



Ethical Development Through the Use of Fiction in a Project Based Engineering Program

Dr. Rob Sleezer, Minnesota State University, Mankato

Rob Sleezer earned his Ph.D. in Microelectronics-Photonics from the University of Arkansas. He attended Oklahoma State University where he graduated with a B.S. in Computer Science and an M.S. and B.S. in Electrical Engineering. He is currently a faculty member at Twin Cities Engineering which is in the department of Integrated Engineering at Minnesota State University, Mankato.

Dr. Rebecca A Bates, Minnesota State University, Mankato

Rebecca A. Bates received the Ph.D. degree in electrical engineering from the University of Washington. She also received the M.T.S. degree from Harvard Divinity School. She is currently Professor and Chair of the Department of Integrated Engineering program at Minnesota State University, Mankato, home of the Iron Range, Twin Cities and Bell Engineering programs.

Considering Future Ethical Behavior Through the Use of Fiction in a Project-Based Engineering Program

Introduction & Background

The use of literature broadly, and science fiction in particular, in engineering courses is a rare but not unheard of phenomenon. Occasionally, the use of fiction connects to technical learning [1] [2], however in most cases where fiction is used, it supports professional learning in areas like ethics. In this paper, the authors go beyond the presentation of a case study where literature was used to frame and guide discussions around ethics in an engineering course by coding student artifacts for values. Specifically, the student engineers participating in a seminar course were required to read and reflect in writing on *Prey* by Michael Crichton [3]. To set the stage for this case, some of the moral philosophy arguments around the use of fiction are discussed culminating in the conclusion that fiction is an appropriate tool in the teaching of ethics. Then, we will examine how literature has been broadly used in technical courses before delving into prior uses of literature in the teaching of ethics in both engineering and other fields. Next, the unit of analysis is defined and the contextual issues related to this unit will be discussed. Finally, details about the coding and resulting themes are presented.

The importance of ethical education, which is a requirement for ABET accreditation, is almost undisputed. After all, one could imagine a hypothetical student that excels technically while neglecting ethical implications, or worse, acting counter to their own values. This is mitigated when students are provided with, and trained to use, the tools of ethical thinking [4]. The challenge is to identify and deploy effective training strategies for developing and using the tools of ethical thinking. An important aspect of this ethical education is that it must demonstrate how morally ideal behavior can be achieved [5]. Additionally, because changing ethical behavior generally involves an evolution of values, double loop learning is required, where learners are asked to confront underlying assumptions and beliefs as they learn [6]. There are two components to this exercise: establishing if a strategy is ethically sound and establishing if a strategy is effective. Below, the use of fiction is broadly described to set the stage for a discussion of the relative drawbacks and benefits of this strategy.

Before using literature as a foundation for discussions of ethics it is important to consider whether it is appropriate to do such a thing even though ethicists regularly engage in such endeavors (see for example the list provided by Nie and Shang [7]). We are motivated to consider fiction in the teaching of ethics because abstract theory does not help us in everyday life where events take place at the margins of such theories. Fiction, among other forms of cases, allows us to universalize such theories through analogy [5]. However, the use of fiction in ethical education is not without controversy. The arguments against fictional cases include that they do not present adequate information and that there are important differences between a fictional case and any real case that limits transference [8]. These arguments are made despite the fact that philosophical thought experiments are generally presented as narrative fiction [9]. Additionally, especially with respect to widely recognized and flawed fictional characters, there is a danger of transference. The risk here is that an engineer is able to project their anxieties on to the fictional

character to improve their self-perception. It is also possible that such anti-exemplars generate a space where bad actions appear good by comparison [10]. The next few paragraphs further explore these issues before moving on to highlight the advantages of the fiction in ethics education.

A counter argument to the first point is to recognize as Buganza states “whatever occurs to the literary character, composed, surely, of words, but where these point towards something that can be shared and experienced in reality, redounds in a new experience for the reader” [5]. In other words, the reader vicariously experiences that which happens to a literary character and thus grows their own knowledge and understanding. As Marples states, “the fact that a novelist acquaints us with non-existent characters is of no consequence for the power afforded by the fictional world they inhabit to provide opportunities from which to learn, and by reference to which we might refine our moral understanding and judgment” [11]. Thus, it is not the trueness of the writing that makes the exercise valid. Instead, it is the ability to envision one’s self in the position of the other, whether real or fictional, and to sympathize or even experience the emotions of the other that leads to improved ethical understanding [5].

