



# Considerations for Improving Comprehensive Undergraduate Computing Ethics Education

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## ABSTRACT

Computing Ethics (CE) courses are an increasingly important component of the undergraduate computing curriculum because of the outsized influence of computing on society. CE encompasses topics from multiple disciplines including the humanities; however, it is typically taught by educators within a Computer Science (CS) department in most undergraduate institutions in the United States, potentially leading to a less than comprehensive CE education for students. We surveyed 318 computing educators in US higher education to investigate CS educators' perceptions of how CE topics should ideally be taught. Most of our respondents thought that CE should be taught by a multidisciplinary team of instructors, and further that it should be taught both as a standalone course and embedded in other courses. Our research provides insights into ways to improve CE education that result in a better student experience.

### ACM Reference Format:

Grace Barkhuff, Jason Borenstein, Daniel Schiff, Judith Uchidiuno, and Ellen Zegura. 2024. Considerations for Improving Comprehensive Undergraduate Computing Ethics Education. In *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 2 (SIGCSE 2024)*, March 20–23, 2024, Portland, OR, USA. ACM, New York, NY, USA, 2 pages. <https://doi.org/10.1145/3626253.3635557>

## 1 INTRODUCTION

Computing ethics is a vital part of an undergraduate's computing education. There are calls for more responsible computing education [5], and in order for an undergraduate computing program to receive accreditation, students must be able to "...make informed judgments in computing practices based on legal and ethical principles" [1]. CE may be included in the curriculum as a standalone course where the sole focus is on ethical content, as an embedded practice where ethical content is included in a non-ethics course, or as a combination of both teaching methods.

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SIGCSE 2024, March 20–23, 2024, Portland, OR, USA  
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ACM ISBN 979-8-4007-0424-6/24/03.  
<https://doi.org/10.1145/3626253.3635557>

Several universities have explored a variety of approaches to teaching CE. For example, Harvard university introduced the Embedded EthiCS program, which uses the embedded method and has philosophy graduate students and postdoctoral fellows teaching ethics modules [4]; Stanford university experimented with a "deeply multidisciplinary approach" where they taught a standalone ethics course with instructors from philosophy, political science, and computer science [6]; and Brown University used a model where undergraduate teaching assistants provided support for embedding responsible computing into multiple courses [2].

An analysis of 202 technology ethics courses conducted by Fiesler et al. found that most technology ethics courses are taught within the computer science department [3], and a recent survey of 138 higher education computing instructors by Smith et al. found that 71.5% of respondents *disagreed* with the statement that CE should be taught by non-computing educators [7]. Despite these findings, CE involves non-computing subjects such as philosophy. Towards a more balanced undergraduate CE education, we explored the following research questions in our study: According to computing educators, (1) who should teach undergraduate CE, and (2) what teaching format is ideal for CE? We present findings from a survey of undergraduate computing educators from the United States (US), some with experience teaching ethics and others without.

## 2 METHODS

We conducted an online survey, administered through Qualtrics, of 318 undergraduate computing educators from the US. 82.4% (n=262) had experience teaching CE and 17.6% (n=56) did not. The survey comprised questions related to why participants did or did not teach CE or include CE in their courses and how they think CE should be included in the curriculum. The survey was distributed through a variety of e-mail lists available to the authors, project advisors, and their networks. Responses were collected between December 2022 and April 2023. Participants were compensated via a gift card raffle. The study was approved by the authors' Institutional Review Board.

## 3 RESULTS

*Who should teach ethics?* Figure 1 summarizes the responses received. Most respondents (67.2%, n=178) indicated that a team of instructors from multiple disciplines would be best suited to teach CE. This was the most common response regardless of whether

the respondent had experience teaching CE or not. 21.5% (n=57) responded that only computing faculty should teach CE. Of those who selected “Other,” 31.6% (n=6) mentioned that what matters most is that those who teach ethics have firsthand experience with the subject, such as those who have encountered ethical issues at work. One respondent shared that the best person to teach is one with “firsthand experience good or bad... that’s the only way I would pay attention so I assume it’s the same for students. It’s not real otherwise.”

### Who would be best suited to teach computing ethics?

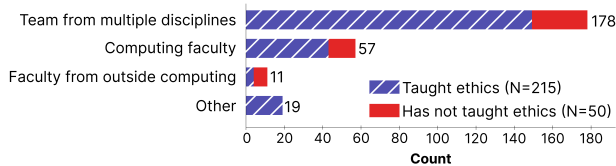


Figure 1: Participant responses to who should teach ethics

*What teaching format is ideal?* Figure 2 summarizes the responses received. A majority, 57.1% (n=153), think ethics should be taught both as a standalone course *and* as part of one or more technical courses. 25.4% (n=68) of respondents selected that CE should be taught using the embedded method. Of the 21 open-response comments received, 9 mentioned that ethics should be included in every course. One participant stated, “Every class should have some discussion of ethics because all courses and topics (even the most purely technical) influence people’s lives.”

### In what format should ethics be taught?

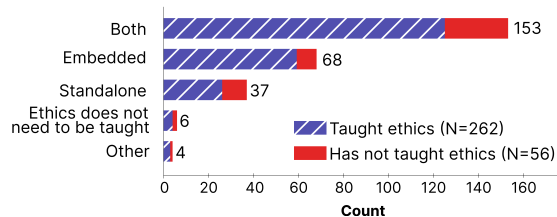


Figure 2: Participant responses to the ideal format for CE

## 4 DISCUSSION AND CONCLUSIONS

Our findings show that respondents believe CE should be taught by multidisciplinary teams and that CE should be integrated both as a standalone course and embedded into other technical courses.

The first finding provides nuance to that of Smith et al. which found that 71.5% of surveyed computing instructors did not believe CE should be taught by educators from outside computing [7]. Our data are in agreement: only 4.2% (n=11) of our respondents thought that faculty from outside computing are best suited to teach CE. However, when provided with the option for a team from multiple disciplines, that option is preferred. Although Smith et al. found that 67% of respondents to their survey felt confident in their ability to add ethics to their courses, some respondents felt their expertise in the area was limited and preferred to leave ethics teaching to others

[7]. One possible explanation is that CE may not have been a topic covered in educators’ own coursework. Therefore, these topics may not be ones that they have expertise in, leading to a desire for a team to teach CE in order to collectively be knowledgeable about both computing and ethics. However, as current students transition to faculty positions, this may no longer be the case.

Our respondents strongly favored teaching CE both as a standalone course and embedded in technical courses. This combined approach allows students to reap the benefits of both approaches, including multiple touch points throughout the curricula for breadth and a standalone course for depth. In the embedded approach, a CS educator is needed to teach the main CS content in an otherwise technical class. In order to use the team approach, educators from outside the CS department could guest lecture, or teaching assistants could teach the ethics content such as in Harvard’s Embedded EthiCS approach [4]. An approach for standalone courses could be to team-teach with instructors from across disciplines. Alternatively, using a non-computing instructor for the standalone course and computing instructors for the embedded courses could achieve a similar team-based approach.

Teaching CE using a team and in both formats is not without challenges. Computing educators are already stretched thin, and additional CE takes time away from technical topics. However, the high amount of support for multidisciplinary and multiple format CE education justifies the need for cross-institutional CE teaching resources, additional educators, and increased institutional support to adequately prepare computing students to make sound professional judgments based on well-balanced ethics principles.

## ACKNOWLEDGMENTS

This work is funded in part by National Science Foundation (NSF) Ethical and Responsible Research grant (SBE-2124745).

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