	4.1
Total	220	100.0

The privacy and civil liberties topic includes: Ethical and legal basis for privacy protection; Privacy implications of massive database systems; Technological strategies for privacy protection; Freedom of expression in cyberspace; International and intercultural implications

Table 42
How Integrated – Privacy and Civil Liberties Coverage

	f	%
Standalone course	59	30.7
Content in other courses	100	52.1
Standalone course and content in other courses	33	17.2
Not sure	0	0.0
Total	192	100.0

Table 43
Computer Crime Coverage

	f	%
Cover	120	54.5
Do not cover	12	5.5
Cover Portions of the content	80	36.4
Not sure	8	3.6
Total	220	100.0

The computer crime topic includes: History and examples of computer crime; “Cracking” (“hacking”) and its effects; Viruses, worms, and Trojan horses; Crime prevention strategies

Table 44

How Integrated – Computer Crime Coverage

	f	%
Standalone course	41	20.5
Content in other courses	111	55.5
Standalone course and content in other courses	47	23.5
Not sure	1	0.5
Total	200	100.0

Table 45

Economic Issues in Computing Coverage

	f	%
Cover	36	16.4
Do not cover	96	43.6
Cover Portions of the content	73	33.2
Not sure	14	6.4
Total	219	100.0

The economic issues in computing topic includes: Monopolies and their economic implications; Pricing strategies in the computing domain; Effect of skilled labor supply and demand on the quality of computing products; Differences in access to computing resources and the possible effects thereof

Table 46

How Integrated –Economic Issues in Computing Coverage

	f	%
Standalone course	36	33.0
Content in other courses	54	49.5
Standalone course and content in other courses	15	13.8
Not sure	4	3.7
Total	109	100.0

Table 47

Philosophical Frameworks Coverage

	f	%
Cover	55	25.2
Do not cover	95	43.6
Cover Portions of the content	53	24.3
Not sure	15	6.9
Total	218	100.0

The philosophical frameworks topic includes: Philosophical frameworks, particularly utilitarianism and deontological theories; Problems of ethical relativism; Scientific ethics in historical perspective; Differences in scientific and philosophical approaches

Table 48

How Integrated –Philosophical Framework Coverage

	f	%
Standalone course	58	54.2
Content in other courses	36	33.6
Standalone course and content in other courses	9	8.4
Not sure	4	3.7
Total	107	100.0

Table 49

Social and Professional Knowledge Units Coverage

	Coverage Percentage				
Social and Professional Knowledge Units	Cover	Cover Portions	Do Not Cover	Not Sure	Total
History of Computing[c]	25%	50%	20%	5%	100%
Social Context[c]	45%	44%	8%	3%	100%
Methods and Tools[c]	38%	37%	19%	6%	100%
Professional & Ethical Responsibilities[c]	48%	45%	4%	3%	100%
Risks & Liabilities[c]	45%	42%	10%	3%	100%
Intellectual Property[c]	54%	35%	9%	2%	100%
Privacy & Civil Liberties[c]	47%	40%	9%	4%	100%
Computer Crime[e]	54%	36%	6%	4%	100%
Economic Issues[e]	17%	33%	44%	6%	100%
Philosophical Frameworks[e]	25%	24%	44%	7%	100%

[c] = core; [e] = elective

Figure 2

Comparison of the Social and Professional Knowledge Units Coverage

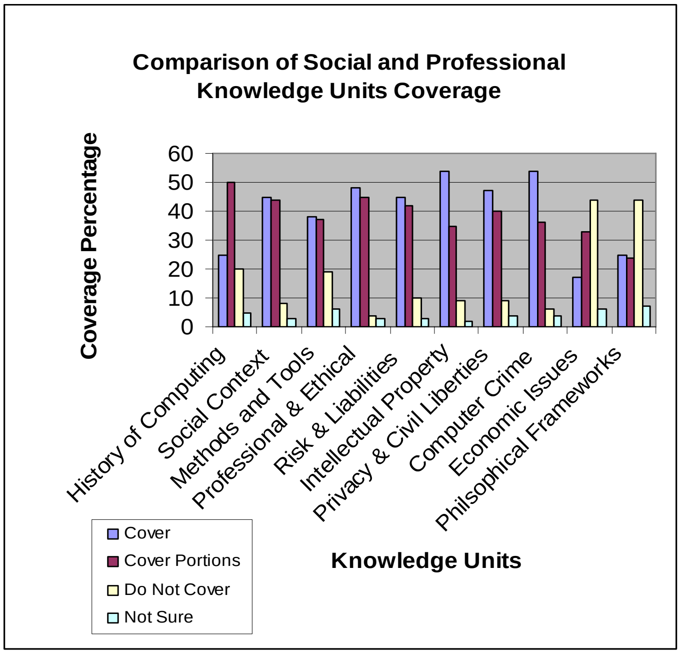


Table 50

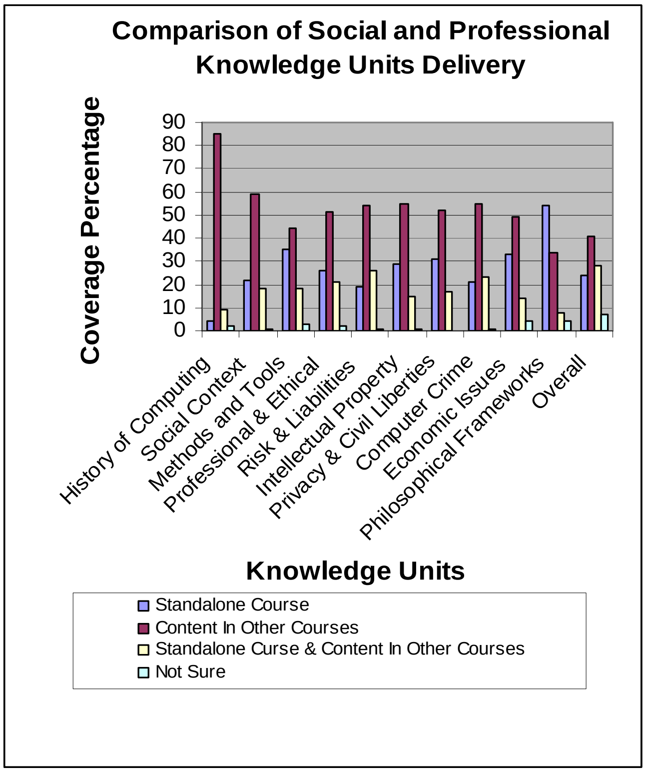
Social and Professional Knowledge Units Delivery

	Coverage Percentage				
Social and Professional Knowledge Units	Standalone Course	Content In Other Courses	Standalone Curse & Content In Other Courses	Not Sure	Total
History of Computing[c]	4%	85%	9%	2%	100%
Social Context[c]	22%	59%	18%	1%	100%
Methods and Tools[c]	35%	44%	18%	3%	100%
Professional & Ethical Responsibilities[c]	26%	51%	21%	2%	100%
Risks & Liabilities[c]	19%	54%	26%	1%	100%
Intellectual Property[c]	29%	55%	15%	1%	100%
Privacy & Civil Liberties[c]	31%	52%	17%	0%	100%
Computer Crime[e]	21%	55%	23%	1%	100%
Economic Issues[e]	33%	49%	14%	4%	100%
Philosophical Frameworks[e]	54%	34%	8%	4%	100%
Overall	24%	41%	28%	7%	100%

[c] = core; [e] = elective

Figure 3

Comparison of the Social and Professional Knowledge Units Delivery



4.13 Research Question Nine

What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?

The 31 survey respondents who indicated that they do not teach social and professional ethics in the undergraduate computer science curriculum were asked why they do not incorporate ethics. Table 51 summarizes the size of the schools that do not teach social and professional ethics. Table 52 summarizes the responses to the question. Note: Respondents were asked to select all responses that applied. Survey respondents who answered “Other” provided answers such as lack of interest, have not spent the time, limited staffing, not accredited and therefore they have ignored these issues, or curriculum change takes time.

