

Introducing PETE: Computer Support for Teaching Ethics

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ABSTRACT

In this paper, we discuss the challenges in providing computer support for teaching professional ethics using a case-based approach. We describe our tutoring software, PETE, which helps students prepare cases for class discussion. PETE enables students to practice methods of moral reasoning. It also encourages them to compare their work to a range of other peer responses. We discuss how the program could incorporate AI techniques and how to evaluate its effectiveness.

1. INTRODUCTION

In teaching professional ethics, instructors engage students in case analysis. This involves teaching the skills needed to apply abstract information about values, principles, and moral theories in the context of detailed fact situations. The task is subtle, complex and performance improves with repetition.

PETE (Professional Ethics Tutoring Environment), our Web-based tutoring program, is designed to help students practice using the skills involved in case analysis. It provides a way for them to learn the structure of moral reasoning and to hone their skills outside class discussion.¹ A key feature of PETE is that it enables students to see and compare how their peers have undertaken the same case analyses.

This paper summarizes the challenges of teaching practical ethics and discusses some recent attempts to apply computer technology in ethics instruction. We then present our approach and illustrate PETE with an example. While PETE does not yet incorporate Artificial Intelligence techniques, we describe how an AI&Law approach could help students learn to use line drawing techniques in analyzing cases with PETE. Since evaluating educational software in ethics presents some special challenges, we conclude with a discussion of some of the evaluation issues.

¹ PETE (<http://pete.lrdc.pitt.edu>) is being developed under NSF grant #9720341, Modeling Learning to Reason with Cases in Engineering Ethics: A Test Domain for Intelligent Assistance. PETE is based on a prototype created by Mac Mirchandani.

2. CHALLENGES OF TEACHING ETHICS

As noted above, ethics instructors commonly engage students in reading, analyzing, and discussing realistic cases. This exercise aims to: “induce students to identify their own values and appreciate a range of values; sensitize them to identifying moral problems and dilemmas, help them to identify and understand problem facts, induce them to consider alternative actions, envision consequences, map out a ‘moral road map,’ choose an action that best promotes the moral community, and induce them to reflect upon and reconsider the decision” [12].

Fortunately, a number of conceptual tools exist for teaching these skills. First, some authors have suggested pedagogically useful processes for moral problem solving like those in *Engineering Ethics*, a popular textbook by Harris et al [9]. Their procedure for case analysis is not intended to be algorithmic but provides some valuable cognitive structure. It helps students identify and integrate information relevant to the analysis:

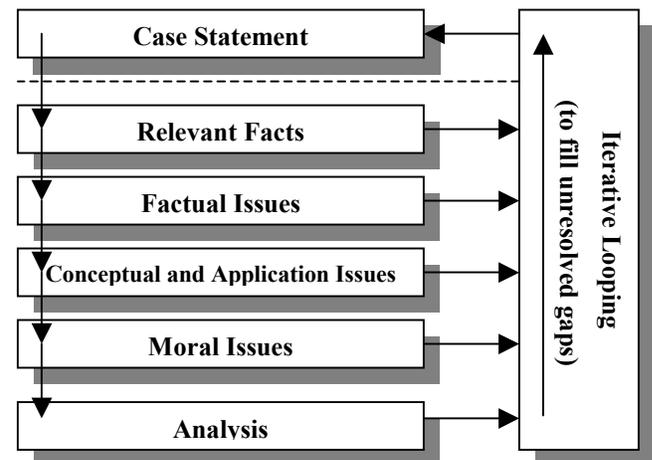


Figure 1. Case analysis according to Harris et al (2000).

Other conceptual tools help students identify moral issues and proceed through the steps; such tools include line drawing, methods for resolving conflicts, general principles of common morality and mid-level principles from Codes of Ethics, creative middle way solutions, considering rights of persons, and others.

The relevant information for analyzing ethics cases ranges from highly abstract moral principles to specific details of the factual scenario. Jonsen refers to the moral theories, for example, as “balloons;” it is not always clear how to use the lofty prospect of an abstract moral theory to guide professionals as they traverse the ins and outs of specific dilemmas, precariously balanced on “bicycles” [11].

The conceptual tools are intended to help students learn to integrate and apply the information at all levels, but even learning to use the tools is nontrivial. Semester-long professional ethics courses focus on giving students practice in applying the tools within the context of complex cases derived from practice.

