Integrating Ethical Content Into Computing Curricula

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Abstract

This paper contributes to the ongoing dialogue about the inclusion of ethics content within computing education. It presents a brief exposition of the challenges facing the teaching of ethics, favouring a highly integrated approach across the curriculum. As an example of how some of those challenges may be simply addressed, it introduces a non-intrusive means of motivating an ethical dimension within existing units of study by innovative use of a survey instrument. The focus of discussion is on the use of this instrument to explore issues related to plagiarism. Finally, the paper appraises this simple concept in terms of the challenges raised at the head of the paper.

Keywords: Ethics. Professionalism. Plagiarism.

1 Introduction

The next section introduces the mandate to include ethical issues in contemporary computing courses. The discussion then identifies some of the principal challenges associated with meeting this mandate.

We then present a simple device for exploring ethical issues within existing units of study. This involves students being periodically surveyed within tutorial or laboratory sessions in order to provide feedback to the population about specific ethical content. The result is the identification of ethical issues that are particularly relevant to the student body. Given that plagiarism persists as a "hot topic", we provide some examples from the plagiarism questions in our surveys. The use of this device is then discussed in terms of how it addresses the challenges identified at the beginning of the paper.

2 The ethical mandate

As early as ACM's Curriculum '78 electives in social impacts of computing were proposed. The role of professional ethics and social impact within the curriculum has been cemented in Curriculum '91 and Curriculum 2001, moving from a peripheral status to a core one.

In the US, professional accreditation of computing and engineering courses has recognised this mandate. The Accreditation Board of Engineering and Technology (ABET, 2001) and the Computer Science Accreditation Board (CSAB, 2001) have all assigned professional ethics a core place in the teaching of computing.

Australian professional bodies have followed suit. The Australian Computer Society accreditation requirements include a core body of knowledge in which "ethics, social implications and professional practice" is mandatory (ACS 2000a).

This mandate has generated some serious challenges for technical and scientific academic staff untrained in the humanities and who may or may not have a history of professional practice within industry. Some of these challenges are identified in the next section.

3 Challenges

We focus on five challenges raised by the demand to include professional ethics in the computing curriculum:

1. The integration of ethical content into technical units;
2. Empowerment of staff in teaching ethical content;
3. Engaging students with ethical issues;
4. Facilitation of valued learning of ethical content; and
5. Doing justice to the content.

3.1 Integration

Considerable debate has raged over whether to include ethical content as an attached, specialised unit or to integrate ethical content across the curriculum.

Some educators relegate ethical issues to an optional capstone unit (e.g., Staehr 1999). However, this does not reflect the centrality of ethics suggested by professional bodies, and risks compartmentalisation of the content (Medley et al 1995). The danger is that non-integrated treatment of ethical issues in undergraduate education may result in a lack of student ability to integrate ethics into their professional life.

Integration of ethics within the curriculum has therefore emerged as the preferred option for treatment of ethical dimensions in computing.

Martin (1999, p11) extends this position and argues for a phased approach incorporating an early introduction:

> *"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."*

This is the sort of approach being widely articulated by computing academics with expertise in the area of curriculum development and ethics. Variations on the theme are adopted in practice. For example, many excellent ethical case studies exist, such as the "Killer Robot" series (Epstein 1995, 1997), which demand time that may be found to be too intrusive in an "across the curriculum" approach; however, an elective capstone may be an entirely appropriate place in which to give this coverage. Such a unit would build upon the skills developed elsewhere in an "across the curriculum" model.

However, spreading ethical content across the curriculum raises challenges for computing educators. It is essential to recognise that attachment (rather than integration) may occur *within* a unit of study (Gotterbarn 1999) as well as at the curricular level. The problem is that the nature of ethics as an academic and professional discipline is radically different to that which most computing educators are familiar with (Moskal, Miller & King 2002). The result is that ethics is often appended to existing content in units, with the domino effect that students may not perceive it as integrated to the profession. There is the potential here that this effect is more detrimental to professional education than no inclusion of ethical content at all, as students have it reinforced that ethics may be as much an afterthought to professional practice as it was in their education.

