

THE INADEQUACY OF ETHICS IN AUSTRALIAN COMPUTER SCIENCE EDUCATION

Ivan Lim Siu Kee¹, Wong Sai Keat¹, Lin Nan¹ & Chong Kian Leong¹

¹ Department of Computer Science and Software Engineering,
The University of Melbourne

ABSTRACT: The fast growth of computer technology has indirectly increased the complexity of ethical decision making in the computing field. Therefore, there is a need for ethics to be sufficiently emphasized in the training of new computer science professionals. Although well designed and feasible solutions and strategies have been proposed to address this need, they do not seem to be widely implemented in Australia. We believe that this is because Australia is still not ready to change its computer science courses to place more emphasis on ethics. Several obstacles exist, and these obstacles must be removed before significant changes to the computer science structure can be made. This paper discusses the inadequacy of ethical education in the current Australian computer science curriculum, using Melbourne University as a case study. It will also identify the obstacles which hinder improvement to the Australian computer science course. This paper will conclude with a set of suggestions to remove the obstacles mentioned, making it easier for the authorities to address the inadequacy of ethics education in the Australian computer science curriculum.

INTRODUCTION

The tremendous growth of computers and data communication technology has impacted not only the computing community, but also society at large. This growth has introduced new factors in professional decisions on issues such as intellectual property rights, privacy and security and increases the complexity of the ethical issues involved. Actions are no longer judged by just a simple answer of right or wrong and computing professionals are faced with increasingly difficult ethical decisions. The need for computing professionals to have an acceptable standard of ethical behaviour is becoming an increasingly important issue in the field of computing. As Greening, Kay, and Kummerfeld [GKK04] describe it: "The role of professional ethics and social impact ... (has moved) ... from a peripheral status to a core one".

The computer science community understands that professional ethics is important and many strategies and solutions have been proposed and discussed. However, not much effort is being made to place a greater emphasis on the study of ethics in Australian computer science education. Why is this so? We believe that there are certain obstacles that make it difficult to put the proposed strategies into action.

Due to the size of the topic, we have decided to limit this paper. We will scope it to cover only the inadequacy of ethics in Australian computer science education (using the University of Melbourne as a case study) and the causes for that inadequacy. To achieve this aim, we will examine the problem from 4 perspectives: society, employers, the Computer Science Department (Melbourne University), and students. We will also provide suggestions to make it easier to address this problem.

PAST LITERATURE

Many papers related to this topic have already been written. Many of them have stressed on the need for increased ethical and social awareness of computer professionals and proposed feasible solutions to the problem. Weltz [WEL98] proposed new topics to be integrated into the present computer science curriculum in the Seattle Pacific University. The "staged progression" strategy suggested by Weltz acknowledges the difficulty in performing a complete overhaul of the present computer science syllabus. The strategy suggests gradual integration of ethical material into the technical subjects.

Martin, Huff, Gotterbarn and Miller [MHGM] proposed a similar solution. They organised ethics and social education into "knowledge units", and proposed various methods of integrating them into the

computer science education. Their solution is very robust and allows the knowledge units to be customized for the different courses in different universities.

Although many solutions exist, they have not been widely implemented in Australia. What are the obstacles hindering the training of ethical computer professionals? The following sections of this paper will identify the main reasons why the education of ethics is not emphasized in Australian computer science education. We believe that “a problem well stated is a problem half solved” – once we know the exact causes of the problem, finding a suitable solution will become an easier task.

IDENTIFYING THE PROBLEM

Society's expectations

Computer technology is integrated into many aspects of our daily lives. Computers are used in education, entertainment, and even in the distribution of basic necessities such as electricity. Society expects the software systems used in power plants and public facilities to be reliable and secure, but when a minor application crashes, the general reaction is just to restart the computer and try again. While it is not acceptable for computer professionals to produce unreliable software just because the impact of program failure is not severe, the attitude of society suggests otherwise. If society accepts faulty software, it indirectly reduces the emphasis placed by computer professionals on the social and ethical implications of their work.

Employer's expectations

The computing industry is the driving force behind the training of new computer science graduates. The constantly changing industry demands that graduates be equipped with knowledge of the latest technology. Job advertisements targeting computer science graduates are usually focused on the technical aspect of the university degree. They do not mention that a person has to be ethical, and thus, very little importance is placed on ethics. In their effort to satisfy this demand and make their graduates more marketable, universities keep ethical education to a minimum, and focus more on the technical training of the students.