PETE is designed to assist students in reading and analyzing such cases in preparation for classroom discussion. It provides support in applying some of the conceptual tools to analyze the fact situations. PETE's organization was adapted from the analytical process in the Harris text (Figure 1).

PETE's structure and case library are augmented by other students' analyses of the same cases. These peer texts were extracted from a protocol analysis of 14 students' moral problem solving methods from a study of case-based reasoning [14]. The excerpts have also been indexed to match PETE's structure based on the Harris text. Students using PETE to guide them through the analytical process can see how their peers analyzed the same case in the same step in the process.

We hope that the peer texts motivate students to perform a meaningful analysis of the case, provide them with some points of reference for comparing their own analyses, act as a source of suggestions that are necessarily not "authoritative" (and so may be challenged, unlike "expert" analyses), and provide examples of different kinds and qualities of analyses.

3. RELATED WORK

There have been a number of attempts to use computers in teaching ethics.

Most basic are "textbook on computer" resources, characterized by static content, no personalization for individual students and no opportunity to collect input. Although these resources could contain rich multimedia content, the student constitutes a passive receiver of information. Examples include the "Online Ethics Center for Engineering and Science" [12], a repository of case studies, codes, and other ethics texts, and "Ethical Judgments in Professional Life" [4], a set of texts gathered specifically to support a course on ethics at Carnegie Mellon University. Such resources succeed on the Web because they offer immediate, ubiquitous access to students with a networked computer.

Cavalier's software "A Right to Die? The Dax Cowart Case" advances beyond the "textbook on computer" approach by including some interactivity [1]. It explores a single ethics case in great detail. The interactivity appears in "guided inquiries," asking the student to make decisions and state opinions about the questions arising at key points in the case. Input can be optionally stored for later review. This software is sold as a CD-ROM, and cannot be used by entire classes of students as easily as Web-based resources, although the multimedia content seems very adaptable to the Web.

The Ethos System by Taknosys Software Corporation is another piece of software that involves inquiry into an ethics case [5]. It advances beyond the detailed exploration of a single case by incorporating a framework for case analysis. The framework, known as HARPS, consists of several ordered stages and analysis methodologies (line-drawing, utilitarian analyses, tests), which can be applied to ethical problems to derive a resolution. HARPS is also based on the Harris text.

As a teaching tool, the Ethos System may suffer from permitting a student to go on to subsequent steps in the analysis before being certain of answers to previous steps. In an ethics case analysis, it is important to understand certain aspects of the case before analyzing others; for example, identifying relevant facts precedes identifying factual issues, which, in turn, precedes identifying conceptual issues. The Ethos System allows the student total freedom in selecting the order of steps in the case analysis. While we have not empirically established that this freedom has adverse pedagogical effects on student performance, it allows floundering; a student may be tempted to perform a step before even attempting prerequisite steps, which is contrary to the procedure for ethics case analysis that we aim to teach. In modern intelligent tutoring systems, interaction is usually restricted to reasonable actions; unreasonable actions are either disallowed by the interface, or cause immediate negative feedback [2].

4. THE PETE APPROACH

We have developed PETE to synthesize the benefits of these varied approaches. PETE is a Web site that implements aspects of the Harris framework for ethics case analysis, and is more suitable for pedagogical purposes than the Ethos System. The main advantages of PETE are Web-accessibility, adaptive interactivity that is guided and structured in response to student actions, and help for students with analyzing specific cases.

PETE is a Web site, easily accessible via any Internet-connected computer.² Students' responses to questions in the case analysis are stored in a remote database, which means that students may repeatedly access PETE from different computers, pausing their work whenever they like, with no need to save their work to external media (e.g. floppy disk), to move among different computers. Professors may access the students' work in progress, which can be useful for directing classroom activity and for quickly assessing the level of student involvement and understanding.

The process of working with PETE makes use of adaptive interface technology. As stated above, some steps in a case analysis should be completed before others. Before allowing a student to proceed with some of the steps, PETE requires that their prerequisites be satisfied. This is accompanied by user interface cues that inform the student of the restrictions, similar to the way modern GUIs disallow some buttons from being clicked by "graying them out" (Figure 2). The sequence of prerequisite steps appears below:

1. Identify known morally relevant facts and unknown morally relevant facts (steps 1 and 2);
2. Identify conceptual issues (step 3);
3. Identify specific ethical issues and general ethical issues (steps 4 and 5);
4. Suggest possible resolutions, examine consequences, and select a resolution (steps 6, 7, and 8).