The challenge to educators, then, is to carefully integrate the ethical content into the technical domain.

3.2 Empowering staff

There is some risk that staff charged with the incorporation of ethical content within their area of expertise remain unconvinced that this mandate is anything more than a fashionable trend. Another risk is that staff convinced of the value of ethical content remain uncertain as to how to facilitate its presence within existing course work. Both risk scenarios may benefit from some assistance in the area of staff training; however, it is interesting to note that there seems to be a lack of support in the literature for the education and training of academic staff in this area. The US National Science Foundation is attempting to remedy this situation, sponsoring projects to assist in the education of teachers (Moskal, Miller & King 2002).

With respect to the possibility that ethics is under-valued by staff, there are numerous well-grounded research outcomes that offer support for the core placement of professional ethics. Three examples follow:

1. There are discernible differences between the ethical judgements made by students and computing professionals (Pierce & Henry 1995). Clearly, if we aim to produce computing professionals we must either bridge this gap or adopt the unlikely position that industry experience should be left to somehow foster it after graduation.
2. Employers are starting to treat ethics as a competitive economic resource (Harris 1998). Quite simply, there are emerging trends that a sound understanding of professional ethics offers an employment advantage to the student.
3. Observation (over 5 years) of students in a third-year work experience unit revealed a number of worrying issues (Preston 1998). In particular, student lack of awareness of their ethical responsibilities was used against them, and there was increasing evidence that they were exploited by being asked to perform unethical and – sometimes – illegal activities.

Clearly, the same sort of arguments may be of interest to the student body!

With respect to the uncertainty as to what to teach and how to teach it, an obvious starting point are professional codes of ethics, such as those produced by the ACS (2000b) and IEAust (2000). However, a reliance on these documents as a pedagogical tool is unlikely to be found satisfying over time. Harris (1998) cites research which suggests that organisations find codes of ethics "useful but insufficient" in terms of satisfying the ethical needs of their profession, so it does not necessarily do the ethical dimension justice. Furthermore, in terms of student engagement, it has been reported that students find codes of ethics difficult to apply to realistic scenarios because they are too vague or too abstract to relate to reality (Werth, 1997).

It is tempting, in this environment, to favour the argument that professional philosophers become responsible for these aspects of the teaching, enabling computing staff to concentrate on their areas of existing expertise. However, Gotterbarn (2000) argues that although the philosophical foundations of ethics may require deep commitment before they become accessible, the practical applications are relatively manageable. A more important issue emerges. Engaging an ethicist to manage ethical content runs the risk of suggesting to students the fruitlessness of ethics education. Surely, if a specialist is required to introduce ethics content in a computing course, it sends the message that the issue of ethics exceeds the capacity of a computing professional given the students' academic experience that a computing teacher is unable to embrace it (Martin & Holz 2000).

Furthermore, employing a specialist to deliver ethical content does not readily fit into a highly integrated model, although it may be more feasible for a capstone unit.

The literature reveals high levels of discomfort with this situation. There was strong criticism within the SIGCSE community over Curriculum '91's mandate for inclusion of ethical and social issues of computing as it did not specify what to include or how to include it (Gotterbarn, 1991). In the ACM Curricula 2001, although "computer science ethics" has been added to the ACM Body of Knowledge, the criticism over the lack of specification about implementation remains (Ghafarian 2002). Certainly, examination of the Australian counterparts indicates that the same criticisms may be leveled. However, do we interpret these criticisms literally (in which case professional bodies need to better define the territory), or do we see this as symptomatic of a lack of empowerment by academics in computing with respect to

ethical content (in which case, we need more training and more resources)? Clearly, the two interpretations are somewhat dependent. However, as computing educators, our most manageable challenge is in terms of gaining better training and resources in professional ethics.

3.3 Achieving student engagement

The level of student engagement is likely to influence whether students react to ethical content as an externally-delivered set of rules or, more favourably, as an internalised commitment.

