Experience Report: Teaching Computer Science Ethics using Science Fiction Across Multiple Institutions and Course Types

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Abstract

Engaging undergraduate students in the study of ethics and technology is an important and difficult task for both computer science programs and individual instructors. Narratives, especially science fiction, have become a popular way to entice students to deeply engage with ethics topics. We detail experiences across six different institutions of implementing full-semester, part-semester, and single-lecture lessons from the recently-published book *Computing and Technology Ethics: Engaging through Science Fiction*. We provide an overview of both the book and related instructor materials; explaining how they can be used to effectively teach topics in ethics to undergraduate students in computing and technology development courses. We close by reflecting on how the book was received by students, and general suggestions for implementing ethics education across a range of institutional contexts.

CCS Concepts

• **Social and professional topics** → **Computing education programs**; **Codes of ethics**.

Keywords

Computer Science Education, Ethics, Science Fiction

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1 Introduction

Technology professionals of all kinds, from user interface designers to mechanical engineers to programmers, exert influence over many aspects of our daily lives. In a world increasingly held together by technical details, they are able to navigate those technical details in ways that many people cannot, giving them significant power in our present world. The engineers and computer scientists we are training now will have a hand in building the systems that will establish the basic conditions for social, economic, and cultural interactions in the near future [15, 25].

As a reflection of this outsize influence, nearly all major accreditation and professional computing societies now include ethics, responsible innovation [11], responsible design [18], and/or responsible research in their undergraduate education recommendations [1, 2, 28]. Fiesler et al. [17] provide a comprehensive overview of more than 300 courses across computing on ethics education detailing the breadth and depth of techniques and approaches. Surveys of ethics education also detail important techniques and trends including stand-alone courses v. embedded design (e.g., modules) [20, 37]; complicating the traditional "easy answer" and "knowledge gap" framings of education [7, 34]; the importance of culturally relevant dimensions of technology and ethics lessons [23]; and the effectiveness of different techniques like debates and value sensitive design for encouraging imagination in technology development [18, 31, 32]. Implementing these lessons has also received significant study including an overview of techniques for ethics lessons in traditional CS1 courses [16]. Finally, when evaluating when and how to incorporate ethics education, Horton et al. [21] conclude that more exposure is not always better (e.g., embedded versus single course) while Horton et al. [22] show that embedding modules works well and is effective in raising ethical reasoning.

But how is this teaching to be done most effectively? How can ethics be incorporated meaningfully into the computer science curriculum, such that students continue to feel responsible for ethical reflection and decision-making once class is over, and such that they are prepared to meet specific challenges and situations that we have not yet imagined?

A growing consensus in undergraduate ethics education [17, 36] is that *narratives*, which offer a uniquely deep mode of interaction and reflection, can enhance student engagement and practice on the societal and ethical implications of their work [13, 14]. A recently-published CS ethics textbook that was highlighted by Cecilia Aragon in her keynote talk [3] at the opening of SIGCSE 2025 is *Computing and Technology Ethics: Engaging through Science Fiction* [5, 7–9]. This book, in keeping with the larger push for narrative-based education, takes the position that instructors can meet the challenges of CS education by understanding ethics as a practice

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that includes describing things as well as making judgments about them. The critical resources of ethics enable us to describe the same situation in multiple ways, each of which makes it possible to ask different questions about what is really going on, and what is the right thing to do, or even how best to reach a judgment about the right thing to do. This broad variety of questions helps us to tune into a wider array of potential moral hazards and to think more creatively about how to respond to them.

Contribution. Teaching ethics via narratives and science fiction may be a new approach to education for many instructors, and is likely to be particularly uncomfortable for many CS students. In this article, we will identify some of the challenges that can face CS instructors who want to incorporate ethics, discuss the ways in which *Computing and Technology Ethics: Engaging through Science Fiction* helps manage and overcome those challenges, and offer direct experience reports of using the book in a variety of courses, modalities, and institutional contexts.