² Only the Internet Explorer 4.0+, Netscape 6.0+, and Mozilla M18+ Web browsers have been tested to work with PETE.

For example, a student may not proceed to steps at level 3 or above before completing the steps at level 2, but may return to steps at level 1 to revise his responses.

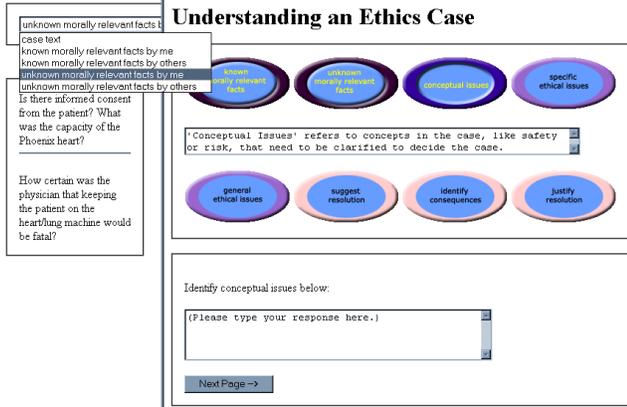


Figure 2. PETE’s main screen consists of the reference pane (left) and input pane (right).

The most interesting feature of PETE is the help it provides to students analyzing specific cases via the peer texts we mention above. Let us follow an imaginary PETE session with a student named Pat.

Pat begins by logging into PETE (so we can distinguish her responses from other students’). At this time she also selects the ethics case she will be analyzing, the Artificial Heart case.³ The main screen of PETE, now before Pat, consists of reference and input panes (Figure 2). By default, the reference pane contains the case text. Pat’s main work is with the input pane. There, eight buttons correspond to eight steps in case analysis, adapted from the Harris process. Pat has already completed the two steps involving identifying known and unknown morally relevant facts, and so the conceptual issues step has become available to her. PETE will disallow Pat from attempting further steps until she has at least begun working on the conceptual issues.

Pat clicks on the conceptual issues button, and PETE asks her to identify some conceptual issues in a text box. PETE updates the reference pane to contain Pat’s entries from the step directly preceding the current one – in this case, the unknown morally relevant facts. In case Pat has forgotten what it means to identify conceptual issues, there’s a simple reminder she can see by pointing to the conceptual issues button with her mouse: “‘Conceptual Issues’ refers to concepts in the case, like safety or risk, that need to be clarified to decide the case.” Pat lists some conceptual issues from the Artificial Heart case in the text box, and clicks the “Next Page” button below the box.

PETE now asks her a follow-up question: “Verifying analysis of conceptual issues. Check off descriptions that fit your response.” PETE then lists some conceptual issues that are known to be present in the case. In this way, PETE invites Pat to self-classify and reconsider her responses. The reference pane has updated to show Pat the conceptual issues she had just entered, so that she

³ Although PETE presently contains only this case, another is in preparation, and peer texts have been collected for five more.

can perform a side-by-side comparison of her input and the stored responses. Pat checks off several of the conceptual issues that she had previously entered, and notes some others she had missed. She also notices that she entered a conceptual issue that PETE had not listed, so she enters it a second time in a special text box.⁴

Should some of the conceptual issues that PETE presents puzzle Pat, she can read more about them. The menu at the top of the reference pane currently reads “conceptual issues I listed.” Pat clicks on the menu, and selects the following option, “conceptual issues others listed.” The ‘others’ are actually Pat’s peers from previous semesters of the same ethics class, and the menu leads to the “peer texts” we discuss above. (In fact, the conceptual issues that PETE had listed for Pat’s comparison also came from peer texts.)

Through the use of these peer texts, Pat can compare her answers to the answers of other real students. This carries multiple important benefits. Thanks to the transcription, the answers appear in context, not in stilted, scripted form. Because ethics by itself is concerned with others’ viewpoints, this opportunity to examine peers’ thoughts brings about a relevant emphasis. Lastly, a direct pedagogical benefit we hope for is motivation, stemming from what Philip Greenspun terms the community effect on sites like amazon.com [8]. Not all the students will consider ethics case analysis exciting, so in response we do something pedagogically effective that also attracts the students. Engaging students in a virtual dialogue with their peers creates a sense of community and involvement, and serves to engage students in greater interaction with PETE and, we hope, more intense ethics case analysis.⁵

PETE also speaks to some logistical concerns that teachers and students face. Because it can be used outside of class, there is no time limit on how long a student might use it to practice. This allows students to focus on case analysis in a way not possible in a class setting. In addition, PETE helps in tailoring study schedules to individual students. Another use of PETE is as a “fill-in” exercise – the teacher could complete some of PETE’s tasks, and ask the students to fill in the rest.