Students – as well as staff – may need to be encouraged to fully appreciate the value of an ethical component to their course. Some of the arguments presented in the previous section (about staff commitment and empowerment) may therefore have equal validity for the student population.

The possibility of student uncertainty with regards to the relevance of ethical content argues in favour of a number of recommendations made previously:

1. High levels of integration;
2. Early introduction; and
3. Staff adoption and empowerment.

All of these are likely to impact on levels of student engagement with the material.

However, additional issues are also evident.

Firstly, engagement requires some level of relevance. Although staff are responsible for ensuring coverage (and, therefore, exercising some control over the ethical content), students need to identify some ownership of the material if we expect engagement at the level likely to lead to personal commitment.

Another problem is that students in technical disciplines tend not to engage with ethical issues when they are required to produce an essay or critique (Schulze & Grodzinsky 1996; Allison & Halstead 1996). Furthermore, staff are often inexperienced in equitable assessment of these tasks (Moskal, Miller & Kin 2002), which raises the possibility of further alienation of students. Although courses on ethics are typically located in the humanities, the adoption of assessment methods more common to the humanities (than the sciences) are not necessarily appropriate. Despite a strong trend to encourage report-writing skills within technical disciplines, it is possible that attempting to bind ethics to report writing might put both at risk.

Schulze and Grodzinsky (1996) reveal other approaches that result in a failure to get the ethics message across:

- the issue wilts (due to a lack of strong opinions, not having done some assigned reading, or an absence of passion);
- students taking the same side on an issue;
- individual students dominating the discussion;
- the failure of international students to participate due to culturally-based reluctance or English problems;
- inappropriateness of lecture format for delivery; and
- insecurities of staff in teaching and assessing the content (as presented in the previous sub-section).

3.4 Facilitation of valued learning

With the high profile given to valued learning within the computing education community, it is quite remarkable that the literature on ethics education in computing rarely applies these concepts with the same tenacity. For example, when educators discuss technical content they consider approaches to learning that may be described as "deep" or "shallow"; the learning tasks may be assessed in terms of their level of authenticity; or the need to encourage life-long learning is emphasised. Similar discussion is less obvious when the topic involves ethical issues in computing.

One danger for students who adopt a "shallow" approach to ethics education is that they risk disowning the content by externalising it and, for example, equating it with law. Accordingly, ethical dilemmas are resolved by determining whether or not the actions are "legal". Alternatively, a "shallow" approach to learning might equally result in a reduction of the content to a matter of opinion, a state of solipsism in which ethical dilemmas are completely addressed by internal dialogue. Both of these may be shown to be inadequate. That ethics is not simply a matter of personal opinion is evident by the existence of professional codes of ethics. That ethics does not simply equate to law may be questioned by definitions of ethical principles, such as that offered by Colero (1999), that include compliance with legal obligations but raise civil disobedience as an ethical exception. However, these realisations will not necessarily propel the student to deeper approaches to learning ethical content. The question is how to instill in students a professional response to potentially complex situations that are ethical and self-regulatory (Meyenn, 2001). If we teach rules (e.g., law), then we put at risk any continuing engagement with ethical issues and reduce it to application of external (rather than internal) principles. If we over-simplify ethical issues we run the same risk. With respect to authenticity, many ethical case studies are too obvious, whereas real world situations involve complexity and ambiguity (Gersting & Young 2000). If students are to negotiate these complexities they must be exposed to qualitatively similar ethical dilemmas.

The challenge flagged here is the need to tackle the teaching and learning of ethical material with the same passion for facilitating valued learning of technical content.

3.5 Doing justice to the content

Mahowald and Mahowald (1982) summarise some of the difficulties associated with the demand to teach ethics within a scientific or technical discipline, including the following:

1. *The technical curriculum is already crowded and the inclusion of ethics threatens essential technical content.* In reality, it is more likely that the ethical content will be assigned a meagre presence within the unit, in order to reduce this perceived threat of technical content starvation.