2 The Urgency of CS Ethics Education

Computing technologies have and will continue to transform the world [19, 30]. These changes have not been wholly for the better. Social media has enabled people with common concerns and interests to find one another, which has benefited birdwatchers and indie music fans but also white supremacists [27]. Putting financial records and transactions online has made banking more efficient and often more secure, but it has also left individuals and institutions more vulnerable to hidden theft [35]. The growing technology gap between rich and poor countries could leave developing economies at a greater disadvantage than before [4].

This mixture of good and bad is not unique to computing or even to technology in general. Any intervention that changes the world will have negative effects as well as positive ones. But how do we think through the trade-offs in a coherent and responsible way? Which kinds of costs are acceptable, and how do we distinguish them from unacceptable ones? What measures can we take, when designing and executing a new project, to minimize harm? When are harms truly being minimized, and when are they simply being redistributed to those with less political or economic power?

These are hard questions, and they don't have "right" answers the way that many technical problems do. Technical problems, in ideal, stylized settings like an undergraduate classroom, offer clear benchmarks for success, e.g., efficiently produce this output from that input. But if you're trying to answer questions like "should I build this system in this particular way? Should I build it at all?" the benchmarks are less clear. Those questions — ethical questions — demand that we evaluate the merits of the benchmarks themselves. They require us to consider why a project, or a particular way of building it, is helpful or beneficial; whom it helps; what specific kinds of benefits it produces; or to articulate why it is the right thing to do. Answering these questions well requires that we engage in ongoing critical reflection on the definitions we use to answer them.

If we want to teach ethics in a way that has a meaningful impact beyond the end of the term, we cannot simply give students a list of right answers, or even a set of formulae for calculating correct answers. A good ethics education must equip students with, *"a means and a process for achieving [your] own moral judgments"* [10]. We must teach them to ask questions that will help them to describe the difficult and complex situations they face, to imagine in detail the effects of the solutions they are considering, and to think broadly and compassionately about who will bear the costs of their choices.

3 Science Fiction and Narratives as a Resource for Teaching Computing Ethics

To elicit the kind of discussion that meaningful ethics education requires, many courses employ case studies. Case studies are specific scenarios — sometimes fictional, sometimes historical — that distill common or representative challenges in ethics. Case studies are useful in an ethics classroom in several ways. First is that they give everyone in the class a shared set of information to work with. Another reason is that a good case study can capture some of the messiness and complexity of ethical quandaries when they occur in the midst of other experiences, as they do in real life, and thus communicate the reasons why a given problem is difficult to recognize or understand and why it is hard to figure out a good response.

A good story can do all the things that really matter in a case study, and in many respects can do them better [29]. Stories avoid a problem that is inevitable when using a case study: the problem has already been framed for the reader, who then cannot help but skip over one of the most important and challenging parts of ethics. Stories are embedded in larger story-worlds, in which many other things are also happening. In a good story, you are not merely presented with a problem that requires solving. Instead, you get to see a particular individual (or set of individuals) with their own goals and interests and unrelated problems, who ultimately has to confront the ethical quandary. In this way, stories can better capture how challenging it can be to pay attention to ethical issues in the first place. Stories also can effectively capture the reality that ethical quandaries tend to crop up unexpectedly in the middle of a project, when you're thinking about something else and have other plans. In other words, stories much more effectively replicate our lived experience than is possible even for an excellent cast study. As the philosopher Bernard Williams wrote: "Why not take examples from life? It is a perfectly good question, and it has a short answer: what philosophers will lay before themselves and their readers as an alternative to literature will not be life, but bad literature." [38]

Another advantage of stories is their characters. Instead of the typically featureless figures of a case study, a story's characters have personalities of their own that shape their perceptions and choices. By watching a story's characters make decisions (and mistakes), we can gain perspective on how actual humans might react in a similar situation, and why. Stories can also help us understand that a person might have interests, concerns, or vulnerabilities we might not share and that are affected by the story's situation in ways that we otherwise might not have noticed. This combination of qualities also helps an engaged reader develop the moral imagination that is a key component of successful ethics education [10].