Table 51

No Ethics Inclusion Reported by Overall Enrollment

	Overall Enrollment					
	Under 1,000	1,001 – 5,000	5,001 – 10,000	10,001 – 20,000	Over 20,000	Total
No Ethics Inclusion	0	18	4	3	6	31
%	0%	58%	13%	10%	19%	100%

Table 52

Reasons Not To Incorporate Ethics (Multiple Answers)

	f	%
We are not aware of the ACM social and professional ethics issues standards	2	6.5
There is no room in the curriculum for the coverage of social and professional ethics issues	13	41.9
Computer Science faculty are not trained to teach social and professional ethics issues.	15	48.4
Social and professional ethics topics belong in an ethics or philosophy course, but not in the computer science curriculum.	3	9.7
Philosophers or sociologists should teach social and professional ethics, not computer science faculty	6	19.4
Other	14	45.2

Chapter V

DISCUSSION

5.1 Introduction

This study's overall objective was to obtain a comprehensive measurement of how social and professional issues are covered in undergraduate computer science programs in the United States, analyze the results, identify possible causes for trends or curricular design choices, and provide recommendations. The study is grounded on nine important research questions which were derived from a variety of themes which surfaced during the computer science and ethics literature review. These nine research questions are: (1) are social and professional issues (computer ethics) being covered in undergraduate computer science curricula, (2) how do undergraduate computer science programs integrate social and professional issues into their curriculum, (3) have faculty received any special training, (4) what are the perceptions of faculty concerning computer ethics, (5) how are decisions made, (6) what are the disciplines of those who teach computer ethics, (7) what pedagogy is used, (8) what topics are covered and what is the delivery method of these topics, and (9) what are the reasons for not covering computer ethics.

5.2 Statistical Safeguards Regarding Study Design

Several measures were taken to increase the power of the statistical tests used on the survey data colleted. Attempts were made to include a large sample size as evidenced by the selection of 700 universities and colleges from a population of 797 and random selection from overall enrollment strata from the universities and colleges (under 1,000, 1,001 – 5,000, 5,001 – 10,000, 10,001 – 20,000, Over 20,000) was used to make sure that the sample was a fair estimation of the population strata. These safeguards in the study design were used to reduce the plausibility of alternative explanations for the observed results of the survey, to provide an unbiased sample, to provide statistical power for any tests of differences between strata and to allow the researcher to better generalize the sample results back to the population (Shadish, Cook & Campbell, 2002).

5.3 Survey Population and Respondents

The population of universities and colleges in the United States offering Computer Science majors was 797, the stratified random sample size was 700 and the number of survey respondents was 251 or a 36% response rate. The sample respondents closely mirror the stratified population of universities and colleges. Therefore, based upon the safeguards taken prior to the survey, the survey respondents have provided an excellent representation of the population for this research study. Table 53 reports the analysis of survey responses in relation to the population.

Table 53
Analysis of Survey Responses in relation to Population Divided into University or College Strata

University or College Enrollment	Number of Schools (Population)	Proportion of Schools by Category	Expected Distribution of Survey Responses	Actual Usable Survey Responses	Proportion of Survey Responses by Category
Under 1,000	35	4%	10	12	4%
1,001 - 5,000	345	43%	108	112	45%
5,000 – 10,000	173	22%	55	52	21%
10,001 – 20,000	136	17%	43	42	17%
Over 20,000	108	14%	35	33	13%
Total	797	100%	251	251	100%

5.4 Research Question One

Are social and professional issues integrated into the undergraduate computer science curricula? Null Hypothesis: For the general population of schools, there is no relationship between size of school and whether social and professional issues are integrated into the undergraduate computer science curricula.

Of the 251 survey respondents, 220 (87.6%) indicated that they do include ethics in their undergraduate computer science curricula. Based upon the results of the Pearson chi-square test of independence we retain the null hypothesis and conclude there is insufficient evidence to report a relationship between the size of school and whether social and professional issues were integrated into the undergraduate computer science curricula.

However, four statistically significant relationships were found. The first significant relationship found was between social and professional issues required/not required by the number of computer science majors when grouped into two groups (under 100, 100 and above) and was ($\chi^2(1, n=219) = 10.67$, $p < 0.001$, ø = 0.22). Table 11 suggests that that if the number of majors is less than 100 then ethics will likely be required by a ratio of 2.5 to 1. Additionally, Table 11 suggests that if the number of majors is 100 or above, then ethics will likely be required by a ratio of 9.4 to 1.

The second significant relationship found was the size of university or college enrollment when grouped by (0-5,000 and above 5,000) and whether an institution was accredited and was ($\chi^2(1, n=218) = 39.85$, $p < .001$, ø = 0.42). Table 12 suggests that if the overall school enrollment is from 0 to 5,000 then the schools will likely not be accredited by a ratio of 6.5 to 1. Additionally, Table 12 suggests that if the overall school enrollment is above 5,000 then the school will likely be accredited by a ratio of 1.2 to 1.

The third significant relationship found was the number of computer science majors when grouped by (less than 100 and 100 or above) and whether an institution was accredited and was ($\chi^2(1, n=218) = 61.69, p < 0.001, ø = 0.53$). Table 13 suggests that if the number of computer science majors is less than 100, then a school will likely not be accredited by a ratio of 7.2 to 1. However, if the number of computer sciences majors is 100 or above, then the school will likely be accredited by a ratio of 1.7 to 1.

The fourth significant relationship found was whether ethics was required and whether an institution was accredited and was ($\chi^2(1, n=217) = 20.294, p < .001, ø = .31$). Table 14 suggests that if the school is accredited then ethics will likely be required by a ratio of 24 to 1. However, if the school is not accredited then ethics will likely be required by a ratio of 2 to 1.

One additional interesting set of findings were the reasons for incorporating ethics into the computer science curricula. Survey respondents could provide more than one reason. Table 15 showed that the majority of survey respondents (90.9%) incorporate social and professional ethics into the undergraduate computer science curricula because they believe it should be incorporated, while 62.3% of the survey respondents does so because ACM recommends coverage and only 48.2% does so because CAC/ABET requires coverage. These findings indicate that while a large percentage of survey respondents are influenced by ACM or CAC/ABET recommendations, a larger percentage incorporate social and professional issues because they believe it should be incorporated.

5.5 Research Question Two

How do undergraduate computer science programs integrate social and professional issues into their curriculum? Null Hypothesis: For the general population of schools, there is no relationship between size of school and how social and professional issues are integrated in undergraduate computer science programs.

Survey respondents reported that 41.1% integrate ethics into other courses, 23.6% teach a standalone course, 27.3% integrate ethics using a standalone course and integrate ethics into other courses, and 7.7% use other means. The Barroso & Melara (2004) study reported that 54.4% of their survey respondents teach computer ethics as a separate course, 20.6% integrate ethics as a topic in another subject and 8.8% teach ethics as a specific unit within a course of a different subject. Although the categories in the two research studies do not match exactly, this research study does differ from the Barroso and Melara study in that this study found a higher percentage of schools integrate ethics into other courses than the Barroso and Melara study found. This research study does not match their findings and supports the notion that most schools integrate ethics into other courses rather than standalone courses. This difference in results could be because the size of schools in the Barroso and Melara study were from larger universities and did not contains colleges or small universities.

We retained the null hypothesis and conclude that there is insufficient evidence to report a relationship between the size of school and how social and professional issues are integrated in undergraduate computer science programs. However, two statistically significant relationships were found. Table 16 suggests the first significant relationship the number of computer science majors by groups (less than 100 and 100 or above) and how ethics was integrated into the computer science curricula and was ($\chi^2(1, n=220) = 18.61, p < 0.001, ø = 0.17$). This relationship suggests that if the number of computer science majors at a school is less than 100 then how ethics will likely be delivered makes no difference. However, if the enrollment of computer science majors is 100 or above, then content will likely be integrated using a standalone course or a standalone course and integrated in other courses by a ratio of 2 to 1.