2. *Staff inexperienced in teaching ethics may unintentionally misrepresent the material, perhaps resorting to a prescriptive moralistic stance in place of encouraging students to actively engage with ethical issues.* This relates to the lack of resources and training described earlier, although the focus here is the effect on the teaching of ethical content rather than staff empowerment *per se*.

3. *The inclusion of ethics in a technical curriculum may not do justice to the ethical issues due to dilution or error.* We have favoured the case for integration of ethics with technical content, and therefore do not make the assumption that dilution or error is necessarily associated with it, given appropriate resource support. However, it is a legitimate concern that is the focus of this sub-section.

In negotiating the issue of what constitutes fair representation of ethical content, we need to decide how we will meet the mandate to include such content. Certainly awareness of professional ethics is a minimalist response to these demands; a readiness to facilitate deeper engagement with ethics would be preferred. However, whether or not this requires leaving the domain of professional ethics and touching upon philosophical ethics is an open question.

For example, it may be useful (at least for staff, and quite possibly for senior students) to develop an awareness of internally-consistent ethical frameworks (or "world views") within which individuals may unknowingly locate themselves. Philosophy offers some treatment of this that may be a useful tool for exploring ethical issues (Harris 1998; Medley et al. 1995) or designing interesting ethical content. Ethical dilemmas may be interpreted according to operational frameworks, such as:

1. *Utilitarian*: ethical decisions are made on the basis of maximisation of happiness;

2. *Deontological*: ethical decisions are made on the basis of the application of righteousness (possibly determined by religion or reason);

3. *Virtuous*: ethical decisions are made on the basis of individual character; and

4. *Relativist*: ethical decisions are made on the basis of personally defined truth, in the absence of any belief in universality.

However, this additional perspective does not necessarily require a deep association with the rich philosophical literature on ethics.

On the other hand, it is essential not to trivialise the content. Gotterbarn (2000) criticises what has been referred to as the teaching of "pop computer ethics", as perpetuated by the media. It is typically taught by repeated presentation of a negative use of technology (in the form of "computer risks"). The danger is that it occurs in an ethical vacuum, with no structure and no exposure to tools that a professional might use to resolve a complex ethical issue. It is harmful in that "ethics" may be equated simply as "dilemmas", and ethical reasoning is thereby effectively dismissed. The resultant problem for facilitating anything more than a vague awareness of professional ethics is that it favours a retrospective, reactionary approach at the expense of a proactive one.

Harris (1998) recognises two different types of ethical issue that do not fall under the heading of "pop computer ethics". The first (the "acute dilemma") is characterised by a context in which it is not readily obvious what should be done. Accepting a job to develop a new on-line gambling system might be an example. The other (the "acute rationalisation") is characterised by a situation in which the ethical path is clear but becomes personally difficult to take. Being directed by a team leader to rush through the software-testing phase of development in order to get a product out before the competition might be an example.

The challenge is to include ethical content in a manner than does more than offer passing acknowledgment of its importance, but exposes some of the richness of the discipline to the technically oriented student.

4 The survey

We describe a survey instrument used to explore the integration of ethical content in a second-year unit on software development methods (incorporating C programming in a UNIX environment). Four surveys were conducted throughout the semester, each with 8 variations (explained below). These are available for download from the resource repository available at the *webworkforce* site (webworkforce).

Surveys are more typically applied to a population sample in order to test inferences about the wider population. Our interest is different. We are not focussing on the testing of hypotheses about the ethical standards of university computing students more widely. Rather, we aim to explore ethical issues with our student population. The use of this tool is much more aligned to a teaching device than a research device in this case. However, we still use inferential statistics in order to investigate the significance of responses.

Each survey run consists of two questions only. Each question asks students to register their opinion about the behaviour of an individual in a given scenario, using a 7-point Likert scale with the following meanings:

- Passionately opposed
- Strongly opposed
- Opposed
- Neutral
- In favour
- Strongly in favour

- Passionately in favour

The first scenario is common to all students in the unit. On expressing their feelings about the actions of a certain individual within the scenario, students are permitted to see the second scenario. This is always a modification of the initial scenario, adding information in order to see if this causes students to alter their reaction from the initial case. There were 8 modification scenarios for each initial question, sufficient to offer these in different lab sessions without the "grapevine" effect interfering with the responses.