Finally, stories can be a useful way to get some distance from a charged issue. For example, many people are likely to have strongly-held opinions about many technology-and-society issues such as warfare, elections, and appropriate forms of public speech. Because of that baggage, it can be hard to have a productive conversation about the underlying ethical issues or even to get to those issues

in the first place. But if those same tensions and dynamics are relocated to an unfamiliar place and time, where nobody in that space has been affected, it can be easier to understand.

Fiction has long been recognized as a potent resource for teaching philosophy, and ethics in particular [29]. This textbook is one of many recent efforts to integrate fiction into computing ethics education. Doore et al. [14] compare ethical education outcomes in both the US and Nigeria using modules and resources from the *Computing Ethics Narratives* project which houses narratives to integrate and teach applied ethics into undergraduate computing education. There have been many examples of work using this database: teaching about predictive algorithms [6], integrating ethics early and often [33], and the need to blend skill building lessons with ethical reasoning [12]. Klassen and Fiesler [26] draw on science fiction, using episodes of the hit show Black Mirror to encourage students to imagine ethical dimensions of their work.

4 Overview of the Text and Instructor Resources

Computing and Technology Ethics: Engaging through Science Fiction [9] contains an introduction chapter, five content chapters, and an anthology of twelve stories. The first content chapter is an overview of ethical frameworks that are then used throughout the following chapters on modern technological settings, specifically the following. **Ethical Frameworks** introduces Deontology, Virtue Ethics, Communitarianism, and Utilitarianism, as well as contemporary developments (responsibility ethics, feminist ethics, and capabilities), written specifically for a CS undergrad audience. **Managing Knowledge** details the epistemic roots of data, cultures of knowledge, storing and working with large data, and bias in automated reasoning systems. **Personhood and Privacy** complicates common definitions of personhood, offers a history of privacy, and outlines how modern technology reconfigures relationships between the two. **Technology and Society** introduces sociotechnical systems and analysis, and applies these ideas in a modern context in areas such as structures of care, public discourse, labor, and power. **Professional Ethics** surveys major ethical codes, a history of professionalization, and practical advice for ethical practitioners.

The textbook also contains an anthology of science fiction stories, anchored to the main content text, providing stories that illustrate the concepts in the text. While the book and pedagogy guides provide one way to teach the material, the anthology format allows the instructor, to connect the stories (or other outside resources) to the main book content. The stories are integrated into the text by the following. **12 Science Fiction Stories** from contemporary authors including Ken Liu, T. Coraghessan Boyle, Elizabeth Bear, Paolo Bacigalupi, Rebecca Roanhorse and many more. **Story Frames** for each story with setup and reflection questions that links elements of the story to ethical frameworks. **Story Points** where each story is "anchored" to 2-3 concepts throughout the textbook. **Instructor Pedagogy Guides** dive deeper into the stories, providing discussion and delivery resources for instructors.

5 Experiences

We now give six reports on using the textbook for undergraduate education. Each of these uses the book in different ways, providing reflections and examples of ways to deliver ethics education.

5.1 Computer Science Ethics Course Required of All Undergraduate CS Majors

Setting. University of Illinois Chicago is a large, urban public R1 in the Midwest. The course is a standalone computer science ethics course that is required of all undergraduate CS and data science majors, capped at 30 students per section and open only to those students. It is taken primarily by juniors and seniors. The undergraduate student body includes many first-generation college students, first-generation Americans, and international students. A large percentage of students receive significant federal aid.

Philosophy and Aims. This course's role in the CS curriculum is to ensure that students are aware of the key ethical issues that can arise in computing work and to help them develop a sense of professional responsibility. My approach includes issues literacy (alerting them to the major issues in the field), but my main focus is helping students develop the sensitivities and capacities necessary to keep "doing ethics" once the course is over: to notice potential ethical hazards as they arise, to be able to tolerate the discomfort of confronting messy problems without perfect answers, and to bring both imagination and compassion to bear as they reflect on and respond to ethical problems.