Employers already expect a certain level of ethical behaviour from the graduate (included in the package called “professionalism”), and therefore do not specify it in their job advertisements. This means that employers trust universities to produce graduates of a certain quality. Are universities betraying that trust when they compromise on the ethical education of students? Perhaps universities do not understand the main reason of including ethics in a computer science course. By concentrating on the development of technical skills required by employers, universities are neglecting the ethical aspects of being a computer professional.

ATTEMPTS TO SOLVE THE PROBLEM

Professional societies have designed professional codes of ethics to “inspire, guide, educate, and discipline” its members [TAV04] with regard to ethical behaviour. Besides serving as a standard upon which computer professionals can evaluate their actions, it also serves as a quality benchmark for the public. For example, if a computer professional is a member of a particular professional society, then that person can be expected to behave in accordance to the code of ethics of the society he/she is in.

If each professional society had their own code of ethics, and a person was a member of more than one society, which code of ethics should he adhere to? Should that person choose the one that he/she feels most comfortable with, or the one he/she perceives to be stricter and of a higher standard? Gotterbarn (cited in Tavani [TAV04]) acknowledges that “no code could reasonably anticipate every possible moral controversy that can arise”. There are no defined criteria for the selection of the best code of ethics, and the problem of cultural relativism makes it difficult for a universal standard to be agreed upon. Hence, many different codes of ethics exist, and we do not have any assurance that computer professionals who follow different codes of ethics will have the same standard of ethical behaviour.

For the purposes of the following argument, assume that a universal code of ethics does exist, and it is recognized by all cultures to be of the “highest ethical standard”. This would solve the problem of cultural relativism. However, it would not solve the problem of unethical behaviour by professionals. There is no law or requirement saying that in order for a computer professional to practice in the

computer field, he/she has to adhere to a code of ethics. Having a universal code of ethics does not guarantee universal adherence to it by professionals.

Up till now, attempts to find a solution to the problem of the lack of awareness in the computer professional have revolved around the code of ethics itself. As stated by Heinz Luegenbiehl (cited in Tavani [TAV04]) "... we can better appreciate the importance of codes of ethics if we recognize them for what they really are – guides". We believe that the solution to this problem does not lie with the finding of the "best" professional code of ethics that all computer professionals can follow, but with the actual education of computer professionals. In order to make sure that there is an increased understanding of ethics among computer professionals, we need to examine the education system and the training that a computer professional goes through. This will be discussed in detail when we examine the University of Melbourne as our case study.

CASE STUDY: MELBOURNE UNIVERSITY

To facilitate our discussion, we will examine the University of Melbourne as our case study. The following is a generalized version of the course structure for the computer science degree in the University of Melbourne in the year 2004¹:

First Year
Technical subjects x 5
Electives x 3
Second Year
Technical subjects x 4
Electives x 4
Third Year
Professional Issues in Computing ²
Technical subjects x 6
Elective x 1

¹ Source: Melbourne University Undergraduate Handbook 2004 [HAND]

² Subject is compulsory

In this case study, we find that out of the 24 subjects in the computer science curriculum, only one subject is related to ethics, and this subject is taught in the final year of the degree course. We believe that this is "too little, too late". The purpose of this course is to train students in the computer science field and to prepare them for work. How will a person be "prepared for work" if they are educated in the complex subject of ethics only a few months before they graduate and enter the workforce? Students do not have much time to practice what they have learnt about ethics in a controlled environment (i.e. the university). Within the university, the penalties for bad ethical judgements are much less severe compared to the price of bad ethical decisions made in the work environment. Such mistakes in the workplace can be very damaging to one's professional reputation, and may result in lawsuits.

The ethics course is a compulsory subject in the computer science degree course in the final year. This, together with the lack of ethics education in the earlier university years will not be effective in training students to be ethical. Let us look at a common example: According to the Australian Copyright Council [ACC01], an individual is only allowed to copy up to "10% of the number of pages or one chapter" for research or study. A student may be unclear about the fact that photocopying entire textbooks to save money is considered as unethical behaviour. Like their peers, they spend most of their university life thinking that it is perfectly legal to do so. Only in the final year will the student be taught that his/her actions were unethical. Will that student be able to change his/her behaviour in such a short time?