The use of a 7-point scale was intended to allow students more room to express any feelings of change from their reaction to the initial scenario.

A number of design features of the survey were focussed on encouraging students to present "honest" reactions to the given scenarios rather than succumb to the temptation to provide "desirable" responses. These include:

- *The very use of a modifier scenario*: We suspect that increasing the level of complexity of the scenario, such as is achieved by modifying it after initial exposure, reduces the likelihood of responding to it according to external expectations.
- *Anonymity*: Students were given anonymity in answering the surveys.
- *Time limit*: it was important that the surveys did not cause a deep intrusion into the planned technical activities for the lab. Therefore, a limited time was given to respond to the two questions. This was also believed to ensure an "honest", rather than cautious, response to the scenarios presented.
- *Third-person scenarios*: The use of the third-person to articulate the scenarios was intended to distance the situation from the respondent, placing them as an observer rather than a participant, and thereby increasing the chances of an honest reaction to the scenario.
- *The favouring of "acute dilemma" scenarios*: The majority of scenarios avoided the temptation to present simple ethical problems (of the "acute rationalisation" nature) in which the "correct" response is evident, even if in reality the "correct" response in such a scenario may be difficult to implement. The "acute dilemma" is preferred.
- *Surveys precede lectures:* Our intent was partially to use the surveys to motivate a lecture on ethics, by presenting students with interesting ethical dilemmas throughout the semester. It has the important additional benefit that at the time of the surveys, students have not had exposure to the underlying issues on which some of the ethical scenarios are founded. Thus, they are less likely to have their responses coloured by what might otherwise be construed as "desirable" responses.

To further clarify the nature of the survey, the following section provides partial results of one survey question that focussed on plagiarism.

5 Sample results – the example of plagiarism

In the second week of semester, students were asked to react to the following scenario, using the 7-point Likert scale to react to Bertie's behaviour:

> *A number of students had complained that the programming assignment included a lot of things that they had not learnt in lectures. Bertie only just submitted his on time. He later admitted to Fred that he copied much of the code from some he found on a web-site.*

Note that the question already hints at a level of ethical complexity that removes it from simple "right or wrong" categorisation. This opens the possibility for accusations of vagueness in the survey instrument. There are two responses to this criticism. The first is a reminder that our emphasis is on engaging our students in a discussion of ethics. It is not a research project *per se*, and we are more interested in exposing students to ethical complexity. Our second response is that the importance of the modifier scenario is increased in this context, and were we to run this as a research exercise, much of the information of value would come from the change in student response to the additional context added by the modifier scenario.

The reactions to this initial scenario covered the full range of responses, but the median result was "opposed" ($n = 243$). However, this was not found to be significantly different from a "neutral" response ($n = 180$; $T = 45$; $\alpha = 0.05$; 2-tailed). Refer to section 9 for a justification of the tests used in this section.

The remainder of this section summarises a number of the modifier scenarios posed, and the responses that were received. Discussion of any these results is deferred to section 6.

5.1 "Everybody does it"

> *In the scenario just described, Fred also revealed that he copied much of the code in his answer from the web as well. He also stated that most of the people he knew had done the same thing.*

This modifier scenario is simply intended to explore the possibility that a "culture" of cheating somehow makes it more acceptable or that there is a "critical mass" at which cheating gains more acceptability. The median for this modification remained at "opposed", and the modifier was not found to result in a significant shift in response ($t_{calc} = -0.79505$; $df = 54$; $\alpha = 0.05$; 2-tailed).