The second significant relationship found was the number of hours of coverage by groups (1-12 and 13 and above) and how ethics was integrated into the computer science curricula and was ($\chi^2(1, n=218) = 30.12, p < 0.001, ø = 0.21$). Table 17 suggests that if ethics content is integrated into other courses then the hours of ethics coverage will likely be between 1-12 hours by a ratio of 2.6 to 1. However, if content is integrated using a standalone course, then the hours of ethics coverage will likely be 13 and above by a ratio of 1.5 to 1. Additionally, if a standalone course and integration into other courses are used then the hours of ethics coverage will likely be 13 and above by a ratio of 2.3 to 1.

5.6 Research Question Three

Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so what type of training have they received? Null Hypothesis: For the general population of schools, there is no relationship between size of school and training to teach social and professional issues.

Only 22.8% (n = 50) of the survey respondents provide some type of training for faculty who teach social and professional ethics. Forty-eight (96%) of the 50 universities and schools that provide training require ethics coverage.

Table 18 shows that of those survey respondents that provide training, 44.9% indicate that faculty training was not required but that faculty were receptive to receive training. An additional 26.5% indicated that other types of training were provided. Based upon these results over 70% the faculty are receptive to ethics training when it is provided and therefore it appears that faculty will participate in ethics training when provided by universities or colleges.

Table 19 shows that when asked how ethics training was provided, the majority of respondents (53.1%) indicate that faculty were responsible for their own training. Training from within the university or college (32.7%) was almost equally split with training from outside the university or college (30.6%). Workshops from (1 to 9 hours) accounted for approximately 26.5% of the training. These data indicate that when universities or colleges are supportive and provide training that the majority of faculty will take advantage of ethics training. In general, when universities and colleges require ethics coverage, they are more willing to provide support for ethics training of faculty.

There was a significant relationship between whether training was or was not provided by whether ethics was required or not required at a school, ($\chi^2(1, n=218) = 11.40$, $p < 0.001$, $\phi = 0.23$). Table 20 demonstrates that if ethics is required than training will be provided by a ratio of 2.6 to1. However, if ethics is not required then training will not be provided by a ratio of 22 to 1.

5.7 Research Question Four

What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum? Null Hypothesis: For the general population of schools, there is no correlation between the size of school and computer science faculty opinions about incorporating social and professional issues into the undergraduate computer science curriculum.

Table 22 shows the relationship between “Should Incorporate Ethics” with “Include Ethics”. Agreement with “Should Incorporate Ethics” was ranked by faculty on a six-point scale ranging from completely agree (1) to no opinion (6) while “Include Ethics” was ranked either no (1) or yes (2). “Should Incorporate Ethics” is negatively correlated to “Include Ethics”, (*rho* = -0.420, n = 251, p < 0.01, two tails). The strength of the relationship -.420 indicates that while a large percentage of faculty strongly agree or agree with ethics incorporation, there are many faculty who do not implement what they believe.

Table 23 summarizes the cross tabulations of should ethics be incorporated by the number of computer science majors. Number of Computer Science Majors was ranked ranking from under 100 (1) to above 500 (4). “Should Incorporate Ethics” is negatively correlated to “Number of Computer Science Majors”, (*rho* = -0.270, n = 251, p < 0.01, two tails). Considering the large number of faculty who agree with the statement that social and professional ethics should be incorporated into the undergraduate computer science curriculum, it is interesting to note that there is not a strong relationship between whether ethics should be incorporated and the number of computer science majors.

5.8 Research Question Five

How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?

Decisions regarding how social and professional ethics are incorporated into the undergraduate computer science curriculum are done so mainly by a committee of faculty (39.5%) and a committee of faculty and individual decisions (33.2%) as noted in Table 24. It is interesting to note that most accredited schools make decisions by committee or a committee of faculty and individual decisions (88%), while non accredited schools (65%) make decisions by committee as noted in Table 25. A smaller percentage (23.2%) is incorporated by individuals with only four (1.8%) accredited schools making decisions by committee. Of the four accredited schools making individual decisions, two were universities or colleges with an overall enrollment of 1,001 – 5,000 and two with an overall enrollment of 10,001 – 20,000.

Table 26 shows that schools that require ethics make decisions using a committee (36%) or a combination of faculty and individual decisions (31%). If ethics is to be integrated throughout the curriculum and one wants to make sure that ethics are appropriately integrated throughout the curriculum, then decisions made by committee will ensure better supervision of the implementation and will provide an opportunity for more faculty to become involved.

5.9 Research Question Six

What is the practicing discipline of faculty that teach social and professional issues courses or modules?

The practicing disciplines of faculty who teach social and professional courses or modules are computer science (84.5%), philosophy (4.5%), team make up of computer science and other disciplines (4.5%) and other (6.4%) as shown in Table 27. The large percentage of computer science faculty teaching social and professional ethics matches the Barroso and Melara (2004) study which found that professors who teach ethics have studied computer science (39.7%), information sciences (29.4%), engineering (8.9%), as opposed to philosophy (11.8%) or theology (1.5%). Considering the discussion during the 1990's regarding whether computer scienctists were qualified to teach social and professional ethics, the high percent of computer science faculty teaching indicates that the computer science education profession has truly embraced teaching social and professional ethics from within the computer science profession.

5.10 Research Question Seven

What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?

Survey respondents when asked to identify all pedagogies used to teach social and professional ethics indicated that lectures (77.3%) group discussions (76.5%), readings (66.1%) and case studies (60.2%) had the highest percentages as shown in Table 28. This somewhat consistently replicates the findings of the Barroso and Melara (2004) pedagogy findings in their study as shown below in Table 53. These findings indicate that professors expect students to read, listen and discuss social and professional ethical concepts and case studies. Given the importance of communication skills that involve listening and communicating with others, these findings demonstrate that most computer science programs integrate communication skills within the teaching of social and professional ethics topics.

Table 53

Comparison of Respondents Pedagogy to Barroso & Melara (2004) Study

	United States Computer Science Program Respondents	Barroso & Melara 2004 Study of California Universities and Other Countries
Pedagogy	%	%
Lectures	77.3	79.4%
Group Discussion	76.5	70.6%
Readings	66.1	72.1%
Case Studies	60.2	80.9%
Presentations	48.6	-
Research Papers	43.6	70.6%
Exams or quizzes	43.4	55.8%
Videotapes	17.1	-
Other	9.6	-

5.11 Research Question Eight

What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?

Ten social and professional knowledge units are included in the *Computing Curricula 2001: Computer Science* report with seven listed as core knowledge and three listed as elective knowledge units. Table 49 recaps the survey respondents report regarding what ethics topics have been chosen to be incorporated into the undergraduate computer science curricula. Figure 2 shows a bar share that compares the knowledge unit coverage.

Some interesting patterns appear in these results. It is interesting to note that computer crime, an elective knowledge unit, has the highest percentage for those survey respondents that cover all or portions of this topic. This speaks to the importance of introducing students to the topics of history and examples of computer crime, cracking (hacking) and its effects, viruses, worms, and Trojan horses, and crime prevention strategies, and perhaps to the importance of these topics in today's world of cyberspace. The importance of these topics has grown from an elective topic to a core topic. Given that society relies more upon computers, that computer networks and the Internet are more accessible, that computer crime has become a very serious problem for businesses as demonstrated by the $130 billion losses a year reported in the 2005 CSI/FBI Computer Crime and Security Survey (Gordon, Loeb, Lucyshun, & Richardson, 2005), and that the impact of the Sarbanes-Oxley Act on information security has raised business's interest in information security, it is not surprising that computer crime has become a significant topic which deserves more prominence in the computer science curricula of today.