Implementation. Our "lab" for cultivating the relevant skills is small-group discussion, usually focused on stories from the textbook's anthology. All of the assignments are rooted in structured reading and interpretation of the stories. I pair each ethical framework with a story, and ask the students to describe and analyze that story using the concepts from that framework. In the final month, after a series of prep assignments, each student takes a turn leading a story-based discussion in their small group.

Because my version of the course forefronts the epistemological dimension of ethics — that is, the fact that knowing things isn't as straightforward as we usually assume, and that being responsible citizens of the world requires us to take responsibility for how we interpret — I find the first two sections of chapter 3, "Managing Knowledge," useful to introduce early. I also spend a day apiece on "Personhood and Privacy" (ch 4) and "Technology and Society" (ch 5), drawing on different selections depending on recent news issues and student interests. "Traps" (in ch 5) is useful to guide students to self-diagnose: which traps are they personally most prone to? Most of my students are not prepared for conceptually challenging reading; indeed, many are not native speakers of English. I have therefore found it more effective to assign 8–12 well-chosen pages for a course meeting and introduce ideas from other parts of the chapter during class discussion.

Outcomes and Reflection. A few students complained that the course is "too much like an English class;" some felt that the textbook itself, as well as the stories, require a facility with reading that is beyond their comfort level. These complaints demonstrate that both the textbook and the stories are less comfortably suited to schools with large international populations, or with students who have received weak preparation in reading.

Nevertheless, even though those things are true of my institution, the significant majority of students report enjoying the course and its focus on fiction. Roughly 75% of students report, in their final reflection or course evals, a heightened sense of empathy or

compassion toward other people. For many of these students, the stories were an essential part of this transformation. In some cases, the reading itself is meaningful: as one student writes, "many times I put myself in the position of the main character. ... I was able to connect my life with theirs. I believe that this allowed me to do this not just with stories, but with other people in my life." For many others, the process of co-interpreting with other students is primary. Another student writes: "Many times, throughout our readings, things I wouldn't have thought about by myself came up through other people. Things like insight as to why a character did something, or what reasons they did something. Talking to others helps you understand things that maybe I haven't experienced."

5.2 Elective Computer Ethics Course Open to All Majors, Grad and Undergrad

Setting. University of Kentucky is a large, land-grant (public) R1 in the southeast United States. The course is a standalone computer ethics course open to undergraduate and graduate students from all departments, but has been primarily taken by CS undergraduates. The course has been offered for many years as an elective; recently, however, the department has started a new Undergraduate Certificate in Artificial Intelligence, which requires an ethics class. As part of this transition, this course went from 45 to 115 students, and is now offered every semester.

Philosophy and Aims. My goals are to have students stop and think before they work on or with computer technology. They should think about their work in a socio-technical context, bringing to bear analyses from different ethical frameworks. These frameworks include highly personal considerations (virtue ethics), basic societal framing (deontology, utilitarianism, communitarianism), and broader frameworks such as feminist ethics, capabilities, and socio-technical systems. This is strongly aligned with the book's content and organization.

Implementation. I structure my syllabus around the book. We spend the first half of the semester on ethical frameworks, and practice close reading of stories, separately and in ongoing groups. I use the stories throughout the semester, and the pedagogy guides are invaluable in directing my attention to subtleties of the stories. For the recent final, groups debated topics related to ethically complex computer-technology issues. This exercise did not directly reference the textbook, but built on the foundations it laid.

Outcomes and Reflection. It was challenging to get students to read the textbook. Our university library bought a license, so they could freely access the e-book. Many of them did not, except for the stories. On the other hand, most students have reported that they enjoy the small-group discussions. It seems that those need to be more closely linked to readings, as echoed by other reflections.

Comments from teaching evaluations: Many students enjoyed the stories, which assignments required them to read, and found that they helped them understand the textbook material. One student wrote: "The readings and in-class discussions were the most helpful in this course. The in-class lecture and discussions paired nicely with the textbook which I really enjoyed reading. ... I personally loved all the readings because they were relevant, engaging, and contributed to a better understanding of the ethical theories being taught." Another wrote: "The short story readings were actually the most helpful. While I didn't like every story, and not every story felt as valuable as others, I think the reading overall was the most helpful way to digest the ethical frameworks introduced in class." Others were less convinced, such as the student who wrote "I didn't really understand a lot of the readings we needed to do for the class or how they related to CS and the course content."