5. APPLYING AI TO PETE

Although PETE attempts to help students in pedagogically sound ways, it uses no intelligence in its processing. We examine some possible areas where AI could help PETE in its operations.

PETE presents an opportunity to employ some techniques from Intelligent Tutoring Systems. In the example about Pat, in each case analysis step she faces the challenge to match her response to peer responses. Latent Semantic Analysis may be capable of monitoring how well Pat meets this challenge by matching the texts independently [10]. LSA could be helpful in providing quick feedback to Pat on her analysis, so that she may benefit from an

⁴ This is an important analytical action of distinguishing two statements of an event – Pat’s versus another’s. Such analysis could help Pat construct a justification for the resolution she proposes.

⁵ We have also considered using audio of the peer interviews to further enhance student-to-PETE and student-to-student dialogue and increase motivation.

early assessment of her skills. It has been reported that using LSA to dynamically assess students' work at the levels of dialogue [7] and essay writing [6] allows an ITS to effectively structure remedial tutoring. In PETE, LSA might show whether students regularly miss aspects of a case analysis, like the issue of informed consent in the Artificial Heart case, triggering remedial instruction.

We may learn further insights into ethics case analysis through cognitive modeling and modifying PETE to teach based on the model. Ultimately, this could help us in getting students to learn on their own the high-level criteria that the instructors use in grading their work. For instance, in a parallel study mentioned below, our analysis of the same protocols that are the source of PETE's peer texts confirmed the importance of line drawing. We are particularly interested in the possibility of using AI&Law techniques to model and teach line drawing with PETE.

5.1 Line Drawing and Factors

Line drawing is an important instrument for ethics case analysis. Supporting line drawing would strengthen PETE as an ethics tool.

The principle behind line drawing is this: the resolutions to some ethics problem situations remain unclear even after identifying their facts, concepts, and ethical issues. To handle such a problem situation, it sometimes helps to compare it to other cases. Line drawing involves envisioning a continuum of similar cases. The extremes of the continuum contain cases that can clearly be solved (e.g., by casuistry) and the problem situation fits somewhere within the continuum between the extremes [9].

From the point of view of the line-drawing algorithm, the cases used to shed the light on the problem situation can be hypothetical, and their number can be arbitrary. The usefulness of line drawing becomes apparent in comparing the cases to the problem situation. The comparison allows one to place the problem situation in the continuum, thereby ranking it. This problem resembles the one addressed by the Hypo system, which makes legal arguments by comparing cases in trade secret law [3]. Hypo's approach used a knowledge representation technique called "dimensions" to model such aspects of a case as can be described by ranges of data. For example, in a problem situation dealing with an ethically questionable gift, a gift worth \$5,000 may matter much more than a gift worth \$50. This aspect of the value of the gift can be modeled within a dimension of monetary worth.

Dimensions would constitute a good way of comparing cases for PETE as well, because of the apparent similarities between the processes of line drawing for ethics case analysis and Hypo's search for precedents [15].

A general procedure for line drawing would consist of steps to:

- identify aspects of the problem situation that prevent finding resolutions even after identifying facts, concepts, and ethical issues;
- from among those, cull aspects that can be modeled with ranges, thus establishing dimensions;
- from among the dimensions, cull those that, when varied, could influence the resolutions (i.e. ensure that the dimensions are based in the morally relevant facts)

- for each dimension, identify interesting ranges (e.g. in the example above, \$50 to \$5,000 may be an interesting range, while raising the upper limit to \$50,000 would not make much difference);
- pick cases (either actual or hypothetical or both, but with clear resolutions) that do not differ from the problem situation in terms of any facts other than those that fall in the dimensions. The cases should span the range of the dimensions;
- rank the problem situation and the other cases along the dimensions.

Both line drawing and Hypo have the need to find (or generate) cases similar to the problem situation as well as significantly different cases. The latter are necessary to establish boundaries for the ranges and to show that varying the values in the case does lead to a clear resolution.⁶

Harris et al. describe the ranking process for the cases as creating a list of features that themselves can be ranked as positive or negative (i.e. belonging to one extreme or the other), and then examining the cases in terms of the features. In such a fashion, the case with many negative and few positive features would fall towards the negative end of the continuum.