Survey respondent's listed intellectual property as one of the top areas of coverage. Safeguarding copyright, patents, and trade secrets have become big business and have grown in importance in today's global economy. It is estimated that half of the U.S. exports depend on some form of intellectual property (IP) protection and that the growth of the global economies in China and India will rely heavily on IP protection to continue their growth (Field, 2006).

Professional and ethical responsibilities were the next highest covered knowledge unit. Students must develop a professional identity that will allow them to understand a code of ethics, relationships with clients, employers, other professionals and with society, acceptable use computing policies in the workplace, an awareness of consequences, public policy, and ethical dissent and whistle-blowing.

Privacy and civil liberties, the social context of computing, and risks and liabilities were the next highest knowledge units with percentages of 47%, 45% and 45% respectively. Although history of computing coverage (25%) is rather low, respondents indicated 50% coverage of portions, which is the highest of the knowledge units for coverage of portions of the knowledge unit. Philosophical frameworks (25%) and economic issues (17%), elective knowledge units, are surprisingly covered by many universities and colleges.

Where there is no guideline provided by the *Computing Curricula 2001: Computer Science* report, it is interesting to note where in the curriculum schools cover these topics. Table 50 provides a summary of where survey respondents indicate that they cover various social and professional topics. Figure 3 is a bar chart that compares the social and professional knowledge unit delivery. It is interesting to note that 85 % indicate that the history of computing is integrated in course and it is highest coverage in other courses. The social context of ethics is also mainly covered by being integrated into other courses (59%). On the other end of the spectrum, it is interesting to note that while philosophical framesworks are an elective coverage and are only fully covered by about 25% of the respondents and 24% cover portions of the topic, the topic of philosophical frames is covered 54% in standalone courses.

5.12 Research Question Nine

What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?

Two answers dominated the reasons that 31 respondents in Table 52 indicate they do not teach social and professional issues in undergraduate computer science curriculum: computer science faculty are not trained to teach these topics (48.4%), and there is no room in the curriculum for social and professional ethics (41.9%). These responses indicate that schools that are not covering ethics hold beliefs that they have not been trained to teach these subjects and that is it difficult to incorporate the coverage into the computer science curriculum. It is noteworthy that three of the schools were not aware of the ACM social and professional standards.

Eighteen of the 31 (58%) universities or colleges not teaching ethics had an overall enrollment of 1,001 to 5,000 as shown in Table 51, which demonstrates that small universities or colleges appear to have the most difficulty integrating social and professional ethics. However, it was equally interesting to note that six (19%) universities or colleges had overall enrollments of over 20,000.

5.12 Summary of Research Questions and Answers

1. *Are social and professional issues integrated into the undergraduate computer science curricula?*

Most universities and colleges do integrate computer ethics (87%) into their undergraduate computer science curricula. There is no evidence of a relationship between integrating ethics and the size of the school. However, relationships were found between integration and the number of computer science majors and accreditation. Additionally, a relationship was found between the number of computer science majors and accreditation and between whether ethics was required and accreditation. The survey found that most faculty incorporate computer ethics because they believe it should be incorporated. However, a large number of faculty are influenced by ACM or CAC/ABET computer ethics coverage recommendation.

2. *How do undergraduate computer science programs integrate social and professional issues into their curriculum?*

The majority (41%)of universities and colleges report that they integrate computer ethics into other courses. This finding differs from the Barroso and Melara study which reported 54%. There is no evidence of a relationship between the size of school and how social and professional issues are integrated in undergraduate computer science programs. However, relationships were found between the number of computer science majors and how computer ethics are integrated into the curricula and the number of hours of ethics coverage and how computer ethics are integrated into the curricula.

3. *Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so what type of training have they received?*

Few schools (22%) provide any special computer ethics training for faculty. Most schools indicate that faculty training was not required, but faculty were receptive to computer ethics training, and that when training was provided faculty were receptive to training through a variety of venues such as workshops or in school training. Most faculty will take advantage of training when provided the opportunity. No evidence was found of a relationship between the size of school and computer ethics training. A likely relationship was found between when ethics is required and training is provided.

4. *What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum?*

Most faculty agree that ethics should be taught in computer science curricula. There was a negative correlation (*rho* = -0.42) between whether computer ethics should be incorporated into the undergraduate computer science curriculum and whether schools actually include ethics. While faculty generally agree that computer ethics should be covered in the curricula, some faculty do not actually implement what they believe.

5. *How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?*

Mainly decisions about how computer ethics are incorporated into the curriculum are made by committee. More accredited schools make decisions by committee than unaccredited schools.

6. *What is the practicing discipline of faculty that teach social and professional issues courses or modules?*

A large percentage (85%) of computer science faculty teach ethics. This shows that computer science faculty have embraced the challenge of teaching computer ethics versus having the philosophers teach computer ethics for them.

7. *What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?*

A variety of pedagogical instructional methods are utilized. Lectures (77.3%), group discussions (76.5%) reading (66.1%) and case studies (60.2%) showed the highest percentage of pedagogical instructional methods. Professors expect students to read, discuss, listen and discuss social and professional ethical issues.

8. *What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?*

Some required social and professional issue knowledge units listed in the 2001 Computer Curricula 2001: Computer Science report are not fully covered, while computer crime an elective knowledge unit has the highest percentage of coverage. Intellectual property, followed by professional and ethical responsibilities, followed by privacy and civil liberties were the highest knowledge units covered. The history of computing, a required knowledge unit, was rather low in coverage as well as philosophical frameworks and economic issues, elective units. The actual coverage of these knowledge units begin to indicate that faculty are not covering the knowledge units to the degree that the curricula report suggested. This suggests that perhaps the social and professional knowledge units should be evaluated to determine if they should broaden or updated.

9. *What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?*

The major reason that schools do not teach ethics is because computer science faculty have not been trained. The second major reason that schools do not teach computer ethics is because there is no room in the computer science curricula. It appears that small schools are having the most trouble integrating computer ethics into their computer science curricula.

5.14 Weaknesses of the Study

A weakness of this study is that the question regarding whether universities and colleges were accredited was only asked of schools that indicated they taught social and professional ethics. While the researcher thought that schools would not be accredited if they did not teach social and professional issues, the research now wishes that she had asked this question of all the schools. Another weakness of this study is that there may have been many other follow up questions to ask of schools that teach ethics, but the amount of time to complete the survey controlled which questions could be asked.

5.15Future Work

Further analysis should be done on this research study to identify differences between accredited and non-accredited schools, size of schools, number of majors and hours of coverage for the knowledge units.

Chapter VI

CONCLUSIONS

6.1 Introduction

The *Computing Curricula 2001: Computer Science* report included 10 knowledge units covering social and professional issues in an effort to help students "understand the basic cultural, social, legal and ethics issues inherent in the discipline of computing" (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002, p. 152). The report included additional suggestions concerning detailed topics and learning objectives by knowledge unit, the minimum hours of coverage by knowledge units, core versus elective coverage, how the knowledge units could be integrated into the curricula, and a discussion concerning the level (freshman-sophomore versus junior-senior) social and professional content be introduced to students. Previously no research study has attempted to measure what universities and colleges are doing to carry out these suggestions. This research study attempted to measure the status of social and professional issues using a random stratified sample of 700 undergraduate computer science programs in the United States. This chapter provides a summary of the conclusions and recommendations reached in response to the nine research questions identified in this study.

6.2 Recommendations

Research Question 1: *Are social and professional issues integrated into the undergraduate computer science curricula?*

Faculty are influenced by the ACM or CAC/ABET computer ethics coverage recommendations and therefore the majority of universities and colleges will look to these groups for guidance concerning social and professional computer ethics. Continued emphasis in the next ACM Computer Science report is appropriate. Additionally, the ACM Special Interest Groups should include social and professional as topics of interest within each special interest group.

Research Question 2: *How do undergraduate computer science programs integrate social and professional issues into their curriculum?*

The survey determined that 41.1% of the universities and colleges integrate ethics into other courses, 27.3% integrate ethics using a standing course and integrate ethics into other courses and 23.6% teach a standalone course. Two recommendations are made for this research question.

