A Comprehensive Survey on the Status of Social and Professional Issues in United States Undergraduate Computer Science Programs and Recommendations

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Abstract

A national web-based survey was administered to 700 undergraduate computer science programs in the United States as part of a stratified random sample of 797 undergraduate computer science programs. The 251 program responses (36% response rate) regarding social and professional issues are presented. This article describes the demographics of the respondents, presents results concerning whether programs teach social and professional issues, how social and professional issues are integrated, perceptions of computer science faculty regarding the importance of social and professional issues, pedagogies used to teach social and professional issues, and what specific social and professional topics have been included in the computer science curriculum. Additionally, we (a) provide suggestions for computer science programs regarding the integration of social and professional issues into the computer science curriculum, (b) suggest ways to encourage more social and professional coverage in computer science programs, pedagogy, and (c) recommend what social and professional topics should be included in future computer science curriculum reports.

1. Introduction

Serious and popular news regularly highlight the role that social and professional issues 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, accessibility, workplace and employee monitoring, electronic voting and identity theft, healthy working environments, environmental sustainability and legislation such as the Sarbanes-Oxley Act of 2002. Computer science (CS) faculty have been charged to help undergraduate CS majors develop an awareness of social and ethical considerations in the context of CS and learn that these are important topics in the field of CS and should be evaluated in the context of computing technology as it is used and produced (Martin & Weltz, 1999). Likewise, CS 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 CS programs is paramount to the enlightenment of CS students.

The *Computing Curricula 2001: Computer Science* report (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002) clearly outlines social and professional knowledge units that should be included in the undergraduate CS curriculum. While many university and college programs have embraced the inclusion of social and professional issues into the undergraduate CS curriculum, some programs have not. Note that in our work, we assume computer ethics to be part of the social and professional issues and in some of the discussions pertinent to previous work of other authors, we retain the term “ethics” when it is consistent with our assumption.

Many articles regarding social and professional issues have focused on what to teach (Huff & Martin, 1995), what to expose and how to best expose students to ethical issues within the computing field (Martin, Huff, Gotterbarn & Miller, 1996, Martin, 1999b), who should teach computer ethics (Johnson, 1994), the preferred method of integration by committee (Martin, 1999a), whether computer faculty are receiving training and how programs make decisions regarding social and professional integration (Spradling, Soh, & Ansorge, 2008), but few studies have been undertaken to discover the perceptions of CS faculty regarding social and professional integrations, if and how schools are teaching social and professional issues, the pedagogies used, what specific social and professional topics are integrated and how they are integrated. Our study answers these questions, some of which have not been answered in other literature.

A related regional study regarding how CS programs have dealt with social and professional issues was conducted by Barroso and Melara (2004) in California universities and universities in some foreign countries. However, our research design utilized a stratified random sample of a large number of programs (700) in the United States with a 36% response rate. Our study provides the first insight into how many hours programs devote to teaching social and professional issues, how social and professional issues are integrated either through a stand alone course or overall integration, whether faculty receive training and what decision making process is used to integrate social and professional issues into the curriculum, the Barroso and Melara study did not. Additionally, our study surveyed schools that were not teaching social and professional issues and uncovered reasons that CS programs are not teaching social and professional issues. Finally, our study addressed computer science programs and not engineering programs.

2. Methods

2.1 Survey instrument

Survey questions were developed with guidance from the literature (Barroso & Melaram, 2004; Huff & Martin, 1995; IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002; Johnson, 1994; Martin, Huff, Gotterbarn & Miller, 1996; Martin & Weltz, 1999) and covered social and professional topics such as coverage, integration, training, who teaches, faculty perceptions, decision-making process, discipline of faculty teaching, pedagogy, delivery method, and reasons for not teaching. The web survey contained approximately 41 questions and may be viewed at https://catpages.nwmissouri.edu/m/c_sprad/survey.doc.

This article will address the following questions that were asked in the web survey.

1) Are social and professional issues integrated into the undergraduate CS curricula?
2) How do undergraduate CS programs integrate social and professional issues into their curriculum?
3) What are the perceptions of CS faculty regarding the importance or lack of importance to integrate social and professional issues into the CS curriculum?
4) What pedagogies are used to teach social and professional issues in the undergraduate CS curriculum?
5) What specific social and professional topics have been chosen to be incorporated into the undergraduate CS curriculum and how are they incorporated into the curriculum?

2.2 Sampling frame

The sampling frame of 797 CS programs was used to draw an unbiased random sample and provide an equal opportunity for every member of a known population to be 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).

A sample size of n=700 was selected from the 797 program population and then divided into strata (subgroups) according to the size of institution. This stratified random sample ensured that subgroups were represented in portions equal with the population. A total of 700 e-mails with the survey link and password were sent to the stratified randomly selected programs. There were 251 usable survey responses received for a response rate of 36%. Table 1 identifies the proportionate stratified random sample results.

Table 1. 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%**

2.3 Analysis plan

Data collection was completed in December of 2005 using SurveyMonkey.com and then imported into a statistical package where an extensive analysis of the data was completed. This paper includes analysis related to social and professional integration, faculty perceptions, hours of coverage, pedagogy, and topics covered and how they are covered. However, the study also includes analysis of areas relating to who teaches social and

professional issues, faculty training, the decision-making process and reasons why programs are not teaching social and professional issues, which has been reported (Spradling, Soh, & Ansorge, 2008). Descriptive statistics for the independent variables were summarized and chi-square tests of independence were used for some hypotheses. A family-wise alpha of .05 was used for all tests using a simple sequentially rejective multiple test procedure to ensure a small probability of rejecting any true hypotheses (Holm, 1979). Effect sizes of small, medium, or large were determined using Cohen's guidelines (1988).