Unlike the technical subjects that train a person in a certain set of skills, the study of ethics molds a person's character. Developing one's character take a much longer time compared to learning the necessary facts for a technical subject. If the professional ethics subject is introduced in the final year of study, students will most likely treat it as "just another subject", and use the same studying methods

that they use when studying for technical subjects. In an effort to pass the ethics subject, memorization and logical reasoning will be used instead of more time-consuming, but effective methods such as self-reflection and in-depth ethical analysis. We believe that the late introduction of the professional ethics subject will affect the way students learn ethics in the computer science course.

The problems resulting from unethical behaviour of students can be seen from the fact that each year, approximately 12% of the students who take the professional ethics subject in their final year plagiarize (statistic provided by Paul Gruba, Melbourne University lecturer for the professional ethics course in Semester 1, 2004). This contradicts with the results from the recent survey of the students currently taking the professional ethics subject. The survey shows that the majority of the students believe that it is essential for them to be ethical, even before entering the workforce. If this is true, then why do plagiarism cases still occur each year? This shows that including a subject on ethics in the final year of the computer science course does not necessarily result in an increased understanding of professional ethics or more ethical behaviour.

What if universities taught ethics earlier in their computer science courses? Will they fare any better? For example, the University of New South Wales begins teaching ethics earlier in its computer science course. This is a good start to training ethical computer science professionals. However, a closer look at the course structure shows that only one professional ethics subject is taught throughout the entire course. Any benefit gained by the students from the early introduction to professional ethics is lost through the absence of any other ethics related subject in the later years of their computer science education.

Many subjects in the third year of the computer science course are complex, and thus students are required to take prerequisite subjects before they are considered capable of learning these subjects. We believe that the same thing applies to the subject of professional ethics. Students should be prepared and trained in the necessary reasoning skills before being exposed to such a subject. According to Paul Gruba, the students taking the professional ethics subject have trouble understanding the subject material because they do not have the necessary comprehension/critical thinking skills that a third year computer science student "should" have. By focusing on the technical side of the course, it would seem that the department has neglected to focus on the training of certain generic skills. According to Martin [MAR99],

"It is essential to provide an early introduction to the principles and skills of ethical and social analysis ... In this manner students can begin to move from awareness to the ability to evaluate and make decisions about such issues."

We agree with Martin's statement, and believe that the current Australian computer science education is generally inadequate.

COURSE ACCREDITATION AND THE COMPUTER SCIENCE DEPARTMENT'S ATTITUDE

In the case study, professional ethics is a compulsory subject in the computer science course. Initially, it would seem as though the Melbourne University Computer Science & Software Engineering (CSSE) Department is making an effort to produce more "ethical" computer science graduates. However, closer examination shows a different picture. For the computer science course to be accredited by the Institute of Engineers Australia [IEAUST], the course should include:

"Integrated exposure to professional engineering practice (including management and professional ethics). This element should be about 10% of total program content"

Source: Manual for the Accreditation of Professional Engineering Programs.

It seems that the professional ethics subject has been included in the computer science curriculum to fulfill the minimum requirement for accreditation. There does not seem to be a genuine effort by the CSSE department to incorporate more ethics in the course. The percentage of professional ethics in the course content is 1 subject out of 24, which amounts to approximately 4.2% of the total program content. According to IEAust [IEAUST], the skills that a graduate should have include:

- understanding of professional and ethical responsibilities and commitment to them; and

- understanding of the social, cultural, global and environmental responsibilities of the professional engineer, and the need for sustainable development

By compromising on the education of professional ethics, can Melbourne University truly claim that its computer science graduates are equipped with these skills?

The attitude of the CSSE Department towards the education of professional ethics shows that the accreditation of courses does not add much value to a university course in Australia. The situation is different in countries such as America – there are many universities in America, and the market competition for student applications is very keen. With so many universities available, students begin to look for attributes that set one course apart from another. One of these attributes is course accreditation. Course accreditation becomes more valuable because it means that a particular course has been recognized by a professional society in the related field to be of acceptable quality. In this situation, universities are indirectly forced to improve the quality of their courses. Compare this to the situation in Australia, where there are only 37 Universities in the whole country. This means that competition for the market is much less. A university's reputation is a much better advertising tool compared to the accreditation of its courses. In the case of Melbourne University, it is well known as a prestigious university. Its good reputation allows it to compromise on the education of professional ethics without affecting the public's perception of its "quality". Therefore, the attitude of the department also contributes to the inadequacy of professional ethics education in the computer science course.