(1) Textbooks on topics such as database systems, networking, and software engineering do not often integrate social and professional issues into the content. However, because a large percentage of universities and colleges integrate social and professional issues into other courses, the textbook industry should work with authors and stress that social and professional issues are an important topic and should be integrated into textbook materials and not presented as a separate chapter in a textbook. This will be a challenge to the textbook industry because many authors are not trained in social and professional issues and therefore may not feel confident writing on social and professional issues. However, textbook companies can be encouraged to hire faculty that specialize in social and professional issues, ask them to review textbooks and encourage them to provide feedback regarding where and how ethics topics may be incorporated into subject matter textbooks. Additionally, ethics terms, discussions, exercises and problems should be incorporated throughout the chapter and in the exercise and problem

materials at the end of a chapter. Current ethical cases and problems should be incorporated whenever possible. This will accomplish two goals (a) provide a means to incorporate social and professional issues into the courses and (b) provide materials for all faculty regardless of school size that are not familiar with social and professional issues.

(2) While a standalone course may serve the purpose of introducing students to certain ethical topics, social and professional issues may be best addressed within the context of other technical computer science units or courses. For example, Florence Appel (2005) is developing privacy units that are directly integrated into the context of topics in the database course. Computer crime and security issues would be best addressed within the context of a computer networking course and risks and liabilities of computer-based systems would be best addressed in a software engineering course.

Research Question 3: *Have computer science faculty received any special training to teach social and professional issues in the computer science curricula and if so what type of training have they received?*

There is a great need for faculty social and professional ethics training. A number of factors have heightened the awareness for this need and include many high profile cases of ethical misconduct, increased scrutiny by governments based upon many new regulations, and limited formal ethics training of current computer science faculty. Survey respondents that do not teach social and professional issues list lack of training as one of their main reasons for not incorporating ethics into the curriculum. Additionally, the research study indicates that when universities and colleges provide or support training for faculty, they will embrace the training. Social and professional training could be accomplished in many forms. While the study shows that most universities or colleges do not provide their own ethics training, it does demonstrate that universities will support their faculty through outside ethics training in the form of workshops, conferences, or seminars. In short, universities and colleges that do support faculty training expect faculty to be responsible for their own training. Therefore, more workshops, seminars, and professional conferences need to provide opportunities for social and professional issue training.

Research Question 4: *What is the practicing discipline of faculty that teach social and professional issues courses or modules?*

Computer science is the practicing discipline of faculty that teach social and profession al issues. Computer science faculty have embraced teaching computer ethics. No further recommendations.

Research Question 5: *How are decisions made concerning how to incorporate the social and professional issues components into the undergraduate computer science curriculum?*

Most faculty do not have a background in social and professional ethics and therefore decisions regarding the integration of social and professional issues are best made by a committee of faculty. This study demonstrates that most schools that teach ethics (73%) use a committee of faculty to make decisions regarding the integration of ethics in the computer science curricula. Additionally, most accredited schools (93%) and schools that require ethics (81%) make their decisions by committee. Universities and colleges should be encouraged to develop an integration plan for social and professional issues that appropriately address where these topics are integrated into the curriculum using the expertise of many faculty.

Research Question 6: *What are the perceptions of computer science faculty regarding the importance or lack of importance to integrate social and professional issues into the computer science curriculum?*

Most computer science faculty recognize the importance of integrating social and professional issues into the computer science curriculum. No further recommendations are offered.

Research Question 7: *What pedagogies are used to teach social and professional issues in the undergraduate computer science curriculum?*

This research study demonstrated that computer science faculty use some primary instructional methods, such as lectures, group discussions, cases studies and readings but other instructional methods (presentations, research papers, exams or quizzes, and videotapes) are also used. Most computer science educators do not receive any training in their advanced degrees regarding pedagogical instructional methods. The 2001 report provided a discussion concerning at what course level (freshman-sophomore, or junior – senior) social and professional issues should be integrated and whether issues should be incorporated in a standalone course or throughout the curriculum. For this reason, it would be appropriate to include a discussion of pedagogical instructional methods in the next computer science curricula report.

Research Question 8: *What specific ethics topics have been chosen to be incorporated into the undergraduate computer science curriculum and how are they incorporated into the curriculum?*

The 10 social and professional issues incorporated in the Computing Curricula 2001: Computer Science report should be revisited to update the knowledge units based upon changes that have occurred in the computing field since the report was last released. Several suggested revisions are listed below:

(1) IT professionals must possess communication, presentation and group work skills in order to work effectively with co-workers and with clients. Computer employers often rank communication skills and teamwork skills on a par with technical skills (University of Arkansas at Little Rock 1999 Information Technology Committee, 1999, New Media Knowledge/Burn Owens Partnership, 2002) and therefore, the knowledge units should reflect this change in thinking. Student should be provided opportunities to practice their written, verbal, and presentation skills and to work in teams to solve problems. For these reasons, these types of skills should be incorporated into the social and professional issues knowledge units or in other segments of the next Computer Curricula Report.

(2) Lapses in ethical judgment on the part of individuals and companies should make it apparent that more and not less social and professional ethical coverage is required in the knowledge units. The minimum number of hours of coverage (16 hours) should be revisited as well as the content of the social and professional issue knowledge units. Additionally, social and professional issues must be referenced as being fundamental in the discipline of computer science so that all computer science faculty begin to view these issues as important as other technical topics and should be covered in the context of technical topics. Therefore, courses such as database, computer networks, software engineering should incorporate ethical issues within the curriculum.

(3) Computer crime and security should be incorporated as a core topic rather than an elective topic. The survey results indicated that universities and colleges teach this topic more than any other ethics topic. Students should be well versed in topics related to computer crime and security. Given the importance that business must place on compliance with the Sarbanes-Oxley Act, computer crime and security deserves a more prominent place in the social and professional issues knowledge units.

(4) Experts in the computer industry should be consulted regarding the content of the social and professional knowledge units. Some type of survey or informal interviews with several industry CIO's and government officials would be beneficial in determining whether we are covering the important social an professional issues and provide an element of credibility to the knowledge units.

Research Question 9: *What are the reasons schools are not teaching social and professional issues in the undergraduate computer science curriculum?*

The major reasons that universities and colleges do not teach social and professional issues are the lack of training (48.4%) and the lack of room in the curriculum for ethics. Several of the previous recommendations concerning the need for training and the incorporation of ethics topics in textbooks will help universities and colleges to alleviate these problems.

Other Recommendations:

Further research should be done to determine what accredited universities and colleges are doing differently from non-accredited universities. Lessons may be learned from the processes that accredited institutions are using to integrate social and professional issues into the undergraduate computer science curricula. Additionally, data mining will be done in the future to look for interesting patterns.

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Appendix A

UNL IRB Approval Letter

Nebraska UNIVERSITY OF Lincoln

RESEARCH COMPLIANCE SERVICES
Institutional Review Board

October 31, 2005

Carol Spradling
Dr. Leen-Kiat Soh
160 Whiteridge
Maryville, MO 64468

IRB # 2005-10-050 EP

TITLE OF PROJECT: **A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty Perspectives**

Dear Carol:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study. Your proposal seems to be in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).

Date of EP Review: **10/21/05.**

You are authorized to implement this study as of the Date of Final Approval: **10/31/05.** This approval is Valid Until: **10/30/06**

1. Please include the assigned and approved IRB # on the emails sent to potential participants and the information page for the survey. Please return one copy of each, with the number, for our records.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

For projects which continue beyond one year from the starting date, the IRB will request continuing review and update of the research project. Your study will be due for continuing review as indicated above. The investigator must also advise the Board when this study is finished or discontinued by completing the enclosed Protocol Final Report form and returning it to the Institutional Review Board.

If you have any questions, please contact Shirley Horstman, IRB Administrator, at 472-9417 or email shorstman1@unl.edu.