2.4 Respondents demographics

The 251 survey respondents from various regions of the country, large and small colleges or universities, represented were 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 CS curriculum committee, 12 (4.8%) as another category, which included college deans, adjunct professors, program director, etc., and one survey respondent who did not indicate his position. The respondents were represented from a variety of regions in the United States (Figure 1), by the number of CS majors (Figure 2), by school size (Figure 3), and from accredited and non-accredited institutions (Figure 4).

Figure 1. D*emographic breakdown of 251 survey program respondents by region of the United States*

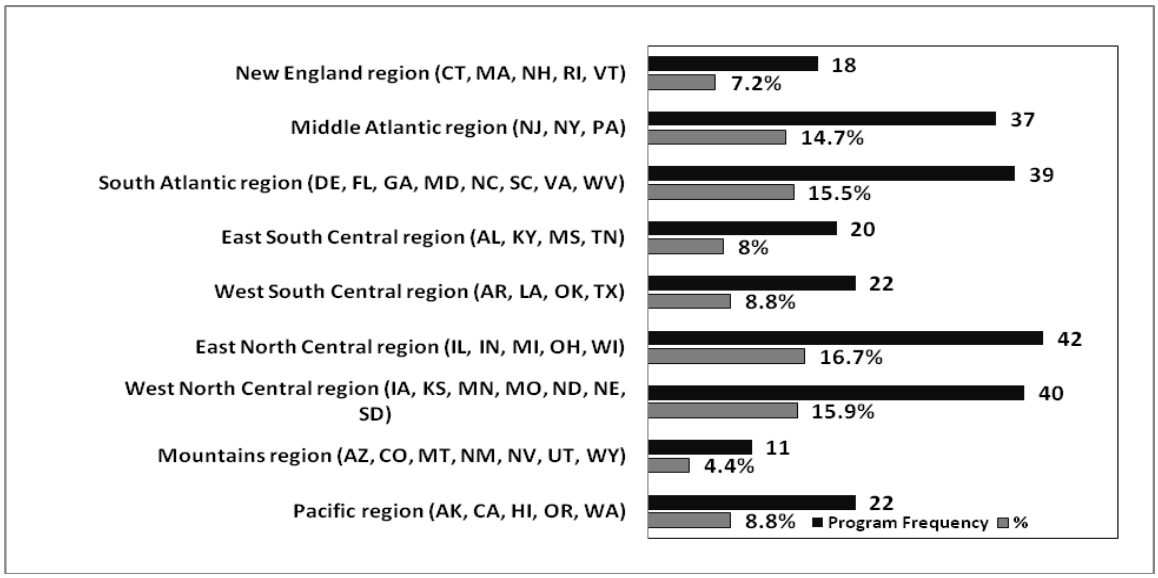


Figure 2. D*emographic breakdown of 251 survey program respondents by number of computer science majors*

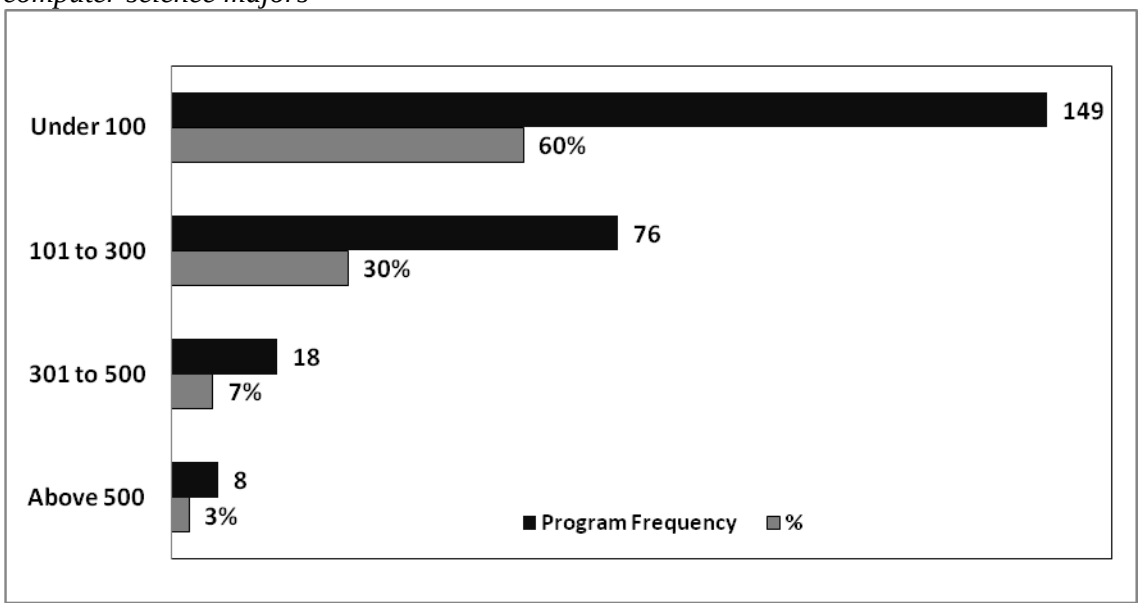


Figure 3. *Demographic breakdown of 251 survey program respondents by student enrollment by school*