5.2 The risk of being caught

> *In the scenario just described, Fred also revealed that he copied much of the code in his answer from the web as well. He also stated that most of the people he knew had done the same thing. Further discussion revealed that almost everyone in Bertie's group of friends had copied code from the same source. Someone then pointed out that plagiarism-detection software would be run on submissions.*

This varies the previous modifier scenario only in that we increase the prospect of getting caught. There was a slight move towards increased opposition in these responses, but the effect of the modifier question was again found to be insignificant (t_{calc} = 1.146563; df = 13; α = 0.05; 2-tailed).

5.3 Legitimation: unfair lecturer expectations

In the scenario just described, Fred showed Bertie a document he had been reading for a different course of study. The document was written by a well-respected academic; it established that in most cases when students copy material without acknowledgment it is a symptom of being over-worked. Typically, the document claims, the expectations of lecturers were too high.

The median remained as "opposed" to this modifier scenario, used to present the case that there were external forces responsible for plagiarism. The change in response was found to be insignificant (t_{calc} = 0.647524; df = 44; α = 0.05; 2-tailed). However, students from the advanced stream were also given this modified scenario in their survey, and the result was different. In the initial question the median for the advanced class was "strongly opposed", but the modifier question resulted in a significant move towards acceptance, with a change of median to "opposed" (t_{calc} = – 3.007084; df = 17; α = 0.05; 2-tailed).

5.4 The last resort

In the scenario just described, Bertie discussed with Fred how he had tried for some time to address the issues in the assignment, but found it too difficult. It was only at the last moment that he resorted to searching for solutions on the web, in order not to fail the assignment.

The modifier in this scenario was intended to explore the ethical issues that emerge when it is revealed that the plagiarism occurred only as a "last resort" after some (undefined) legitimate effort had been made to tackle the problem. Within this group, the median response to the initial scenario had been "neutral", which is where it remained after that scenario had been modified. However, the movement in response to the modifier scenario was regarded as significant (t_{calc} = 2.236068; df = 15; α = 0.05; 2-tailed). Although the sample was small (n = 16), the significant movement showed a 37.5% increased acceptance in response to the new information.

5.5 Defeating feedback for improved teaching

In the scenario just described, the assignment was only worth 4%. The lecturers had stated in class that the main purpose of the assignment was to identify weaknesses in programming so they could tailor the course to be as useful to student learning as possible.

In this case, the modifier explores the possibility that the plagiarism occurs in a context where staff had primarily used the task to tailor the teaching to meet student needs. 55.5% of respondents increased opposition to the act of plagiarism when this context was added, and this movement was found to be significant (t_{calc} = – 3.11789; df = 26; α = 0.05; 2-tailed).

5.6 A missed learning opportunity

In the scenario just described, Bertie later found that he was having trouble with many aspects of the course work. He revealed to Fred that he now believes he missed out on some learning objectives by copying parts of the assignment.

This was intended to explore the realisation that plagiarism may reasonably be expected to result in reduced learning. The reaction to the modifying information was found to be significant (t_{calc} = 3.809908; df = 34; α = 0.05; 2-tailed). What was interesting was that the movement was towards increased acceptance (with 48.6% of students changing their reaction favourably)! This is something that would be explored in feedback to the student body (e.g., discovering that they were registering increased acceptance of Bertie's new recognition that he disadvantaged himself, rather than more acceptance of his decision to cheat).

5.7 Credentialism

In the scenario just described, Bertie discussed with Fred how he was only doing the programming subject because his parents had pressured him to do it. He did not care about the unit content, and would not be pursuing related units, but needed a pass in this unit to satisfy his parent's expectations.

This modification was intended to explore the ethical implications of plagiarism in unvalued areas of learning simply to achieve a "required" credential. No significance was found to be associated with movement based on the additional information (t_{calc} = –0.50427 ; df = 50; α = 0.05; 2-tailed).

6 Meeting the challenges

In this section we appraise the simple example given by the survey device just described in terms of the challenges raised in section 3 of the paper.