Sincerely,

Dan R. Hoyt, Chair
for the IRB

Shirley Horstman
IRB Administrator

cc: Faculty Advisor

Alexander Building West / 312 N. 14th Street / P.O. Box 880408 / Lincoln, NE 68588-0408 / (402) 472-6965 / FAX (402) 472-9323

Appendix B

FACULTY SURVEY

UNIVERSITY OF Nebraska Lincoln

Introduction to the Survey

IRB #:

Welcome to the web-based survey designed to examine the status of social and professional ethics in undergraduate computer science programs in the United States.

The survey should take between 5 and15 minutes to complete based upon your answers to the questions. There are three sections in this survey. The first section includes questions that address the coverage, or lack of coverage, of social and professional issues (computer ethics) in your undergraduate computer science program and the associated reasons for inclusion or exclusion from your program. The second section includes questions that address a variety of topics regarding the status of computer ethics in undergraduate computer science programs. The third section includes four demographic questions.

All of the information you provide is protected by a secure web site and is strictly confidential.

Thank you for taking the time to complete this web-based survey. Your input is greatly appreciated.

Carol Spradling

I indicate my agreement to participate in this study by completing this study.
___ Yes
___ No

Part 1

1. **To what extent do you agree or disagree with the following statement. "Social and professional ethics topics should be incorporated into the undergraduate computer science curriculum."**
____ Completely agree
____ Generally agree
____ Undecided (neither agree nor disagree)
____ Generally disagree
____ Completely disagree
____ No opinion

2. **Does your department's undergraduate computer science curriculum include any social and professional ethics issues content?**
____ No (Skip to question 5)
____ Yes

3. **Is coverage of social and professional ethics issues required in your undergraduate computer science curriculum?**
____ No
____ Yes

4. **What are your reasons for incorporating social and professional ethics into your undergraduate computer science curriculum? (Please select all responses that apply.)**
___ The Computing Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (CAC/ABET) requires coverage of social and professional ethics.
___ ACM recommends the coverage of social and professional ethics.
___ We believe that social and professional ethics are a topic that should be incorporated into the undergraduate computer science curriculum.
___ Other
(Skip to question 6)

5. **What are your reasons for not incorporating social and professional ethics into your undergraduate computer science curriculum? (Please select all responses that apply.)**
___ We are not aware of the ACM social and professional ethics issues standards.
___ There is no room in the curriculum for the coverage of social and professional ethics issues.
___ Computer Science faculty are not trained to teach social and professional ethics issues.
___ Social and professional ethics topics belong in an ethics or philosophy course, but not in the computer science curriculum.
___ Philosophers or sociologists should teach social and professional ethics, not computer science faculty.
___ Other. Please describe below
(Skip to question 29)

Part 2

Delivery of Social and Professional Ethics

6. **How does your department deliver social and professional ethics issues content in the undergraduate computer science curriculum?**
____ A standalone course
____ Content integrated in other computer science courses (Skip to question 8)
____ A standalone course and integrated other computer science courses
____ Other: Describe below how the content is covered (Skip to question 8)

7. Please indicate at what level your standalone course that covers social and professional ethics content is offered in your undergraduate computer science curriculum.

____ Lower-level course (i.e. Freshman, Sophomore)
____ Upper-level course (i.e. Sophomore, Junior, Senior)
____ No level of standing
____ Other, please explain ____

8. How does your department introduce social and professional ethics into your undergraduate computer science curriculum? (Select all that apply)
____ Textbook readings
____ Lectures
____ Case studies
____ Group discussions (in class or online)
____ Examinations or quizzes
____ Student research papers
____ Student presentations on ethics topics
____ Video tapes
____ Other: Please describe below

9. Does your department teach portions of the social and professional ethics topics online?
____ No
____ Yes

10. Does your department teach any social and professional ethics topics in a course which is offered completely online?
____ No
____ Yes

11. Are students at your university or college required to take a philosophy course as either a general education course or a required course as part of their computer science curriculum?
____ No
____ Yes

Decisions Making Process

12. Who made the decision concerning how to incorporate social and professional ethics content into the undergraduate computer science curriculum?
____ Committee of faculty
____ Individual decisions made by faculty in their courses
____ Committee of faculty and individual decision make by faculty in their courses
____ Other: Please describe how below

Faculty Training

13. Did your department (or school or college) provide faculty that teach the social and professional ethics content with opportunities for training?
____ No (Skip to question 16)
____ Yes

14. Please select the answer that best describes the circumstances of the faculty training for social and professional ethics issues.

____ Faculty training was mandatory and the majority of the faculty embraced the training.
____ Faculty training was mandatory and the majority of the faculty were resistant to the training
____ Faculty training was not required but the majority of the faculty were receptive to receiving some type of training
____ Faculty training was not required and the majority of the faculty were not interested in receiving any training
____ Other: Please describe below.

15. How was training provided to faculty teaching the social and professional ethics issues? (Select all that apply)

____ Training from within the university or college
____ Training from outside the university or college
____ 1-3 hour workshop
____ 3-6 hour workshop
____ 6-9 hour workshop
____ Faculty are responsible for their own training
____ Other: Please describe below.

Who Teaches Social and Professional Ethics

16. Who teaches the social and professional ethics issues incorporated into your computer science curriculum?

____ Philosophy faculty
____ Computer Science faculty
____ Social science faculty
____ A team made up of computer science and faculty from other disciplines
____ Other: Please describe below

Coverage of Social and Professional Topics

Note: For Questions 17 through 26, question B will only be asked of survey participants that selected "Cover" or "Cover Portions of the Content".

Curriculum Topics:		**Content Coverage**		
17A. What is the extent of your department's coverage of the topic of the history of computing? The history of computing topics include: Prehistory – the world before 1946; Pioneers of computing; History of computer hardware, software, networking	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
17B. How does your department cover the topic of the history of computing?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure

Curriculum Topics:	Content Coverage			
18A. What is the extent of your department's coverage of the topic of the social context of computing? The social context of computing topics include: Introduction to the social implications of computing; Social implications of networked communication; Growth of, control of, and access to the Internet; Gender-related issues; International issues	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
18B. How does your department cover the topics of the social context of computing?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure
19A. What is the extent of your department's coverage of the topic of the methods and tools of analysis? The methods and tools of analysis topics include: Making and evaluating ethical arguments; Identifying and evaluating ethical choices; Understanding the social context of design; Identifying assumptions and values	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
19B. How does your department cover the topic of methods and tools of analysis?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure

Curriculum Topics:		**Content Coverage**		
20A. What is the extent of your department's coverage of the topics of professional and ethical responsibilities? The professional and ethical responsibilities topics include: Community values and the laws by which we live; The nature of professionalism; Various forms of professional credentialing and the advantages and disadvantages; The role of the professional in public policy; Maintaining awareness of consequences; Ethical dissent and whistle-blowing; Codes of ethics, conduct, and practice (IEEE, ACM, SE, AITP, etc.); Dealing with harassment and discrimination; "Acceptable use" policies for computing in the workplace	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
20B. How does your department cover the topics of professional and ethical responsibilities?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure
21A. What is the extent of your department's coverage of the topics of risks and liabilities of computer-based systems? The risks and liabilities of computer-based systems topics include: Historical examples of software risks; Implications of software complexity; Risk assessment and management	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
21B. How does your department cover the topics of risks and liabilities of computer-based systems?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure

Curriculum Topics:		Content Coverage		
22A. What is the extent of your department's coverage of the topics of intellectual property? The intellectual property topics include: Foundations of intellectual property; Copyrights, patents, and trade secrets; Software piracy; Software patents; Transnational issues concerning intellectual property	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
22B. How does your department cover the topic of intellectual property?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure
23A. What is the extent of your department's coverage of the topics of privacy and civil liberties? The privacy and civil liberties topics include: Ethical and legal basis for privacy protection; Privacy implications of massive database systems; Technological strategies for privacy protection; Freedom of expression in cyberspace; International and intercultural implications	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
23B. How do you cover the topics of privacy and civil liberties?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure
24A. What is the extent of your department's coverage of the topic of computer crime? The computer crime topics include: History and examples of computer crime; "Cracking" ("hacking") and its effects; Viruses, worms, and Trojan horses; Crime prevention strategies	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
24B. How does your department cover the topic of computer crime?	Standalone course	Course Content in Other Courses s	Standalone Course and Course Content in Other Courses	Not Sure