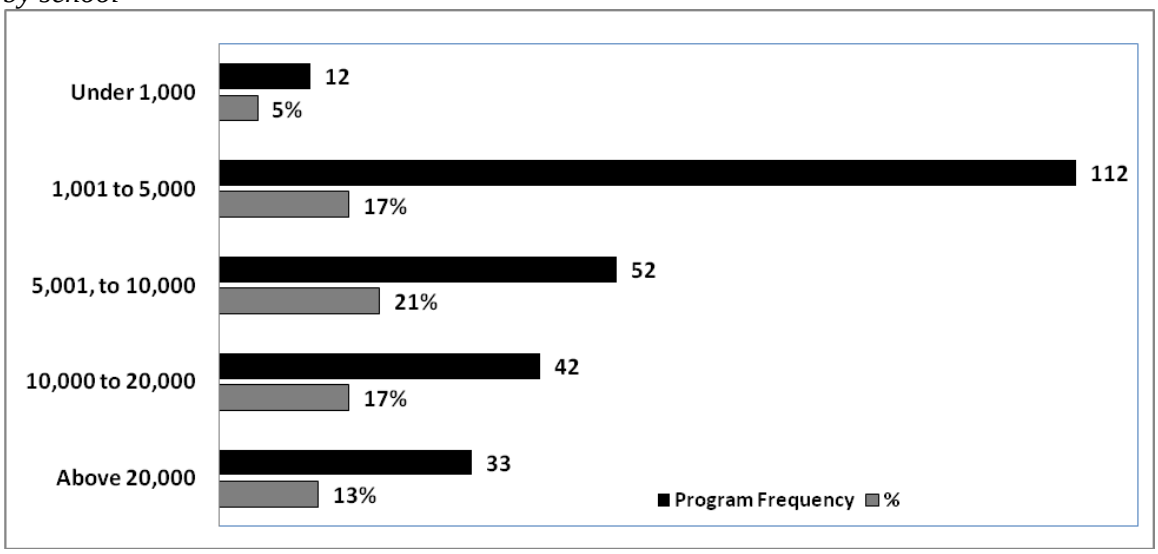
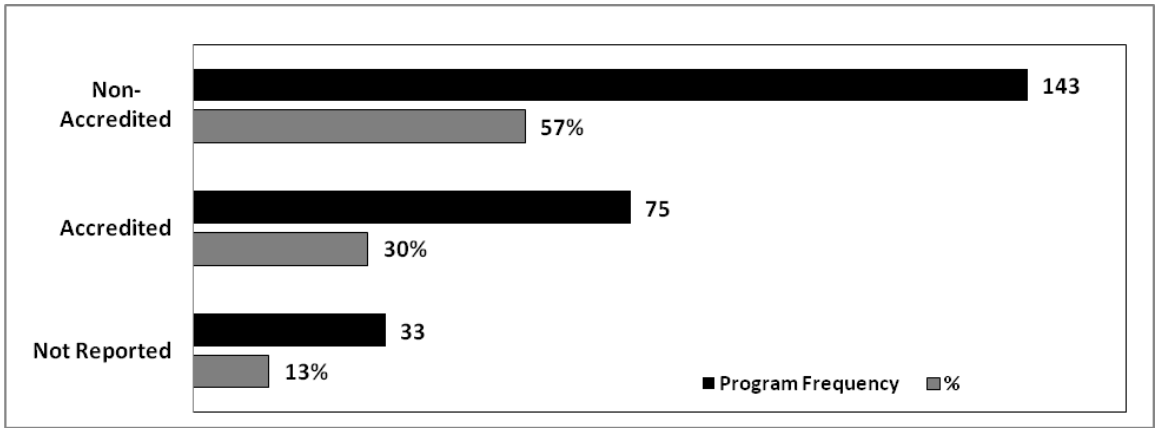


Figure 4. *Demographic breakdown of 251 survey program respondents by accredited versus non-accredited schools*



3. Results

3.1 Research question one

Are social and professional issues integrated into the undergraduate CS curricula?

3.1.1 What percentage of schools include social and professional issues in their CS Curriculum?

Survey respondents were asked if their department's undergraduate computer curriculum included any social and professional issues. Of the 251 responses to this

question, 31 (12.45%) indicated that they do not include any social and professional issues in their CS curricula, while 220 (87.6%) answered that they do include social and professional issues.

3.1.2 Does the size of school enrollment relate to whether social and professional issues are included in their CS curricula?

A chi-square test for independence was conducted to compare the inclusion of social and professional issues in the curricula and the overall school enrollment as summarized in Table 2. No relationship was found between the size of the school and whether social and professional issues are integrated into the curricula.