The second point is resolved by recognizing that fiction is not intended to generate identical cases to the real world. Rather, it provides a safe space to practice with and engage in ethical thinking. Fiction provides an avenue of application for abstract moral principles that require imagination for application beyond one’s own circumstances and past experiences [11]. It is the development of critical thinking and the training of one’s mind in ethical thought processes. Buganza states that in the case of fiction “the circumstance is different [from real life], and inten[t] of the empathetic exercise, is trying to put the interpreter in that circumstance to envision how the other sees reality” [5]. In other words, the light shed on ethics by understanding the plight of the other is no less valid if the other is imaginary. After all, emotions felt while consuming fiction are still real emotions [11]. Fiction exposes and sensitizes the consumer to the other in the story. This exposure and sensitivity is transferred to the other in the real world [11]. In fact, fiction provides many benefits to non-fiction when used as case studies in the development of ethical thinking.

Using fiction to teach ethics is effective because the consumption of fiction provides a mental playground where we can use our ethical imagination to operate outside our sphere of experience [12] [13]. This playground is a good space to practice the application of ethical principles and frameworks in order to develop an ability to reflection-in-action [14] because of the reader’s ability to empathize with the characters of the story at a pace that is convenient. The philosophical thought experiments that happen in this space serve the purpose of providing conceptual possibilities that show how the claims we make about universally applicable principles are not, in fact, so universal [9]. Fiction allows us to engage in the context-dependent process of ethical analysis where we are able to discern when one thing or another is appropriate [15]. Enhancing this aspect of literature, the heightened realism allows us to more clearly observe the characters’ struggles [16]. Further, by design, fiction may force us to confront aspects of our being that make us uncomfortable [11]. For example, an examination of Victor Frankenstein, from Mary Shelly’s *Frankenstein; or, The Modern Prometheus* [17], in professional education may help scientists’ frame ethical thinking particularly around unintended consequences [10]. Despite this discomfort, because fiction is separate from reality, it provides a way to approach sensitive topics in an unbiased way [12] [4]. Marples eloquently summarizes

this by stating “it is the powerful combination of the values we bring with us when we engage with a work of art, as well as the values which they themselves convey, which help refine our perception and sensitivity towards the salient features of moral reality. Such engagements provide unique and invaluable insights into what it is to be human, as well as powerful stimuli to encourage us to reflect on the kind of people we are, and aspire to become” [15]. Importantly, according to Schon, the lessons learned from exploring ethical boundaries in a fictional space should be transferable to real world applications with some limitations [18].

Furthermore, fiction may broaden students’ perspectives beyond western ethics. Traditional approaches to engineering ethics education often overlook and underrepresent non-Western ethical frameworks. For example, Confucian ethics, which deals with the ethics of leadership through role modeling, is largely absent from contemporary engineering ethics education [19]. Not only is literature full of models for ethical behavior which are analogically accessible as the reader empathizes with the characters, but it is also rife with exemplar models that are both grounded in ethics and aspirational [5]. Another related benefit to this approach of teaching ethics is that literature, and in particular science fiction, is multidisciplinary in nature [12]. The impact is that approaching ethical education in this way may grow ethical leadership and reduce the gap between business ethics and engineering ethics [19]. Science fiction allows us as readers to consider many possible futures as well as the consequences of those futures [20].

The two final advantages of fiction we touch on here are engagement with the medium by the students and the availability of source material. Science fiction is embraced by students, and possibly foreshadows the future of technology [4]. Additionally, fiction does not violate confidentiality like a real case might [21]. Before moving on to our case and analysis, it is worth noticing that the use of fiction is prevalent in ethical education regardless of the appropriateness. After all, many case studies are a form of fiction. Furthermore, both the general public and scientists are influenced by works of fiction [10].

Fiction has a long history in ethics and ethics education. Just the act of engaging with learning literature resulted in ethical growth for students in the 8th and 12th grades [22]. Additionally, fiction has been used as case studies for teaching ethics in nursing [21]. One use of fiction in teaching ethics in a technical space focuses on AI [23]. This experience consisted of both literary and film case studies which students consumed and reflected on. They also wrote essays on AI and ethical issues. In another example of using fiction in a technical field, another course starts with an introduction to ethical theories and ethics codes before engaging in critical readings of fiction with the intent of developing analytic competency. Finally, the course delves into fiction in the technical area. Importantly, this course included several writing assignments where students develop skills articulating ethical thoughts [4]. It is also worth touching on the fact that fiction influences the views of the public and scientists outside of formal coursework. In one study examining the influence of *Frankenstein; or, The Modern Prometheus* by Mary Shelly, scientists were interviewed about the technical and ethical implications of science with a focus on the actions of Victor Frankenstein. The researchers found that “this image of Victor Frankenstein gives form, direction, and self-relevant meaning to members of the scientific community, and helps them articulate the importance of ethical guidelines and values surrounding science” [10].