5.3 Science Fiction and Ethics as Part of A Large, General Enrollment Course

Setting. Tulane University is a private, large R1 university in the southern United States. The course is a new elective cross-listed between the history department and computer science. The course was aimed at all levels and backgrounds with no pre-requisites. Enrollment was 150 students from nearly all majors on campus, though most students were from liberal arts and business, with very few from science and engineering. Enrollment skewed slightly older, about 2/3 third and fourth year.

Philosophy and Aims. The course was designed to use both *Computing and Technology Ethics: Engaging through Science Fiction* [9], *The Innovators: How a Group of Hackers, Geniuses, and Geeks Created the Digital Revolution* [24], along with other resources to introduce non-major students to the history of technology; a light introduction to technical details of computing and programming; and the impacts of technology on society. The book was used as a two-week section focused on ethics and society. The goal of the course was twofold: 1) to offer a light introduction to programming (binary numbers, fundamentals of what an algorithm is, and working with data) for students with no prior background/interest, and 2) to equip students to think more concretely about the role of technology in society, help them understand some of the changes in society stemming from the advent of digital technology, and give them an understanding that they are a part of that change either as consumers and/or producers of technology. The sections from the book were used to provide students with some language to express and evaluate technology in an ethical and societal context.

Implementation. For this course students read the short story *Here-and-Now* by Ken Liu along with Chapters 5-5.4.3 which covers the definitions of technology and some of the common traps that one can fall into when designing and evaluating tech. In class students gathered in small groups and completed a worksheet, with class readouts in the second lecture where they analyzed both the technology in the *Here-and-Now* story along with any technology that they wanted. The students were allowed to use any technology, as long as they defined it as such, which gave them exercise in identifying and defining technology for themselves, and analyzing the various stakeholders and potential pitfalls of that technology.

Outcomes and Reflection. Even the small section of the book was very useful as it gave the students more language to discuss technology critically with a better vocabulary than, "this is bad" or "that isn't fair"; equipping them to talk about technological frames and analyze the stakeholders of various systems. Including the society and ethics components early in the course (week 2) helped set the stage that ethical thinking and discussion were forefront to the course. Overall the book and content was well received, with

4.6/5 rating on the course materials and worksheets helped learn the material and 35/98 students completing the end of year evaluations cited the readings and worksheets as being a compelling part of the course in their (optional) written comments (e.g., "... [the] strongest aspects of this course were the class discussions [and] worksheets").

5.4 Upper-Years Course at a Midwestern Public Regional University

Setting. The University of Michigan-Flint is a mid-sized public university. The course is a computer ethics course required for upper-year computing students, with a 35-student course size. The student body includes many first-generation college students and a diverse international student population.

Philosophy and Aims. In a landscape where televised debates depict arguments without end, students may enter philosophical discussions prepared for a fight. All too often, it will seem that thoughts are spent only on what to say in rebuttal, or how to humiliate the "opponent," rather than reflect upon ourselves. We seek to flip that notion with a focus on active listening, self-reflection, and mutual confirmation of beliefs. Mutual confirmation of beliefs involves first hearing what your partner says, reflecting on what it means, and then speaking first to confirm your understanding of what you have learned. Verify with the person you are talking to that the understanding is shared. Then, use your voice to speak to your own beliefs. Give your partner the opportunity to similarly confirm that they understand your position as well. Debate of this form is not intended to drag one member or the other to a new side. Rather, it is to prepare all parties for the process of self-reflection, which can and should occur afterwards away from the stage. Students take the reflection home and use that time to write and refine their own beliefs. By understanding the views of others, students can first and foremost learn improvements through reflection. These improvements can then be reported to others in future conversations. There is no need to determine who wins, as with time this process can lead to a point where we all do.