STUDENTS' PERSPECTIVE

During the first semester of 2004, a survey was conducted on Melbourne University students who took the "433-343 Professional Issues in Computing" subject (covering professional ethics) [GRUBA]. The students were asked 20 ethics-related questions. However, only 3 of the 20 questions are relevant to our topic (the following results have been summarized. Notes regarding these results are included at the end of this paper):

1. For me, the means justify the ends – if an act is unethical, it is better to uphold your principles and quit than continue working for a corrupt project. (61% agreed)
2. Understanding ethical behaviour is really important if you work in IT. (81% agreed)
3. Since I am a student, I shouldn't be held to a professional Code of Ethics until I enter the workforce full time. (73% disagreed)

The majority of students agreed to the first two questions, and disagreed with the third. From the results, we can conclude that students recognize the fact that understanding professional ethics is important to an individual in the computer science field even before entering the working environment. Although the majority of students believed that ethics is important, we still find cases where students are involved in unethical behavior (such as plagiarism). This suggests the possibility that although the students believe that ethics is important, they have trouble with identifying what constitutes "ethical behaviour". When a computer science student in his/her final year of study is still unable to distinguish between ethical and non-ethical behaviour, it truly highlights the lack of ethical education in their computer science course.

Course syllabus & textbook

At present, there is no standard list of accreditation requirements that all the professional societies have to follow. This will result in inconsistencies in the education of professional ethics as different professional societies have their individual requirements for course accreditation. Without a standard to follow, the syllabus for teaching professional ethics may vary from university to university. According to Paul Gruba, there is no fixed syllabus for the professional ethics subject, and despite the fact that Melbourne University has been offering the "Professional Issues in Computing" subject for 14 years, there was not even a designated textbook for the subject until last year. Improvements to the subject have been made in the last two years, but this does not change the problem of not having a standard syllabus for professional ethics subjects.

Having a standard syllabus indirectly suggests a need for a standard textbook or standard teaching-material. The textbook used in Melbourne University's Professional Issues in Computing course (Semester 1, 2004) is "Ethics & Technology", written by Herman T. Tavani. The examples given and laws referred to in this book are "America-centric". According to Paul Gruba, this book was selected

because there aren't any "Australia-centric" books on professional ethics available. Students studying in an Australian university will most probably join the Australian workforce. If computer science students are taught professional ethics based on American examples and American laws, it will be harder for them to relate to the examples learnt when they enter the computer industry in Australia. We see that in this sense, the education of professional ethics in the computer science course is inadequate.

SUGGESTIONS & RECOMMENDATIONS

Production of an "Australia-centric" textbook

We believe that effort should be made by authors in the Australian computer science community to produce "Australia-centric" textbooks on the subject of professional ethics and professional issues. An Australia-centric textbook should refer to Australian laws and use Australian examples. This will help improve the quality of the professional ethics education as students will be able to learn ethics in an Australian context.

Universal standard of accreditation

Professional societies that are responsible for accrediting university courses should agree on a universal standard of professional ethics requirements in the computer science curriculum. Currently, different societies have different sets of accreditation requirements regarding computer science ethics education. For example, IEAust requires that approximately 10% of the course curriculum should be related to "professional engineering practice" such as professional ethics [IEAUST]. The Australian Computer Society (ACS), on the other hand, requires that the course contain material of "sufficient depth and breadth" in topics such as Interpersonal Communication, Ethics, and Project Management [ACS03]. Given that accreditation requirements vary from professional society to professional society, different universities will have different levels of professional ethics incorporated in their courses. Universities which do not meet the requirements of one society could get their courses accredited by another, which may have lower requirements. This defeats the purpose of making ethics a requirement in the course curriculum. Instead of ensuring that university graduates will have a certain standard of ethical behaviour, universities which do not put importance on professional ethics will be able to abuse this loophole to get their course accredited.

Having a standard set of requirements will provide uniformity in the teaching of professional ethics in Australian universities. Universities will also be encouraged to go beyond the requirements for accreditation to attract more students.

Advertising to increase society's awareness & expectations

Society needs to be well informed of the level of quality they should expect from the software products they use. Advertisements and announcements via the mass media will keep the public informed, and exert more pressure on computer professionals to consider the ethical and social implications of their software before releasing it.

Change in computer science course structure

The solutions listed above will help remove the obstacles hindering the incorporation of more ethics in the Australian computer science course. Once this is done, action has to be taken to change and improve the Australian computer science course structure. We will not discuss how this will be done, as various strategies have already been developed. See the papers written by Martin, Huff, Gotterbarn and Miller [MHGM] and Weltz [WEL98] for some strategies to include more ethics education in the present Australian computer science curriculum.