6.1 Integration

There are many options for integration of ethical material within the technical curriculum. For example, Gotterbarn (1999) suggests simple provision of context to build an ethical dimension onto technical tasks. An exercise on case statements could be contextualised into writing some software to control the movements of a laser performing eye surgery; context could be added to a sorting assignment by suggesting that the task was to alphabetically sort a list of donor recipients. Although highly integrated, such approaches clearly work at the level of ethical awareness, and do not themselves satisfy the depth of learning that we may desire. However, the example is provided to make the case that simplicity and

non-intrusiveness may leverage ethical content into the technical domain.

In the example that we have provided here, we make a similar case. The use of the survey instrument described is a simple idea. It is easy to implement and to modify ethical content appropriate to specific technical material. It is also an example of a device that does not intrude deeply into existing structure.

6.2 Empowering staff

The principal challenge identified earlier with respect to empowering computing educators to integrate ethics into their units was increased access to resources and training. We intend to develop a number of resources for the inclusion of ethics in computing, of which the survey described here is one example. We will be lodging these with the *webworkforce* repository (webworkforce), and take this opportunity to invite others developing such resources to do the same. There are possibilities for funding training and resource development in this area, given that it appears to be seriously under-resourced at present.

The survey is one example of a resource (in this case, an idea) that is readily adaptable to other technical domains. It can be used to generate discussions without the need to venture into unfamiliar territory. It should be mentioned that we have developed a simple spreadsheet template to analyse the responses; complex statistical analysis is not required to quickly gain an understanding of the results.

6.3 Achieving student engagement

On the issue of relevance, this simple idea leads to a balance being achieved between the need for staff to cover specific issues and the need for students to develop a sense of ownership of the ethical content. Staff develop the scenarios. However, the simplicity of the idea means that they may be tailored in response to issues affecting students. For example, students that have accidentally left their directories world-readable need to have this brought to their attention. However, it also offers an opportunity to raise the level of awareness about this issue by developing an interesting plagiarism scenario as part of the ethics survey: are students who have their files world-readable culpable if some act of plagiarism may result?

The survey approach offers a means of engaging the student body in a dialogue on the ethical issues involved. Student ownership is inherent to this use of the tool, as any discussion that takes place does so in reply to student responses to the survey rounds.

It also avoids many of the approaches that were found to have a negative effect on engaging students with ethics:

- An issue is less likely to wilt in the discussion if that discussion is framed in terms of actual student responses to given scenarios;
- An issue is less likely to have one-sided responses given the use of multiple modifier scenarios;
- An issue will not be dominated by a few individuals as statistical tests are used to locate the contexts of interest;
- The lecture is motivated by the use of the surveys, with the intention that they create a “need to know” which may be addressed via discussion throughout the semester, but is formalised by a single lecture towards the end of semester; and
- It does not involve binding the ethical content to assessment methods that may be unfamiliar to students.

Consider some of the interesting discussion questions that are generated by the plagiarism example. Why was there no significant deviation from the “neutral” position in response to the initial plagiarism scenario? Why did the increased risk of getting caught by plagiarism-detection software *not* significantly alter the reaction to the initial scenario? Why was there significantly increased opposition to cheating when the task was one that was to be used by staff to tailor the course? Why is there evidence of increased acceptance of plagiarism as a “last resort”? Indeed, what constitutes a reasonable effort before a “last resort” act of plagiarism may be entertained? The list goes on. The point is that these are questions raised in part by the student body.

6.4 Facilitation of valued learning

It is unlikely that any piecemeal activity will record a high rate of success in encouraging “deep” approaches to learning. We therefore make no claims that the survey device presented here in itself encourages students to adopt a “deep” approach to the learning of ethics. However, it is well suited to representing ethically complex issues. As such, it may readily be used as a device to provoke students who may be adopting a “shallow” learning approach to confront misconceptions about ethical issues that may occur as a result.

Problem-first learning environments (such as Problem-Based Learning, or project-based courses) have a strong literature presence with respect to facilitating “deep” approaches to learning. In such environments, ethics may be readily incorporated as part of the technical problem domain. These highly integrated environments, however, typically require considerable scaffolding to ensure that students maintain a viable, working relationship with the material. In such an environment, we would advocate the use of this survey approach to provide some of that scaffolding with respect to the ethical content.