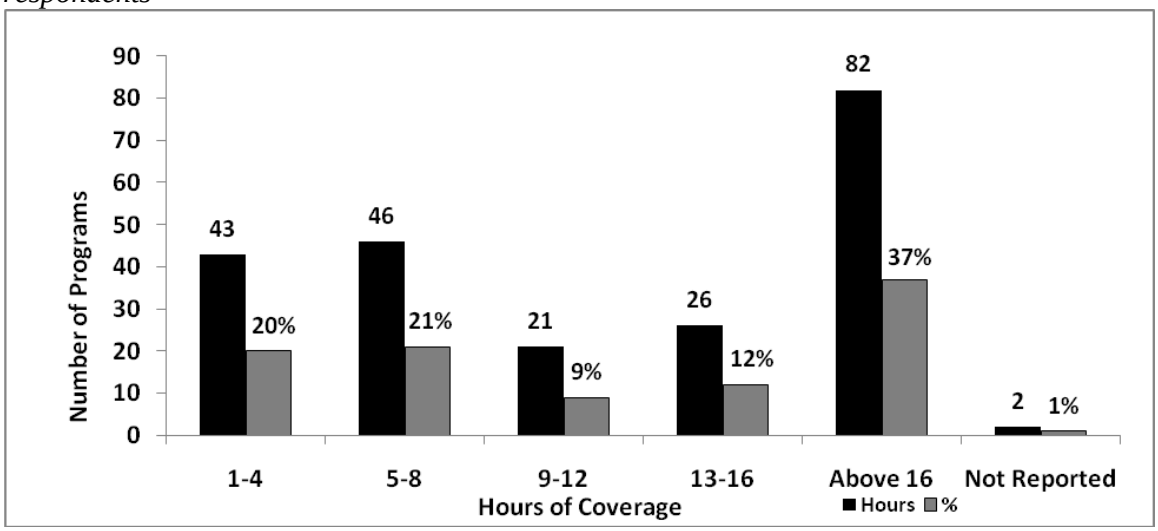
Table 2. *Cross tabulations for social and professional issues inclusion by overall school enrollment*

	Social and Professional Inclusion		
Overall School Enrollment	No (%)	Yes (%)	Total (%)
Under 1,000	0 (0%)	12 (5%)	12 (5%)
1,001 – 5,000	18 (7%)	94 (45%)	112 (45%)
5,001 – 10,000	4 (2%)	48 (21%)	52 (21%)
10,001 – 20,000	3 (1%)	39 (17%)	42 (17%)
Over 20,000	6 (2%)	27 (14%)	33 (13%)
Total	**31 (12%)**	**220 (88%)**	**251 (100%)**

3.1.3 How many hours of coverage on social and professional issues do programs provide?

Survey respondents that teach social and professional issues were asked to identify the number of hours (classroom) that social and professional issues were covered in the undergraduate CS curricula. Figure 5 records the hours (classroom) social and professional issues are covered for the 220 colleges or universities that include social and professional issues coverage in their curricula.

Figure 5. *Social and professional hours (classroom) of coverage by 251 survey program respondents*



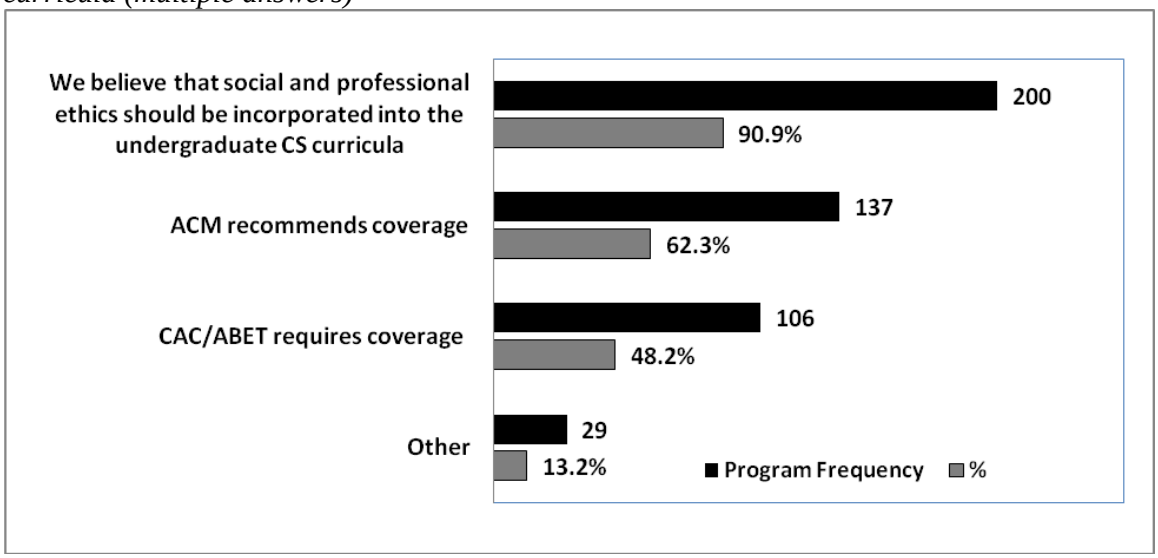
3.1.4 Is social and professional issues coverage required?

Survey respondents were also asked whether they required social and professional coverage in their undergraduate CS curricula. Of the 220 respondents that include social and professional issues, 173 (78.6%) require social and professional coverage, 46 (20.9%) do not require social and professional coverage, and 1 (.5%) did not answer this question.

3.1.5 What are the reasons for incorporating social and professional issues?

Survey respondents were also asked what their reasons were for incorporating social and professional issues into their undergraduate CS curricula and were allowed to select multiple answers. Figure 6 summarizes the responses for 220 survey respondents.

Figure 6. *Reasons for incorporating social and professional issues into computer science curricula (multiple answers)*



Survey respondents that teach social and professional issues were asked whether they required social and professional coverage in their undergraduate CS curricula. Of the 220 that include social and professional issues, 173 (78.6%) require social and professional coverage, 46 (20.9%) do not require social and professional coverage, and 1 (.5%) did not answer this question. The Pearson chi-square test of independence conducted on the number of majors regrouped into two groups (under 100, 100 or above) showed that there was a significant relationship between whether a school required social and professional coverage and the number of CS majors as shown in Table 3 with ($\chi^2(1, n=219) = 10.67$, $p < 0.001$, $ø = 0.22$). This small effect size signals that programs with 100 or above CS majors are more likely to require social and professional coverage.