CONCLUSION

In this paper, we found that little emphasis is placed on professional ethics in the education of Australian computer science students. We also showed that even though many strategies to improve the Australian computer science course structure exist, it is difficult for these strategies to be implemented in Australia because of various obstacles. These obstacles include: society's low expectation of computer professionals, the emphasis on technical rather than ethical aspects of computer science education, the absence of an Australian-centric textbook, and the varying requirements of different professional societies for university course accreditation. Once these

obstacles have been removed, it will be easier for changes and improvements to be introduced to the Australian computer science course and Australian educational institutions will be able to work towards producing ethical computer professionals.

SURVEY RESULTS

The results used in this paper were taken from a survey given to the students studying the “433-343 Professional Issues in Computing” subject in Semester 1, 2004 at the University of Melbourne [GRUBA]. A total of 197 responses were received. The survey questions covered issues such as the students’ view on ethics, privacy, piracy, professionalism and open source development. For each question, the students were given 5 choices: **Strongly agree**, **Agree**, **No opinion**, **Disagree**, and **Strongly disagree**. In this paper, we simplified the results by combining the results for **Strongly agree** and **Agree**. The actual results are shown below.

Table 1. Table showing the detailed results of the relevant survey questions.
SA – Strongly agree, **A** – Agree, **N** – No opinion, **D** – Disagree, **SD** – Strongly disagree, **U** – Unanswered.

Questions	SA	A	N	D	SD	U	Total
For me, the means justify the ends – if an act is unethical, it is better to uphold your principles and quit than to continue working for a corrupt project.	31	89	40	32	4	1	197
	16%	45%	20%	16%	2%	1%	100%
Understanding ethical behaviour is really important if you work in IT.	60	101	13	18	4	1	197
	30%	51%	7%	9%	2%	1%	100%
Since I am a student, I shouldn’t be held to a professional Code of Ethics until I enter the workforce full time.	4	22	25	91	54	1	197
	2%	11%	13%	46%	27%	1%	100%

REFERENCES

[ACC01] Australian Copyright Council (2001), Information sheet G53: Copying for research or study, viewed 9 June 2004, <http://www.copyright.org.au/PDF/InfoSheets/G053.pdf>.

[ACS03] ACS (Australian Computer Society) (2003), Accreditation of courses in universities at the professional level: Guidelines for universities, viewed 29 September 2004, <http://www.acs.org.au/accreditation/AccreditationManual.pdf>.

[GKK04] Greening, T., Kay, J., & Kummerfeld, B. (2004), Integrating ethical content into computing curricula *in* “Proceedings of the sixth conference on Australian computing education”, vol. 30, pp. 91-99.

[GRUBA] Gruba, P. A. (2004), 433-343 Professional Issues in Computing Survey. An ethics-related survey of the opinions of the Melbourne University students taking the 433-343 subject in Semester 1, 2004. Unpublished.

[IEAUST] IEAust (The Institution of Engineers, Australia) (1999), Manual for the accreditation of professional engineering programs, viewed 7 June 2004, <http://www.ieaust.org.au/membership/res/downloads/AccredManual.pdf>.

[MAR99] Martin, C. D. (1999), From awareness to responsible action (part 2): developing a curriculum with progressive integration of ethics and social impact *in* SIGCSE Bulletin, vol. 31, no. 4, pp. 10-12.

[MHGM] Martin, C. D., Huff, C., Gotterbarn, D., & Miller, K. (1996), Implementing a tenth strand in the CS curriculum *in* “Communications of the ACM”, vol. 39, no. 12, pp. 75-84.

- [MW99] Martin, C. D., & Weltz, E. Y. (1999), From awareness to action: integrating ethics and social responsibility into the computer science curriculum *in* "ACM SIGCAS Computers and Society", vol. 29, no. 2, pp. 6-14.
- [TAV04] Tavani, H. T. (2004), Ethics and technology: ethical issues in an age of information and communication technology, International edn., John Wiley & Sons Inc, New Jersey.
- [HAND] Undergraduate handbook for the Melbourne University Faculty of Engineering (2004), viewed 1 June 2004, <http://www.unimelb.edu.au/HB/areas/NELEENG.html>.
- [WEL98] Weltz, E. Y. (1998), A staged progression for integrating ethics and social impact: across the computer science curriculum *in* "ACM SIGCAS Computers and Society", vol. 28, no. 1, pp. 30-34.