6.5 Doing justice to the content

The use of the surveys to create a “need to know” is intended to motivate students to explore underlying ethical issues and be receptive to more formal introduction to ethical content later in semester. To this extent, the exposure to ethical dilemmas via the surveys may be used to leverage the inclusion of related ethical content.

Student responses to the surveys may generate an opening to introduce appropriate readings into the discussion. For

example, the literature on plagiarism contains many excellent, readable studies (e.g., Dick, Sheard & Markham 2001; Sheard, Carbone & Dick 2003) that may be of as much interest to students as academics. Students may therefore be encouraged to engage in a dialogue with the literature. For example, plagiarism is frequently associated with unrealistic expectations of staff and high workloads. As our surveys did not find that this particular scenario modifier generated any significant movement, students may be encouraged to discuss why this may have been the case. Furthermore, our advanced class did express significantly greater levels of acceptance of plagiarism once this information was revealed; again, this is not a research result, but a result that may be used to motivate students to form a basic relationship with the research literature.

With respect to doing justice to the wider ethical issues, staff may quite easily use ethical frameworks as a resource to set interesting dilemmas in the survey tool, ensuring that students are exposed to stimulating levels of complexity in the scenarios to be explored. Whether or not students are ultimately exposed to the philosophical models upon which such complexity is founded is another matter. It may be the case that succeeding in motivating students to explore ethical issues in computing may result in greater interest in, say, enrolling for electives in a capstone unit specialising in professional ethics. On the other hand, even if students never formally explore the underlying philosophical foundations of ethics, the fact that they may be readily used to develop the scenarios does justice to the discipline.

7 Conclusion

The paper has presented a brief exposition of the mandate to include professional ethics within computing curricula and the resultant challenges that arise. We have described a simple example of an idea that meets some of these challenges, making a case that satisfying the ethical mandate does not require radical deviation from existing technical content. However, implicit in much of this argument has been the need for greater pooling of resources for staff to easily integrate ethical material into their teaching.

8 References

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9 Appendix – Statistical tests used

In this section we present a justification for the statistical tests used.

Note that in interpreting the results presented in Section 5 that the survey consisted of two parts. The first part was presented to all students in the unit. The second part was founded on the first part, modifying the scenario it presented; these "modifier" scenarios are presented to different classes within the unit and are discussed in the sub-sections (5.1 to 5.7).

9.1 Descriptive statistics

Data generated directly from responses to the survey instrument creates ordinal data. We therefore use the median to describe central tendency and range to describe dispersion. However, in describing the effect of the modifier question on response behaviour, we subtract the first response from the second. This gives a magnitude of change (in terms of the difference of the second response to the first response) and a directionality of change represented by sign. Providing we are careful to interpret these new data in terms of response behaviour on the survey instrument (and not some "count" of belief!) then these data may be treated as interval data. Thus, the effect of the modifier question on response behaviour may be described in terms of arithmetic mean (for central tendency) and standard deviation (for dispersion).

9.2 Significance of responses to an issue

The responses to the survey generated ordinal data. Therefore, we perform a test on the median of the sample to determine whether or not it is significantly different to a proposed median. The sign test for a single median is therefore an appropriate test. The null hypothesis is that the sample does not have significant reaction to the issue presented (that is, a median "neutral" response). The alternative hypothesis is that the median response is not neutral (2-tailed test).

9.3 Significance of response to a modifier

The *change* in response behaviour between two survey questions can be expressed as interval data (see section 9.1). Since we are interested in comparing this response data against the null hypothesis that the additional information has generated no change in mean response, the *t*-test for a single mean is an appropriate test. A negative datum indicates an increase in opposition, a positive datum indicates an increase in acceptance. Therefore we conduct the test against the null hypothesis that the mean change is zero. The alternative hypothesis is that the mean change is non-zero (2-tailed test).

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