Table 3. *Social and professional inclusion reported by number of CS majors (2 groups)*

	Number of CS Majors		
Social and Professional Issues Required	Less 100	100 or Above	Total
No	36	10	46
Yes	89	84	173
Total	125	94	219

3.2 Research question two

How do undergraduate CS programs integrate social and professional issues into their curriculum?

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.

The Pearson chi-square test of independence showed that there was a relationship between how schools integrate social and professional issues by number of CS majors regrouped into two groups (less than 100 and 100 and above) as shown in Table 4 with ($\chi^2(3, n=220) = 18.61$, $p < 0.001$, $ø = 0.17$). This finding suggests programs with enrollments of less than 100 CS majors tend to integrate social and professional content into other courses.

Table 4. *Delivery by number of CS majors (2 groups)*

	Number of CS 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

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 5 with ($\chi^2(3, n=218) = 30.12$, $p < 0.001$, $ø = 0.21$). These results signal that programs providing less than 12 hours of coverage integrate social and professional content into other courses while programs offering 13 or above hours of social

and professional coverage do so using a mixture of standalone course or integrate the content in other courses.

Table 5. *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.

3.3 Research question three

What are the perceptions of CS faculty regarding the importance or lack of importance to integrate social and professional issues into the CS curriculum?

Survey respondents were asked to what extent they agreed with the statement, "Social and professional ethics topics should be incorporated into the undergraduate CS curriculum." The responses, as shown in Figure 7, demonstrate a strong support for the inclusion of social and professional issues in the CS curriculum among the 251 survey program respondents.

Table 6 summarizes the cross tabulations of "should social and professional issues be incorporated" by whether schools include or exclude social and professional issues. Levels of agreement with "Should Incorporate Social and Professional Issues" were ranked by faculty on a six-point scale ranging from completely agree (1) to no opinion (6), while "Include Social and Professional Issues" was ranked either no (1) or yes (2). A correlation between "Should Include Social and Professional Issues" and "Include Social and Professional" was statistically related, (Spearman *rho* = -0.420, n = 251, $p < 0.01$, two tails).

Figure 7. *Social and professional topics should be incorporated into the undergraduate computer science curriculum*

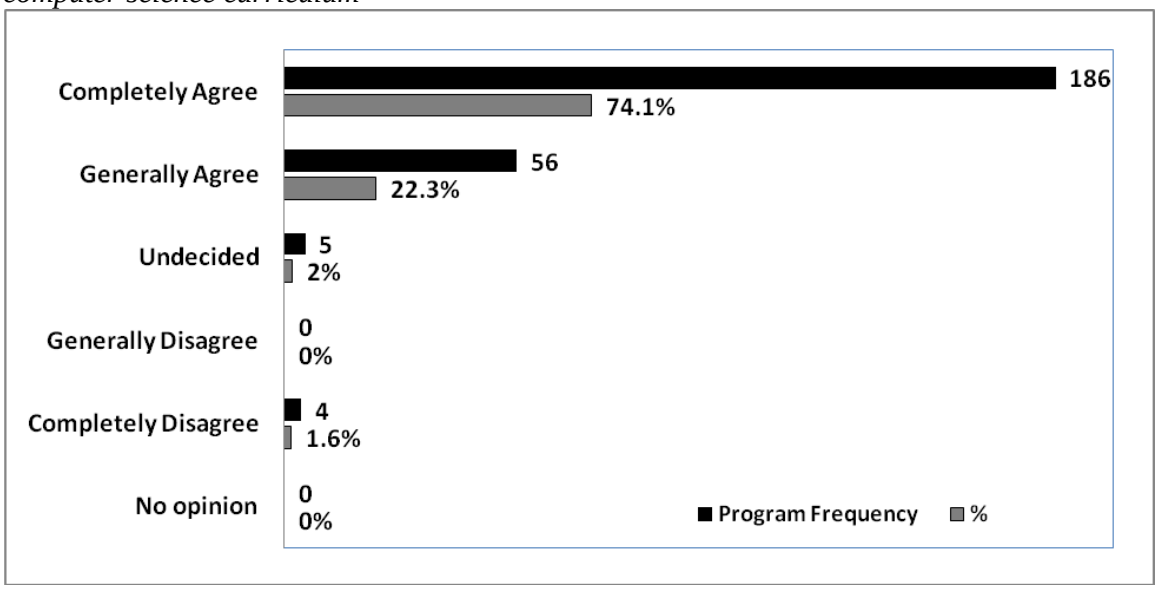


Table 6. *Social and professional issues should be incorporated into the undergraduate CS curriculum by schools including social and professional issues*