Implementation. The course is taught twice a week via Zoom. One meeting per week is dedicated to reading a short story together. Students engage in discussion, group consensus building, and identifying "gray area" issues where consensus is not easily reached,The next meeting uses the textbook chapters as a framework, referring back to short stories we have read thus far. Assignments are crafted to address the specific hurdles students encounter each week and to extend the reflection period . Students and the instructor take time to restate the positions of the discussion partners before pushing back, which means that you must demonstrate understanding of the other person's position before detailing its flaws.

One midterm project with variable deliverable options (creative works, presentations, debates, etc.) allows for freeform expression. The final project asks students to write a code of ethics for an emerging technology, such as GPTs or image generation. The authors' insights into the deeper meaning of each chapter are well informed, although could be improved with more trauma-informed spoilers on certain stories. Students may be surprised at certain contents that can become graphic. This type of material can be re-traumatizing for individuals who have experienced complex trauma (such as involuntary confinement, near death experiences, abuse, and other examples). In class, we skipped scenes as needed, which helped students who otherwise might have encountered these passages unexpectedly without support. At home, students would benefit from notifications prior to each story listing types of graphic elements. Yet totally avoiding graphic material can weaken the message. For example, a story involving sexual assault cannot be understood without some discussion of that assault. It is also important that those who may see themselves in these stories also have support while being exposed to it. This can be a lighthouse, but it must be operated with care.

5.5 Standalone CS Course in Canada

Setting. Carleton University is a research intensive university in Eastern Canada. The course is a standalone upper-years CS elective course, with 60+ CS undergraduates per class, created in 2020 based on early drafts of the textbook.

Philosophy and Aims. The course highlights potential ethical challenges young computer scientists may face in their careers and provides them with the language and tools for confronting these challenges. Because of the rapidly evolving nature of computing technologies, the focus of the course is to hone a keen sense of ethical imagination so students are ready to tackle emerging ethical challenges as they arise. The use of fictional scenarios is central to this approach as it presents vibrant and plausible scenarios on which students will hone their skills.

Implementation. The first half of the course is primarily instructional where students learn ethical theories (virtue ethics, deontology, and utilitarianism) and sociotechnical frameworks. The latter present concepts specific to a type of technology or technology domain (ex: knowledge management, data biases, privacy, generative AI). Most topics open with an introductory lecture and an assigned reading of a short story with accompanying written activity; this is followed by a second class for discussion. In this way, the concepts introduced by the lecture are reinforced by use. The discussion is capped by a breakout roleplay exercise where groups are assigned particular roles pertinent to the story and asked to prepare and present ethical arguments to the class from those perspectives.

The second half of the course is student-led, and consists of in-class debates and project presentations. Each pair of student teams (5-7 students each) engages in a 30-minute structured debate about a current computing issue of their choice. Under time pressure, students must formulate, critique, and defend their ethical positions. The debate culminates in a joint document highlighting their various arguments, with appropriate citations, produced jointly by both teams. The course concludes with a final paper and presentation as a summative assessment (done in groups of 2-4).

Outcomes and Reflection. The textbook chapters on ethical theories are particularly useful, being written to be accessible and relevant to CS students. The introduction is a helpful reminder to both the instructor of the importance and place of ethics in CS, and to the student of the pressing need to for ethics in computing domains. The pairing of chapters with stories (with story frames) is helpful in demonstrating those concepts by example, and reinforcing them by discussion. The course diverges from the text in the treatment

of sociotechnical topics.[1] I incorporate more technical concepts in my course. For example, the privacy unit emphasizes technical tools (differential privacy, contextual integrity) and economic perspectives (surveillance capitalism and chokepoint capitalism). I have also added topics on data biases (mainly in machine learning) and the potential for unintended consequences. Student reception to the course is highly positive both in teaching evaluations (average score 4.73/5) and personal correspondence. Students have pursued academic careers and research projects motivated by their experiences with the course.