Curriculum Topics:		**Content Coverage**		
25A. What is the extent of your department's coverage of the topic of economic issues in computing? The economic issues in computing topics include: Monopolies and their economic implications; Effect of skilled labor supply and demand on the quality of computing products; Pricing strategies in the computing domain; Differences in access to computing resources and the possible effects thereof	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
25B. How does your department cover the topic of economic issues in computing?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure
26A. What is the extent of your department's coverage of the topic of philosophical frameworks? The philosophical frameworks topics include: Philosophical frameworks, particularly utilitarianism and deontological theories; Problems of ethical relativism; Scientific ethics in historical perspective; Differences in scientific and philosophical approaches	Cover	Do Not Cover	Cover Portions of the Content	Not Sure
26B. How does your department cover the topic of philosophical frameworks?	Standalone course	Course Content in Other Courses	Standalone Course and Course Content in Other Courses	Not Sure

27. How many hours do you estimate that you devote to social and professional ethics topics in your undergraduate computer science curriculum?

____ 1 - 4
____ 5 - 8
____ 9 - 12
____ 13 - 16
____ above 16 hours

28. Is your Computer Science program accredited through the Computing Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (CAC/ABET)?

____ No
____ Yes

Part III

29. What is the approximate student enrollment of your university or college?

____ under 1,000
____ 1,001 - 5,000
____ 5,001 – 10,000
____ 10,001 – 20,000
____ above 20,000

30. What is the approximate number of your undergraduate computer science majors?

____ under 100
____ 101 – 300
____ 301 – 500
____ above 500

31. In what region of the United States is your university or college located?

____ Pacific (AK, CA, HI, OR, WA)
____ Mountain (AZ, CO, ID, MT, NM, NV, UT, WY)
____ West North Central (IA, KS, MN, MO, ND, NE, SD)
____ East North Central (IL, IN, MI, OH, WI)
____ West South Central (AR, LA, OK, TX)
____ East South Central (AL, KY, MS, TN)
____ South Atlantic (DC, DE, FL, GA, MD, NC, SC, VA, WV)
____ Middle Atlantic (NJ, NY, PA)
____ New England (CT, MA, ME, NH, RI, VT)

32. What is your current position or job title?

____ Chair of the department containing a Computer Science or Computer Science and Engineering major
____ Chair of the Computer Science curriculum committee
____ Faculty in a department containing a Computer Science or Computer Science and Engineering major
____ Other: Please describe below

Other Comments

33. There may be questions that you were not asked in this survey about the integration of social and professional ethics in your undergraduate computer science curriculum. If there is any other information that you would like to share about this topic, please provide your comments below.

(Comments box here)

Appendix C

PRE-EMAIL TO FACULTY SURVEY (1)

Dear Computer Science Faculty:

In a few days you will receive an e-mail with a request to complete a web-based survey. My name is Carol Spradling and I am an Assistant Professor in the Computer Science/Information Systems Department at Northwest Missouri State University and a doctoral candidate at the University of Nebraska-Lincoln majoring in Educational Studies/Instructional Technology. As part of the research for my dissertation entitled “A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty and Student Perspectives,” I am conducting a national study of 700 undergraduate computer science programs in the United States. I would be grateful if you will allow me to collect some information about the status of computer ethics at your university or college.

IRB approval number: number goes here

The purpose of this national study is two-fold. First, the results of this study will provide a description of the status of social and professional issues (computer ethics) in undergraduate computer programs and the reasons for inclusion or exclusion of computer ethics in the curriculum. Because I want an accurate representation of the status of computer ethics in undergraduate computer science programs, I need to collect feedback and opinions from both sides of the argument to either include or exclude computer ethics in the undergraduate computer science curriculum. For universities or colleges that have chosen not to incorporate computer ethics into your curriculum, the first portion of the survey will take approximately 5 MINUTES to complete.

Second, for schools choosing to incorporate computer ethics into their undergraduate computer science curriculum, this study will attempt to understand the status of social and professional issues (computer ethics) in undergraduate programs concerning a variety of topics including how computer ethics is delivered in the curriculum, whether faculty receive special training to teach computer ethics, how department decisions have been made regarding the integration of computer ethics, who teaches computer ethics, the pedagogies used to teach computer ethics, and computer ethics topics that are covered and where they are covered. The second portion of the survey will take approximately 5 TO 10 MINUTES to complete.

It is my hope that this study allow all computer science educators to gain a better understanding of the status of social and professional issues in undergraduate computer programs in the United States and represent the opinions of undergraduate computer science faculty whether they support or do not support the teaching of computer ethics in the undergraduate computer science curriculum.

In my efforts to conduct this national study, I have solicited the opinions of many computer science professors in undergraduate computer science education. If you would like to read a letter supporting research on this topic, written by Florence Appel, chair of the ACM Special Interest Group on Computers and Society (SIGCAS) and an Associate Professor of Computer Science at Saint Xavier University, Chicago, Illinois, please click the link listed below.

Florence Appel link goes here.

Thank you for your time and consideration.

Sincerely,

Carol Spradling
Assistant Professor, Computer Science/Information Systems
Northwest Missouri State University
Doctorial Candidate, University of Nebraska-Lincoln

Appendix D

COVER EMAIL TO FACULTY SURVEY (2)

Dear Computer Science Faculty:

My name is Carol Spradling and I am an Assistant Professor in the Computer Science/Information Systems Department at Northwest Missouri State University and a doctoral candidate at the University of Nebraska-Lincoln majoring in Educational Studies/Instructional Technology. As part of the research for my dissertation entitled "A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty and Student Perspectives," I am conducting a national study of 700 undergraduate computer science programs in the United States using a stratified random sample of the population. I would be grateful if you would continue to read this e-mail and participate in this national study.

IRB approval number: number goes here

The survey will only require about 5 MINUTES of your time to complete for schools that do not incorporate social and professional issues into their computer science curriculum. For schools that do incorporate social and professional issues into their computer science curriculum, the survey will take about 10 TO 15 MINUTES to complete.

The following information is provided in order to help you make an informed decision whether or not to contribute to this national study. The purpose of this national study is two-fold.

First, the results of this study will provide a description of the status of social and professional issues (computer ethics) in undergraduate computer programs and the reasons for inclusion or exclusion of computer ethics in the curriculum. Because I want an accurate representation of the status of computer ethics in undergraduate computer science programs, I need to collect feedback and opinions from both sides of the argument to either include or exclude computer ethics in the undergraduate computer science curriculum. For universities or colleges that have chosen not to incorporate computer ethics into your curriculum, the first portion of the survey will take approximately 5 MINUTES to complete.

Second, for schools choosing to incorporate computer ethics into their undergraduate computer science curriculum, this study will attempt to understand the status of social and professional issues (computer ethics) in undergraduate programs concerning a variety of topics including how computer ethics is delivered in the curriculum, whether faculty receive special training to teach computer ethics, how department decisions have been made regarding the integration of computer ethics, who teaches computer ethics, the pedagogies used to teach computer ethics, and computer ethics topics that are covered and where they are covered. The second portion of the survey will take approximately 5 to 10 MINUTES to complete.

The entire study should take approximately 10 to 15 MINUTES to complete and will help all computer science educators to gain a better understanding of the status of social and professional issues in undergraduate computer programs in the United States.