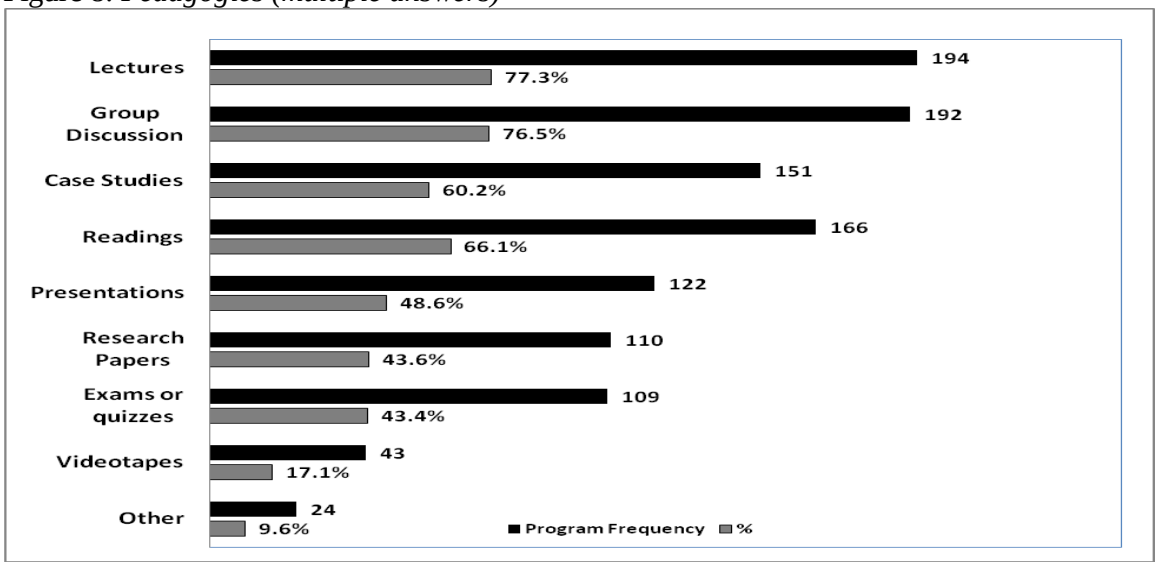
	Include Social and Professional Issues		
Should Incorporate Social and Professional Issues	No	Yes	Total
Completely Agree	9	177	186
Generally Agree	14	42	56
Undecided	4	1	5
Generally Disagree	0	0	0
Completely Disagree	4	0	4
No opinion	0	0	0
Total	31	220	251

3.4 Research question four

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

Survey respondents were asked how their department introduced social and professional ethics into the undergraduate CS curriculum. Figure 8 summarizes the possible responses of the 219 respondents to this question. Respondents were asked to select all pedagogies that applied.

Figure 8. *Pedagogies (multiple answers)*



3.5 Research question five

What specific social and professional topics have been chosen to be incorporated into the undergraduate CS 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 *Computing Curricula 2001: Computer Science* report 10 social and professional knowledge units (IEEE-CS/ACM Joint Task Force on Computing Curricula, 2002) to determine whether the knowledge unit was covered, not covered, or partially covered. (Definitions from the 2001 Social and Professional Issues were provided with each question.) 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). Table 7 provides a summary of the Social and Professional Knowledge Units Coverage. Figure 9 provides a comparison of the Social and Professional Knowledge Units Coverage. Table 8 provides a summary of the Social and Professional Knowledge Units Delivery. Figure 10 provides a comparison of the Social and Professional Knowledge Units Delivery responses.

Table 7. *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 coverage; [e] = elective coverage