Research Context & Method

The unit of analysis for this qualitative study connects to many of the concepts presented above. It is an upper division project-based engineering program where junior and senior student engineers work together in teams of about four to complete design projects that are the same scope and scale of typical capstone design projects. For working on this project, the student engineers earn three credits of design and three credits of professionalism. The design credits account for the actual engineering work associated with the project while the professionalism credits account for the non-technical tasks associated with the project, such as communication, professional development and teamwork. One set of professionalism assignments, of particular interest to this work, is to write reflection journal entries designed to support the student engineers' metacognitive processes and cement important learning. Often, reflections connect to activities done in our one credit seminar where topics related to design and professionalism, including ethics, are discussed. Of course, in addition to the project work the student engineers engage in technical learning through participating in one credit competencies which ideally connect to and support the project. There are required core competencies in mechanical engineering (e.g. mechanics of materials, dynamic systems, etc.), electrical engineering (e.g. AC circuits, electronics, etc.), and engineering broadly (engineering economics, statistics, etc.) as well as technical electives. For more details about the curriculum please see the work by Ulseth, et al [24].

This curriculum connects to this paper's focus of learning ethics with fiction through a common read for the seminar class, which is then reflected on for the professionalism course. In most semesters, the common read is non-fiction and chosen to relate to concepts like the design process, team work, leadership, and contemporary issues. However, about every fifth or sixth semester, a fictional book is chosen as the common read with the intention of providing a space for thinking about and discussing ethics and contemporary issues. Examples of the fiction selections for the common read from different semesters include *Ready Player One* by Ernest Cline [25] and *Neuromancer* by William Gibson [26]. The research presented here is from a semester where *Prey* by Michael Crichton was chosen. Briefly, this work of science fiction envisions a world in which a company has advanced in the fields of computer science and nanoscale engineering sufficiently to generate swarms of artificially intelligent nanobots. The reading was broken into three sections for discussion throughout the semester. Prior to each discussion the student engineers read the section and write a brief summary to serve as a ticket to earn attendance credit for the seminar class. They also submit a reflection that connects to reading that section of the book after the in-class discussion. Each reflection address four points as it pertained to reading that section of the book: describing the learning activity, describing the takeaway knowledge, explaining how the learning will be used in your design project or future as a student and/or engineer, and identifying further questions that you would like to answer or further learning you would like to do as a result of this learning. At the end of the semester the student engineers were also assigned a reflection on the ethical and contemporary issues related to the book. Although the reflection journal assignment contains no specifics with regards to length most reflection journal entries are approximately one typed page.

The case consisted of nineteen student engineers. However, not all student engineers submitted all assignments. The minimum number of submissions for any assignment was 15 and the maximum was 19. Analysis of the reflection journals was done using values coding [27]. This

process involved two researchers reading the artifacts and identifying the values, attitudes, and beliefs written about by the student engineers. The resulting codes were reexamined using pattern coding [28] in conjunction with a grounded approach to extract themes.

Analysis & Discussion

Five themes emerged from the analysis. The first theme is that, in general, the student engineers had positive statements about using fiction in this way. Second, several of the student engineers identified the main character as an ethical exemplar. Third, they demonstrated a perceived connection between the work of fiction and what might happen in a real-world case. Fourth, many of the reflection journal entries included statements about the writers' future behavior. Finally, perhaps better framed as an anti-theme, is the diversity of ethical perspectives represented in the reflection journals. The next paragraphs explore each of these themes in more detail. This section concludes by touching on the limitations of this study.

The first theme observed was that overall most student engineers appeared to enjoy reading *Prey* in this context. There were a total of 17 positive statements about the book from 12 different student engineers. One of these statements indicated that:

It's a very well written book once the action starts, however unfortunately before that point I had a hard time getting myself to read it.

Other statements were less equivocal about the book. For example, one student engineer wrote:

This book was an easy read for me. I really enjoyed the book and finished it within the first two weeks of the semester.