One can envision using the Artificial Heart Case as an example of line drawing within PETE. In the case, a doctor who had successfully implanted an experimental artificial heart into a calf was faced with a patient who had rejected a human donor heart, and was connected to a heart/lung machine, urgently needing a new donor heart. The new donor heart was delayed, and at one point the patient's own physician had decided that the heart/lung machine was becoming dangerous for the patient. The doctor temporarily implanted the artificial heart into the patient substituting it for the heart/lung machine, and when the new donor heart arrived transferred the patient to the machine, and then to the new donor heart. Even though the artificial heart did not cause the patient's ultimate death, the doctor violated FDA regulations by using an unapproved device.

To show that the case resides along at least one dimension, consider the certainty of the patient's physician that the heart/lung machine was becoming dangerous to the patient. We can view certainty as ranging from 0% (uncertain) to 100% (absolutely sure). Establishing how certain the physician had to be to make his decision helps us understand how limited the doctor was in his options, and how inevitable was the death of the patient if he had been kept on the machine and not transferred to the artificial heart. To illustrate, we can propose some hypothetical cases:

- The physician was 100% certain that keeping the patient on the heart/lung machine was fatal. It follows that implanting the artificial heart was the only alternative to letting the patient die. The doctor was faced with an ethical dilemma, weighing the Hippocratic oath versus following FDA regulations.

⁶ In Hypo, "boundary counterexamples" are cases that show "how much worse the situation could be" along a dimension without affecting the resolution.

- The physician was 0% certain that keeping the patient on the heart/lung machine was fatal. It follows that the implanting the artificial heart was not the only alternative to letting the patient die, and the doctor would have been ethically justified in keeping the patient on the heart/lung machine, and unjustified in breaking the FDA regulations.

It follows from analyzing the case along this dimension that the physician's certainty is a morally relevant fact, although unstated in the case description. (This line-drawing example takes the doctor's perspective; one can imagine the patient's and the engineer's being different.) Soliciting unknown morally relevant facts is one of PETE's top tasks, and this line-drawing activity prompts the student to revisit and add to that task. Thus, it is easy to envision line drawing as a tool in case analysis that should always be available to the student, much as different brushes are available to a graphic designer in Photoshop. We suggest that line drawing should be a top-level activity in PETE, independent of the eight steps in case analysis, and that the results of every line-drawing instance be available to the student through the reference pane as she works on the eight steps.

From the viewpoint of design and implementation, the difficulty is this: to support line drawing requires a more detailed knowledge representation for each particular type of factual scenario in PETE's library. For each scenario, one needs to identify and represent relevant dimensions. We are investigating how much knowledge representation is enough to support a useful pedagogical exercise in this regard. In addition, there is an intriguing possibility that at least some of the dimensions may be of a general nature and apply over a range of scenarios.

6. EVALUATING PETE

Much as in other domains where software is used in teaching, in ethics, evaluation is a critical aspect of successful software design. However, the ethics domain presents its own special evaluation challenges, similar to the challenges of software for teaching law.

One of the main problems in evaluating an ethics tutor lies in identifying and implementing appropriate performance measures. Ethics, like law, is a domain where a problem rarely has one demonstrably correct answer. Professional ethics instructors do grade students' case analyses in examinations, however. Our parallel study, performed in connection with analyzing the same protocols that are the source of PETE's peer texts, has identified evaluation criteria and developed coding techniques [14]. In a "good" Bioengineering Ethics analysis, a respondent:

- Uses professional knowledge to frame the ethics issue;
- Views the problem from multiple perspectives;
- Continues to recognize the possibility for harm;
- Uses conceptual tools like line-drawing (see section 2);
- Identifies analogous cases and explains analogies.

In an evaluation of PETE, we can apply these same tools to assess changes in students.

7. CONCLUSION

PETE presents an opportunity to engage students in effective case analysis. PETE advances beyond other computer tools for

teaching case analysis by including a theory of case analysis, by being Web-accessible, and by attempting to motivate students to study the subject more deeply through inclusion of peer responses. It leaves room for AI techniques to enhance its usefulness to students. Evaluating PETE may provide further insights into teaching ethics with and without software support.

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