Participation in this study is voluntary. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigators, or the University of Nebraska-Lincoln, or your institution. Your decision will not result in any loss of benefits to which you are otherwise entitled. There are no known risks or discomforts associated with this research. All information obtained in this web-based study will be kept strictly confidential and protected in a secure web site. The information from this study may be published in educational or scientific journals or presented at meetings, but the data will be reported as aggregated data.

By clicking on the link provided below and logging into the secure site, you are agreeing to participate in this research study. Please click on the link below to access the web-based survey:

Link goes here

Your password is: csfaculty

Please accept my sincere thank you in advance for your cooperation and prompt attention in completing this study. There is no reward for your effort and time other than the knowledge that you have helped a grateful graduate student complete her dissertation and that you have contributed to research on the topic of social and professional ethics in computer science.

If you have any questions or comments about this study, I would be pleased to speak with you. My contact information is below. If you are interested in receiving a summary of the results of this study, please contact Carol Spradling at the e-mail address listed below. The research study should be completed by January, 2005.

Thanks again for your valuable input,

Sincerely,

Carol Spradling, Principal Investigator
Email: c_sprad@mail.nwmissouri.edu
Phone: (660) 582-1588

Dr. Charles Ansorge, Secondary Investigator
Email: cansorge@unlserve.unl.edu

Phone: (402) 472-1702

Dr. Leen-Kiat Soh, Secondary Investigator
Email: lksoh@cse.unl.edu
Phone: (402) 472-6738

NOTE: If for any reason you prefer not to participate in this study and do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.

Removal link goes here.

If you have any questions or concerns about this study, please contact Carol Spradling at (660) 562-1588 or email c_sprad@mail.nwmissouri.edu. If you have any questions about your rights as a research participant that have not been answered by the investigator or to report any concerns about the study, you may contact the University of Nebraska-Lincoln Institutional Review Board at (402) 472-6965.

Appendix E

FIRST E-MAIL REMINDER TO FACULTY SURVEY(3)

Dear Computer Science Faculty:

My name is Carol Spradling and I am an Assistant Professor in the Computer Science/Information Systems Department at Northwest Missouri State University and a doctoral candidate at the University of Nebraska-Lincoln majoring in Educational Studies/Instructional Technology. As part of the research for my dissertation entitled "A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty and Student Perspectives," I am conducting a national study of 700 undergraduate computer science programs in the United States using a stratified random sample of the population. I would be grateful if you would continue to read this e-mail and complete this national study.

IRB approval number: number goes here

Last week you received an e-mail asking you to participate in this national study on the status of social and professional issues (computer ethics) in undergraduate computer programs in the United States. Please accept my heartfelt thanks if you completed and submitted the web-based survey. If you have not responded to the web-based survey, I encourage you to consider responding to the survey. I want to hear from all computer science faculty, whether they support the inclusion or exclusion of computer ethics in the undergraduate computer science curriculum.

The survey will only take about 5 MINUTES to complete for schools that do not incorporate social and professional issues into their computer science curriculum. For schools that do incorporate social and professional issues into their computer science curriculum, the survey will take about 10 TO 15 MINUTES to complete.

In the event that you did not receive or may have deleted by my previous e-mail, I have provided the link to the web-based faculty survey. By clicking on the link provided below and logging into the secure site, you are agreeing to participate in this research study. Please click on the link below to access the web-based survey:

Link goes here

Your password is: csfaculty

If you have any questions or comments about this study, I would be pleased to speak with you. My contact information is below.

Sincerely,

Carol Spradling, Principal Investigator
Email: c_sprad@mail.nwmissouri.edu
Phone: (660) 582-1588

Dr. Charles Ansorge, Secondary Investigator
Email: cansorge@unlserve.unl.edu
Phone: (402) 472-1702

Dr. Leen-Kiat Soh, Secondary Investigator
Email: lksoh@cse.unl.edu
Phone: (402) 472-6738

NOTE: If for any reason you prefer not to participate in this study and do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.

Removal link goes here.

Appendix F

SECOND EMAIL REMINDER TO FACULTY SURVEY (4)

Dear Computer Science Faculty:

My name is Carol Spradling and I am an Assistant Professor in the Computer Science/Information Systems Department at Northwest Missouri State University and a doctoral candidate at the University of Nebraska-Lincoln majoring in Educational Studies/Instructional Technology. As part of the research for my dissertation entitled "A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty and Student Perspectives," I am conducting a national study of 700 undergraduate computer science programs in the United States using a stratified random sample of the population.

IRB approval number: number goes here

During the past two weeks I have been collecting information about the status of social and professional issues (computer ethics) in undergraduate computer science programs in the United States. To those who have completed and submitted the web-based survey, please accept my heartfelt thanks. If you have not responded to the web-based survey, I encourage you to consider responding to the survey. I want to hear from all computer science faculty, whether they support the inclusion or exclusion of computer ethics in the undergraduate computer science curriculum.

The survey will only take about 5 MINUTES to complete for schools that do not incorporate social and professional issues into their computer science curriculum. For schools that do incorporate social and professional issues into their computer science curriculum, the survey will take about 10 TO 15 MINUTES to complete.

I have provided the link to the web-based faculty survey. By clicking on the link provided below and logging into the secure site, you are agreeing to participate in this research study. Please click on the link below to access the web-based survey:

Link goes here

Your password is: csfaculty

If you have any questions or comments about this study, I would be pleased to speak with you. My contact information is below.

Sincerely,

Carol Spradling, Principal Investigator
Email: c_sprad@mail.nwmissouri.edu

Phone: (660) 582-1588

Dr. Charles Ansorge, Secondary Investigator
Email: cansorge@unlserve.unl.edu
Phone: (402) 472-1702

Dr. Leen-Kiat Soh, Secondary Investigator
Email: lksoh@cse.unl.edu
Phone: (402) 472-6738

NOTE: If for any reason you prefer not to participate in this study and do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.

Removal link goes here.

Appendix G

FINAL EMAIL REMINDER TO FACULTY SURVEY (5)

Dear Computer Science Faculty:

My name is Carol Spradling and I am an Assistant Professor in the Computer Science/Information Systems Department at Northwest Missouri State University and a doctoral candidate at the University of Nebraska-Lincoln majoring in Educational Studies/Instructional Technology. As part of the research for my dissertation entitled "A Study of Social and Professional Ethics in Undergraduate Computer Science Programs: Faculty and Student Perspectives," I am conducting a national study of 700 undergraduate computer science programs in the United States using a stratified random sample of the population.

IRB approval number: number goes here

During the past month I have been collecting information about the status of social and professional issues (computer ethics) in undergraduate computer science programs in the United States. To those who have completed and submitted the web-based survey, please accept my heartfelt thanks. If you have not responded to the web-based survey, I encourage you to consider responding to the survey. I want to hear from all computer science faculty, whether they support the inclusion or exclusion of computer ethics in the undergraduate computer science curriculum.

The survey will only take about 5 MINUTES to complete for schools that do not incorporate social and professional issues into their computer science curriculum. For schools that do incorporate social and professional issues into their computer science curriculum, the survey will take about 10 TO 15 MINUTES to complete. The study will close on Monday, November 21, 2005

I have provided the link to the web-based faculty survey. By clicking on the link provided below and logging into the secure site, you are agreeing to participate in this research study. Please click on the link below to access the web-based survey:

Link goes here

Your password is: csfaculty

If you have any questions or comments about this study, I would be pleased to speak with you. My contact information is below.

Sincerely,

Carol Spradling, Principal Investigator

Email: c_sprad@mail.nwmissouri.edu
Phone: (660) 582-1588

Dr. Charles Ansorge, Secondary Investigator
Email: cansorge@unlserve.unl.edu
Phone: (402) 472-1702

Dr. Leen-Kiat Soh, Secondary Investigator
Email: lksoh@cse.unl.edu
Phone: (402) 472-6738

NOTE: If for any reason you prefer not to participate in this study and do not wish to receive further emails from us, please click the link below, and you will be automatically removed from our mailing list.

Removal link goes here.