An indication that some student engineers connected the reading to broader implications was when they linked the quality of the book with contemporary issues or ethics. An example of this was from a contemporary issues entry that said:

Michael Crichton's *Prey* is a fascinating novel that focuses on [the] dark side of nanotechnology and how the lack of responsibility of biological engineers, programmers, and personnel in charge can affect the outcome of a corporate project.

Not all student engineers found reading the book enjoyable however. Of the 19 participants, one who had read the book previously wrote that he:

Began to read it for a second time, but immediately felt as if repeating this was time that could be spent elsewhere and on more productive things.

This individual reiterated this sentiment and indicated they did not like the book in three separate reflection journal entries indicating a persistence of attitude.

In addition to enjoying the experience, a second theme was that many of the student engineers found an exemplar of moral behavior in Jack, the story's main character who is an out of work programmer. Furthermore, they often drew connections between themselves and Jack. Nearly all of the reflection journal entries for the first reading, which primarily introduced the characters

and set the stage for the rest of the book, identified Jack's technical prowess. Several also touched on the role of Jack as homemaker and identified this as a non-traditional role. Importantly, Jack is not currently employed because he reported a scandal at his previous employer that resulted in him being blackballed in the industry. Most reflections noted something related to this in their takeaway descriptions. A typical example of identifying Jack as an ethical exemplar was the student engineer who wrote about their perception of the main character:

It can be seen that the main character places a large emphasis on the goodness and the ethicalness of his own actions.

One student engineer even reflected on learning ethics directly from the main character:

Jack's character taught me to think about what has happened as well as what could happen.

Another student engineer was able to articulate how Jack responded to unfolding situations in both a technical and ethical space:

There are a lot of things that work up to this point but we constantly see our main character trying to orient himself with all of the information that is being discovered.

In addition to viewing the main character as an ethical exemplar, the student engineers often indicate that they are able to relate emotionally:

Reading about Jack and what he was feeling felt very familiar at times and allowed me to stop and think about what I am doing and what I can change.

In another case, the student engineer related to the perceived non-traditional role of the main character at the start of the book:

I am holding a nontraditional position right now. It was harder for me to prove that I belong to this environment and I think I did well. If I determined my mindset for this, every bad criticism would be nonsense to me which was different compared to Jack's case: he wanted to work but then he had to leave and he was in position that he needed to take care of the housework because he was available.

One student did not find Jack to be an exemplar:

The main character was weak in my eyes for the majority of the book and frustrated me.

This counterexample notwithstanding, most student engineers appeared drawn to the main character and associated him with good actions.

The third theme was that students wanted to move from fictional spaces to real world situations, seeing the story as both a story and a potential real-world case. Without the context of the fictional experience, this desire may not have manifested. One student clearly, and repeatedly, wanted to connect to specific real-world situations that matched the story, struggling with the poetic license an author takes to make a good story:

“I want to know what specific types of unethical actions have taken place in industry that are not so commonly known, and how the situation was handled. The book describes a situation that I think would be very hard to accomplish in the real world.

...

But then, the story couldn't have happened the way the author wanted it. So I'd like to learn about real world scenarios and see what occurred, and what type of retaliation there was from the company, superiors, or coworkers, if any.

...

If I have an idea of how these types of incidents have unfolded in the past, I'll be more prepared to face them more appropriately in the future.”

Other students saw more potential for connections to real world cases in the story, as shown by these quotes from four different students:

The book does remind one that there are similar real-world situations that occur. Such as the ways we used to pollute rivers and seas without regards to the consequences, or how large corporations that handle food production in our country continuously have bacteria and virus outbreaks.

There is gray area in the book, and even more gray area in real-life problems.

The results of these unethical decisions seem to be because somehow, the rules (made for a reason) were skirted, or were ignored and now a disaster has arisen. This type of decision-making is in the real world every day, and this fictional book is just describing a possible ending due to poor decisions.

This book although fiction is what happens when profit means rapid development at any cost to beat competitors to the market. And the implications of the rapid development can produce hazards to people, environment, and society at large.

In three cases, student engineers identified specific ethical issues related to contemporary issues that connected to the plotline of the book:

The unethical practices that the employees from Xymos displayed reminds me of the famous Volkswagen scandal that occurred [a] couple of years back where engineers created a defeat code that was able to beat the emission testing standards set up by the EPA and CARB.

In *Prey*, Xymos did not necessarily break the law by allowing nanoparticles to go outside. There are likely no regulations on allowing evolving nanoparticles to be brought outdoors. A real-world example is the Deepwater Horizon oil spill.

