AC 2007-1798: THE CASE METHOD: USING CASE-BASED INSTRUCTION TO INCREASE ETHICAL UNDERSTANDING IN ENGINEERING COURSES

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The case method: Using case-based instruction to increase ethical understanding in engineering courses

Introduction

The paper presents a discussion of how case-based instruction is performed and the perceived benefits of its application. We begin with a brief discussion of the historical background of case-based instruction and then discuss the use of case methodologies within various educational contexts. Connections are then made to its use in general ethics instruction, as well as specifically engineering ethics instruction. Finally, we conclude the paper with a call for rigorous education research to compare the various methods of ethics instruction, including case-based instruction, and evaluate which methods are truly the most effective.

Case-Based Instruction

Christopher Columbus Langdell, who became the dean of Harvard Law School in 1870, has been credited with the creation of the "case method" approach [1,2]. He believed that the best way to study law is by examining actual legal situations (cases) and "that understanding, in turn, was best developed via induction from a review of those appellate court decisions in which the principles first took tangible form"[3]. Christopher Langdell advocated that lawyers, like scientists, work with few core principles and theories; and the use of case method in legal education would help teach law as a science [1,3]. It was indicated that such use of cases would prepare students for the real world of practice. Case method was seen initially as a compromise between the two existing methods of training lawyers - apprenticeship in a private law firm or learning through the lecture method. However, the case method did not turn out to be a compromise; instead it became a new way of teaching legal education [2]. The use of case-based instruction has also been used within other professional fields as a means of educating or training professionals where the domain is complex and ill-structured, such as in medical and business education[2].

Previous research in other fields such as, biology education has shown that using case-based instruction increases student understanding of ethical issues and helps development of moral reasoning skills [4,5]. For example, Lundeberg, Mogen, Bergland, Klyczek, Johnson, and MacDonald [6] examined whether using case studies increases students' awareness about the ethics associated with the particular case. The authors found that using case studies significantly increased students' awareness of ethical issues as compared to students who did not use cases.

As ethics education has moved from didactic instruction to more learner-centered methodologies, new and innovative techniques are being used to teach students how to address ethical dilemmas[7]. One such method has been the use of case studies to teach ethics in engineering. Case-based instruction has been successfully used within various professional fields such as medicine and business as a way to teach ethical issues. Lundeberg[5] stated, "cases provide a situational context for students to connect ethical questions with theoretical concepts."

Role of Cases in Engineering Ethics

Herkert[8] highlighted that the case method is one of the most popular methods for engineering ethics instruction within United States. Gorman and colleagues[9] argued that ethical training using case studies will allow students to "recognize dilemmas, to recognize compartmentalization when addressing these dilemmas, and to employ moral imagination". The use of cases to teach engineering ethics provides students with an opportunity for vicarious mentoring by promoting active learning and requiring them to assume the role of participants in the decision making process [9,10]. Engineering ethics requires individuals to make decisions in a complex environment, where problems are open-ended and vague; the use of case-based instruction allows students to make assessments, judgments, and decisions to define a solution to the problems[10].

The cases utilized to teach engineering ethics are usually high profile events such as DC-10 plane crash in Paris, 1986 Challenger disaster, and Chernobyl. Haws[11] reviewed 42 engineering ethics papers contained in the proceedings of the American Society for Engineering Education annual conferences between 1996 and 1999. Of those papers, 23 referenced the use of case studies. Haws[11] noted that the majority of the identified case studies focused on high profile cases. Herkert[8], on the other hand, argued that even though such high profile cases get the attention for engineering ethics, what is needed are more mundane cases, which present hypothetical ethical dilemmas most engineers typically encounter in their profession. However, such hypothetical cases come with their own challenges and obstacles when implemented to teach engineering ethics. For example, these hypothetical cases do not come across as credible and present pitfalls as students might think that if it is not "real" they are less likely to encounter these hypothetical situations[9]. Thus, it is important for instructors to make sure that even the hypothetical cases present realistic narratives based on ethical dilemmas faced by practicing engineers[9].

An alternative approach that might be more beneficial is to create hybrid cases, which present ethical dilemmas via a combination of real and hypothetical situations[9]. This could be accomplished by changing names, situations, and/or circumstances. The authors also suggest that in addition to crisis cases, there is also a need for preventive cases to provide opportunities for students to make ethical decisions at the beginning of a design process rather than take extreme positions, such as whistle blowing or resignation. Cases can also vary in length, number of perspectives and nature of language, and the method of presentation via text (e.g., book chapters, journal articles, etc.) or video[8].

How to Teach with Cases

Herreid[12] stated that the greatest strength of cases is "that they integrate material across many fields and demand critical thinking in assessing information." This is especially important in today's global milieu when engineers are increasingly asked to participate and contribute to multi-disciplinary and diverse teams. But how does one teach with cases, which allows students to think critically beyond their field of expertise and the subject matter knowledge of their content area?

Herreid[12] stated that teaching with cases could be classified into four major types: (a) individual assignment; (b) lecture format; (c) discussion format; and (d) small group format. The discussion format and the small group format seem to be the most appropriate methods for using cases as they provide opportunities for students to be active and engaged in making the ethical decisions given the situation presented in the case.

Herreid[12] also argued that the best technique for teaching using cases is with a method known as the "Interrupted Case Method." The "Interrupted Case Method" is commonly used in many disciplines. In this method, limited information is initially provided to students (typically working in groups). After time to consider, students are asked to report their thoughts and then more information about the case is provided. The process is repeated, each time provided additional information for the students to consider. This process emulates much of the work conducted in engineering; our thoughts and processes are continually refined as additional data is received. Much like applied practice, this method often leads to the recognition that we have been moving along the wrong path and must reconsider our approach, only after receiving a minimum threshold of information.

As Herreid[12] indicated, this process produces students who begin to recognize alternative methods for addressing problems and encourages critical thinking. This is especially true for teaching engineering ethics where a simple straightforward solution to the ethical dilemma might not be present. Thus, using the "interrupted case method" would allow students to have "flexibility and the ability to see alternative approaches"[12]. These are just some of the ways cases can be implemented in engineering ethics instruction and we do not propose this as an exhaustive list on how to implement cases. However, this provides us with a good starting point to think about how cases can be effectively integrated in engineering ethics as an instructional method.

Conclusion

While case-based instruction is clearly the most commonly employed method of ethics instruction in the engineering curriculum, it is by no means the only method. Other methods of integrating ethics into the engineering curriculum include the use of external course work (e.g., philosophy classes), service-learning projects, team-based senior design course work, and the across the curriculum approach (integration of ethics in multiple courses throughout the academic career). However, we know little about whether or not the use of case studies is better than the other methods of ethics instruction.

In spite of the extensive use of cases for engineering ethics instruction, there is also a lack of research base on whether cases are having any impact on students as compared to other teaching methods. Even though faculty are writing about their use of cases and their own perceptions of the impact of using cases on students moral reasoning skills, there is little empirical research on the effectiveness of case-based instruction. The literature is apparently devoid of formal investigations that conclusively identify case-based instruction as more effective or more efficient when compared to other methods of teaching engineering ethics. We suggest that faculty begin to empirically investigate how these other teaching methods compare to the case approach and their influence on students' critical thinking skills about ethical issues in engineering. Future research needs to assess whether this approach to teaching ethics (i.e, case-

based instruction) has the hypothesized benefits of increasing students' awareness about engineering ethics as well as increase their moral reasoning. Thus, rigorous research methods should be utilized to design investigations that compare the outcomes resulting from various ethics instruction methods, including case-based instruction.

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