Figure 9. *Comparison of the social and professional knowledge units coverage*

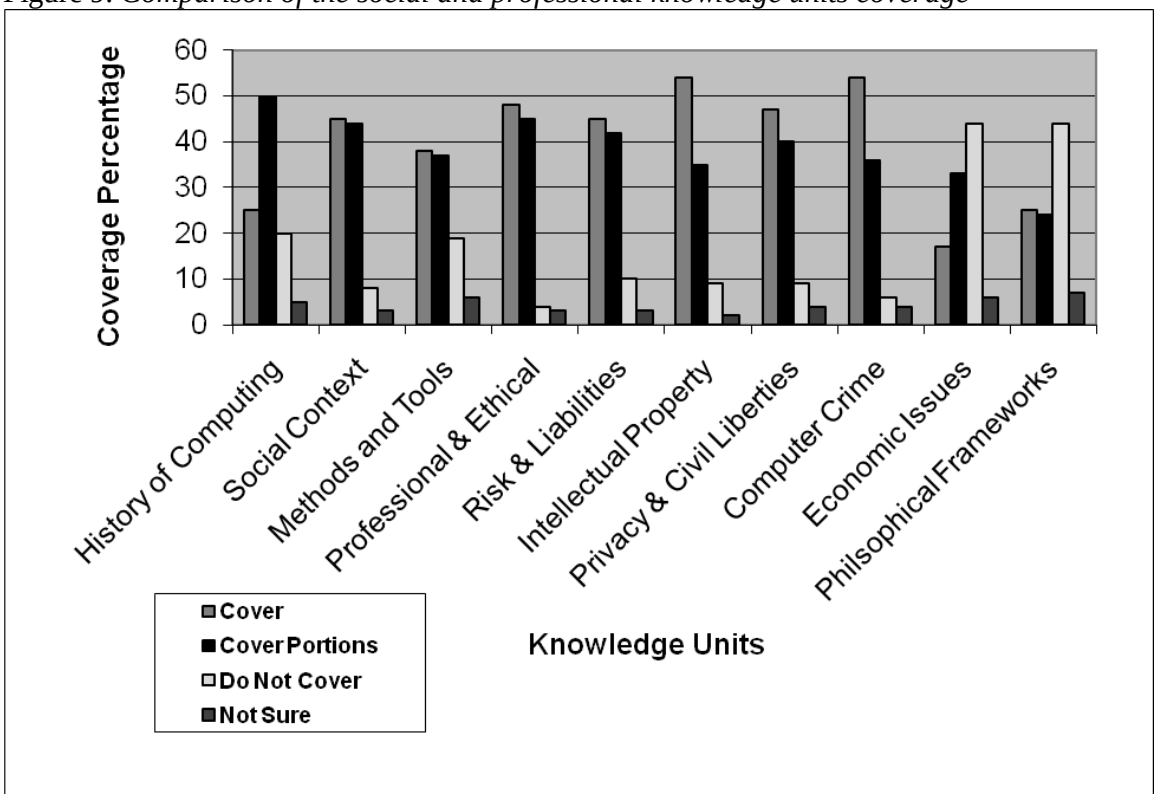
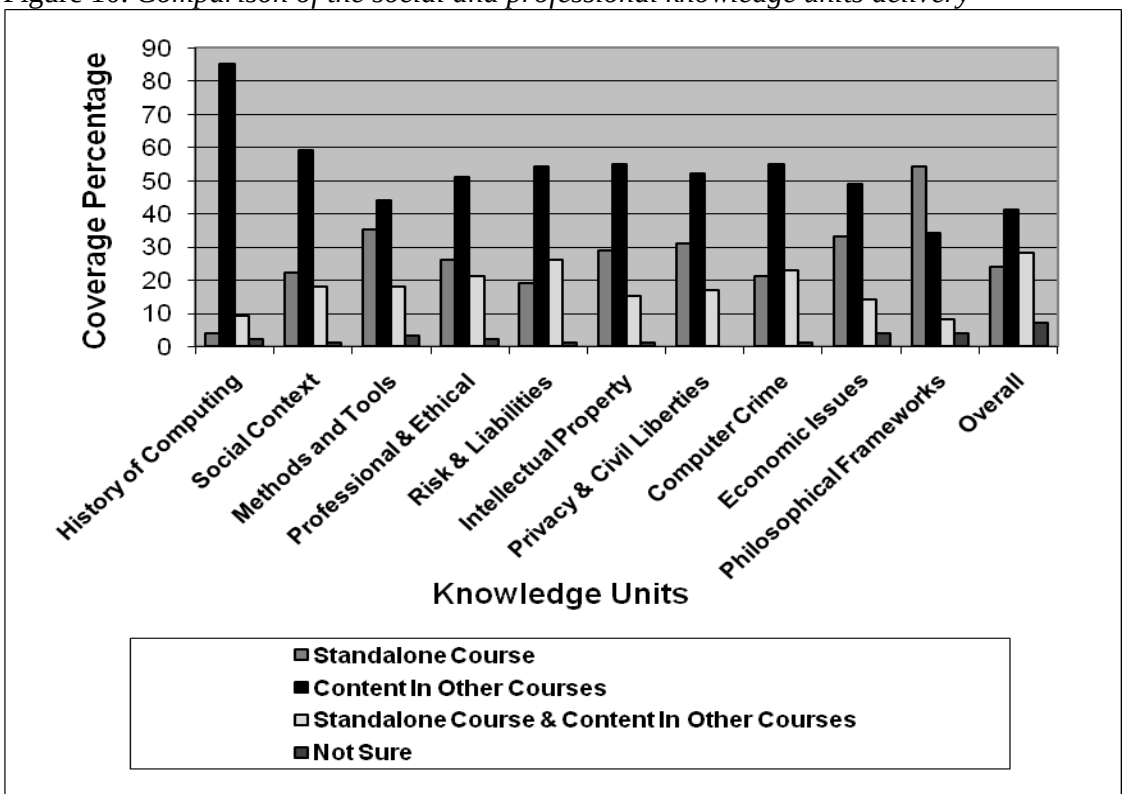


Table 8. *Social and professional knowledge units delivery*

	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 coverage; [e] = elective coverage

Figure 10. *Comparison of the social and professional knowledge units delivery*



4. Discussion, conclusions, recommendations

4.1 Introduction

This study's overall objective was to obtain a comprehensive measurement of how social and professional issues are covered in undergraduate CS programs in the United States, analyze the results, identify possible causes for trends or curricular design choices, and provide recommendations. The results and conclusions are summarized below by each question.

4.2 Research question one

Are social and professional issues integrated into the undergraduate CS curricula?

Most universities and colleges do integrate social and professional issues (87%) into their undergraduate CS curricula. Further, as reported in Section 3.1.5, the number of CS majors (<100 vs. 100+) exhibits a statistically significant relationship on whether social and professional issues coverage is required ($\chi^2(1, n=219) = 10.67$, $p < 0.001$, $\phi = 0.22$). Table 3 further suggests that social and professional issues will likely be required by a ratio of 2.5 to 1 if the number of majors is less than 100 and by a ratio of 9.4 to 1 otherwise.

The reasons for incorporating social and professional issues into the CS curricula comprised one additional set of findings. As shown in Figure 6, while a large percentage of survey respondents are influenced by ACM (62.3%) or CAC/ABET (48.2%) recommendations, a larger percentage incorporate social and professional issues because *they believe it should be incorporated* (90.9%) Therefore, we recommend continued social and professional issues emphasis in the next ACM CS report and within ACM Special Interest Groups is appropriate.

4.3 Research question two

How do undergraduate CS programs integrate social and professional issues into their curriculum?

As shown in Section 3.2, survey respondents reported that 41.1% integrate social and professional issues into other courses, 23.6% teach a standalone course, 27.3% integrate social and professional issues using a standalone course and integrate social and professional issues into other courses, and 7.7% use other means. This study supports the notion that most schools integrate social and professional issues into other courses rather than standalone courses.