The situations and decisions many of the characters are exposed to in the novel cause me to review them as if I were exposed to similar dilemmas.

Students saw some of the predicted value of working with fiction to grapple with ethical issues, as one student wrote:

The science fiction book helped depict issues by separation from reality. This allowed free discussion without threat or offence.

The fourth theme was the focus the student engineers put on their futures. With regards to statements about their own futures students tended to differentiate themselves on two axes. One axis ranges from declarations about specific actions to general statements about ambiguous behaviors. The other axis ranges from technologically specific to technologically ambiguous. Figure 1 shows typical responses for each of the quadrants. While the specific topic/specific action quote may seem unreasonable or unlikely, it illustrates a concrete connection between the reading and the student's planning.

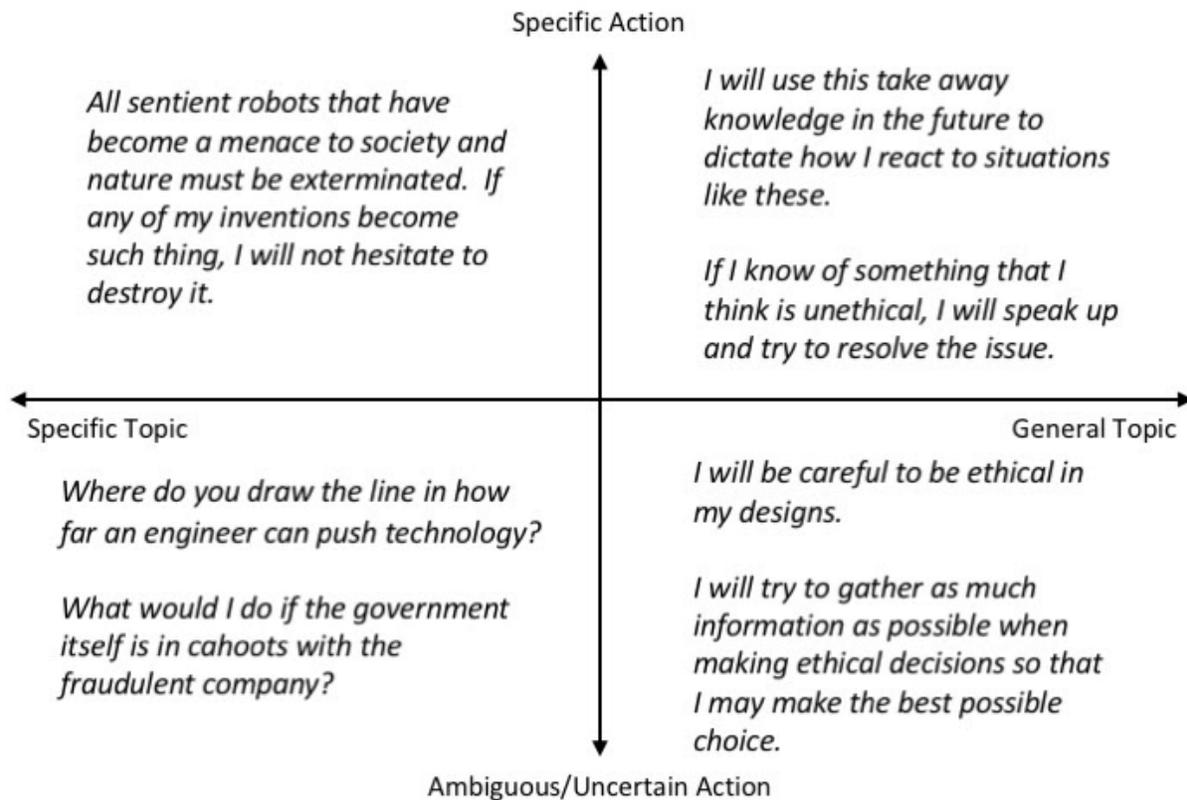


Figure 1. Student responses about planned future actions placed in quadrants reflecting specificity of topic vs specificity or ambiguity of proposed future action.

The final theme was the diversity of topical themes. Emerging technology was a common theme and many of the entries included references to nanotechnology and artificial intelligence. Other technologies mentioned less frequently were autonomous vehicles and cybernetics. Relationships were also discussed at length with many student engineers focusing on friends and family. Several of the student engineers explicitly tied work-life balance to their relationships with their friends and family. Another appearance of relationships were the gender role commentaries inspired by the main character's circumstances. With regards to their ethical responsibility, some student engineers touched on public welfare and safety. Occasionally, this was connected to a specific concern such as the environment. Connections were also made to legal implications of unethical actions. These connections focused on both individual and organizational implications.