5.6 First Year Writing Course at a Small Liberal Arts Women-Centered College

Setting. Simmons University is designated as a Professions-focused Undergraduate/Graduate-Master's institution in Boston. The course a themed first year writing course — a gen-ed requirement — which, in the class section discussed here, is paired with a CS 1 course for a cohort of pre-Engineering students. This course explores ethical impacts of technology though science fiction. The undergraduate college is known for being a small liberal arts women's program with emphasis on professional preparation and social justice.

Philosophy and Aims. The general educational requirement itself is a retention tool that aims to create a community of 15-20 first year students as they become rooted in [the university's city]. It is also designed to sharpen students' writing skills by exploring and writing about some aspect of [the university's city]. In addition to these shared college-wide goals, The section focuses on local technology companies with national reach, examining their ethical impact as case studies. Since many students aspire to work at these companies, this work engages pre-Engineering students in ethical dilemmas, both micro (e.g., company climate) and macro (e.g., product development) that they may face as professionals.

Implementation. The textbook has two main features that were useful throughout this course: a description of various ethical frameworks (specifically virtue ethics, deontology, communitarianism, utilitarianism) and a sample set of short stories for various technology-related issues. This way, the text supported using science fiction to showcase ethically charged situations without activating previously-held commitments on real-world situations. The ethical frameworks allow students to be guided by not vague intuitions (of the *"I feel that genocide is wrong"* variety) but by thoughtful consideration and a broader discussion. These two features (fiction and frameworks) allowed students the freedom to engage and explore eventualities before bringing these thoughts back to their lived experience. The course followed Chapters 1–6, using paired stories and supplemental texts for discussions. Students participated in stable semester-long teams and rotating "jigsaw" groups for daily dialogues. Each team applied a distinct ethical framework as their analytical lens across all texts. In jigsaw discussions, students represented their framework, bringing diverse perspectives to conversations. Writing objectives were met through regular "hot take" freewrites during discussions and 2–3 structured essays, with an optional creative fiction piece.

[1]In part because these draft chapters were not available in 2020

Outcomes and Reflection. Students reported that the ethical framework lens gave them a deeper perspective on ethical issues. Longer pieces (e.g. "Klara and the Sun" for personhood discussions) were used to supplement the short stories, which received mixed reviews. Students found the discussion of abstract ethical frameworks wanting; they expressed a desire for a system that determines right/wrong and were frustrated with competing benefits/harms. As an institution with a signature social justice mission, students were sometimes frustrated when fiction contrived ethically gray areas. Students almost unanimously appreciated the scaffolded student-led discussions and developed close relationships with classmates.

6 Discussion and Conclusion

We have showcased a variety of approaches to teaching computing ethics using science fiction, in a variety of university settings and course formats. Central to this approach to computing ethics is the cultivation of a healthy ethical imagination in students for ethical challenges in domains that may not yet exist. The stories present rich, multilayered scenarios for students to consider. The vibrancy of the story worlds and characters help students see these situations as complex and entwined, and view ethical issues from multiple perspectives. The multifaceted nature of the stories invite students to identify and articulate the nature of the ethical challenges, and weigh the trade-offs inherent in different solutions. Importantly, these solutions rarely draw only on technical domains, but must be woven within the fabric of society.

Starting from this framework, instructors have a variety of approaches from which to choose: A course can emphasize the historical and societal contexts in which computing technology is developed and applied, and how that shapes our relationship with those technologies. Most courses described here take a more introspective approach, examining the nature of knowledge and inviting students to reflect on how they process the world around them, and how that affects their own patterns of thinking. Some of the courses incorporate more explicitly sociotechnical approaches, including discussions of economic incentives and technology regulation. Finally, the courses form one part of a more diverse curriculum, either as components of a comprehensive introduction to computing, or paired with a more technical course.

As emerging computing technologies transform our society at increasing speeds, a computing ethics course must prepare students for challenges not yet envisioned. The text presented and its narrative based approach is a solid foundation for a variety of effective curricula that can foster lasting ethical imagination in the next generation of computer scientists.

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