There is no evidence of a relationship between the size of school and how social and professional issues are integrated in undergraduate CS programs. However, two other statistically significant relationships were found: Table 4 suggests a significant relationship between the number of CS majors by groups (<100 vs. 100+) and how social and professional issues was integrated into the CS curricula ($\chi^2(1, n=220) = 18.61, p < 0.001, ø = 0.17$). This relationship suggests that if the number of CS 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. Schools with less than 100 CS majors showed no difference in how social and professional issues were integrated. Schools with fewer than 100 CS majors are usually in small departments with a small number of faculty and therefore may find it difficult to include a standalone course.

The second significant relationship found was the number of hours of coverage by groups (1-12 and 13+) and how social and professional issues were integrated into the CS curricula and was ($\chi^2(1, n=218) = 30.12, p < 0.001, ø = 0.21$). Table 5 suggests that if social and professional content is integrated into other courses then the hours of 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 coverage will likely be greater than 12 a ratio of 1.5 to 1.

Additionally, if a standalone course and integration into other courses are used then the hours of coverage will likely be greater than 12 by a ratio of 2.3 to 1.

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 which should be integrated into textbook materials. Additionally, terms, discussions, exercises, and current social and professional cases 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 faculty that are not familiar with social and professional issues.
2) While a standalone course may serve the purpose of introducing students to certain social and professional topics, social and professional issues may be best addressed within the context of other technical CS 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. Some security issues would be best addressed within the context of a computer networking course, while risks and liabilities of computer-based systems would be best addressed in a software engineering course.

4.4 Research question three

What are the perceptions of CS faculty regarding the importance or lack of importance to integrate social and professional issues into the CS curriculum?

Table 6 shows the relationship between "Should Incorporate Social and Professional Issues" with "Include Social and Professional Issues." Agreement with "Should Incorporate Social and Professional Issues" was ranked by faculty on a six-point scale ranging from

completely agree (1) to no opinion (6) while "Include Social and Professional Issues" was ranked either no (1) or yes (2). "Should Incorporate Social and Professional Issues" is negatively correlated to "Include Social and Professional Issues", (*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 social and professional issues incorporation, there are many faculty who do not implement what they believe. Spradling, Soh, & Ansorge (2008) indicate that most CS programs do not provide social and professional issues training for CS faculty and CS faculty that do not incorporate social and professional issues in their programs do not incorporate social and professional issues because they have not received social and professional issues training. However, this same study found that when faculty are provided opportunities for social and professional issues training, they take advantage of this training. The study results demonstrate that more opportunities for social and professional issues training should be provided. Additionally resources need to be developed and offered to CS faculty.

4.5 Research question four

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

Survey respondents when asked to identify all pedagogies used to teach social and professional issues indicated that lectures (77.3%) group discussions (76.5%), readings (66.1%) and case studies (60.2%) had the highest percentages as shown in Figure 8. These findings indicate that professors expect students to read, listen and discuss social and professional ethical concepts and case studies. This research study demonstrates that CS 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. For this reason, it would be appropriate to include a

discussion of pedagogical instructional methods in the next CS curricula report. Additionally, the pedagogical methods should be incorporated in subject matter textbooks, such as case studies with group activities, plus links to external reading.

4.6 Research question five

What specific social and professional topics have been chosen to be incorporated into the undergraduate CS curriculum and how are they incorporated into the curriculum?

Results appear in Tables 7 and 8 and Figures 9 and 10 that report on the individual knowledge unit's coverage.

First, computer crime, albeit an elective knowledge unit, has the highest coverage percentage for those survey respondents that cover all or portions of this topic. While computer crime is a serious problem, perhaps this result should be interpreted with some caution. Gotterbarn cautioned that "computer ethics" coverage should be more than a "litany of computer disasters" (Gotterbarn, 1998, p. 9) and that "a catalog of computer disasters reduces computer ethics to an exercise in finger pointing." (Gotterbarn, 1998, p. 13). However, in the same article Gotterbarn (1998) suggests that coverage of computer disaster cases should be delivered using a proactive approach in which students are taught to reason and engage in cases that provide real issues in computer ethics. For this reason, perhaps programs should be cautioned regarding the computer crime coverage and faculty should be provided more instruction regarding pedagogy of this knowledge unit.

Second, survey respondents 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).

Third, professional and ethical responsibilities were the next highest covered knowledge unit with approximately 93% of programs covering this 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. Therefore, it is encouraging to see that programs are covering this topic. Perhaps new topics should be addressed relating to healthy workplace environments and the importance of keeping up to date as a professional.

Based on the above observations, we recommend that the 10 social and professional issues incorporated in the Computing Curricula 2001: Computer Science report 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) 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.
2) Prior, Fairweather, Rogerson and Dave (2004) conducted a professional practice survey with the respondents primarily being professionals from the UK and several African countries, which provided a perspective regarding actual professional ethics practice. Some type of survey or informal interviews with several industry CIO's and government officials should be conducted which could provide feedback on what

industry deemed important and therefore would provide a further element of credibility to the social and professional knowledge units.

3) Further review or studies should also be conducted relating to student motivation and student assessment of social and professional issues. We need to determine if students view social and professional issues as just some lectures with interesting cases/stories or whether students view social and professional issues as important and relevant topics within the field of computer science and therefore better design and deliver the content.

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