Corporate greed and one's responsibility to one's employer were brought up as other themes related to organizations. There were also references to design processes and the advancement of technology. A particular concern was innovation in unregulated spaces. A theme that ties very clearly to individual action is data integrity. Finally, some of the most common themes were public safety and public welfare.

Limitations of this research are the unique nature of the program, the lack of a base line, and the small sample size. The unit of analysis is a project-based program and it is unknown if the outcomes of this work would transfer to a traditional engineering program. Additionally, because no effort was made to determine a baseline for ethical reflection prior to participating in the common read and associated activities, it is unknown if the student engineers were learning new ethical reasoning or reinforcing pre-existing views and perceptions. Finally, it is important to note that only one semester of reflection journals was studied so it is possible that a different group of students in the same program might yield a different result. Additional research will be needed to resolve these limitations.

Implementing Similar Activities

The authors were also the teachers and encourage the use of fiction in ethics education. From a faculty perspective, this was an enjoyable exercise that appeared to result in strong ethical learning. Although the in-class discussions were robust, they were also civil. One challenge was to ensure all voices were represented in the conversation as it was typical for three or four student engineers to dominate the conversation. One approach used to address this was small group discussions that report back to the large group. Ensuring a variety of perspectives is important because the participating student engineers connected both their academic learning and real-world experiences to those of their peers and to the book. Another difficulty was helping people clearly articulate their thoughts. Facilitating these discussions while staying politically neutral and also authentic can be challenging. It is important to maintain an open mind and embrace the learning experience with the rest of the participants. Recommendations for how to implement classroom discussion for long or short works of fiction can be found in [29].

Conclusions

This paper presents a case for using fiction in ethics education, with supporting literature from multiple fields. The case study examines the use of a particular work of fiction in the context of an integrated, project-based learning program for upper-division students. Using a common science fiction read as a case study for learning ethics in an engineering context has strong pedagogical value. The exercise is both morally sound and engaging. The student engineers participating in the experience effectively extracted, discussed, and reflected on ethical themes from the reading. Most importantly, they connected their ethical learning in this context to real world applications.

References

- [1] A. Segall, "Science fiction in engineering instruction: to boldly go where no educator has gone before," in *ASEE Annual Conference*, Montreal, Quebec, Canada, 2002, pp. 7.993.1-7.993.8.
- [2] L. Dubeck, M. Bruce, J. Schmucker, S. Moshier, and J. Boss, "Science fiction aids science teaching," *The Physics Teacher*, vol. 28, no. 5, pp. 316-318, May 1990, doi: 10.1119/1.2343039.
- [3] M. Crichton, *Prey*. New York, NY, USA: Harper Collins, 2002.
- [4] E. Burton, J. Goldsmith, and N. Mattei, "How to teach computer ethics through science fiction," *Communications of the ACM*, vol. 61, no. 8, pp 54-64, doi: 10.1145/3154485.
- [5] J. Buganza, "Ethics, literature, and education," *Ethics Educ*, vol. 7, no. 2, pp. 125-135, July 2012, doi: 10.1080/17449642.2012.733595.
- [6] C. Argyris, "Teaching Smart People How to Learn," *Harvard Business Review*, vol. 4, no. 2, pp. 4-15, May 1991.
- [7] Z. Nie and B. Shang, "Introduction to fiction and ethics in the twenty-first century," *CLCWeb: Comparative Literature and Culture*, vol. 17, no. 5, Dec 2015, doi: 10.7771/1481-4374.2774.
- [8] J. Dancy, "The role of imaginary cases in ethics," *Pacific philosophical quarterly*, vol. 66, no. 1-2, pp 141-153, April 1985.
- [9] N. Carrol, "Aesthetics and the Educative Powers of Art," in *A companion to the philosophy of education*, R. Curren, P. Markie, and G. Mathews, Eds., Malden, MA, USA: Blackwell Publishing, 2003, ch. 26, pp. 365-383.
- [10] P. Nagy, R. Wylie, J. Eschrich, and E. Finn, "Facing the pariah of science: The Frankenstein myth as a social and ethical reference for scientists", *Sci Eng Ethics*, pp 1-23, 2019, doi: 10.1007/s11948-019-00121-3.
- [11] R. Marples, "Art, knowledge and moral understanding," *Ethics and Education*, vol. 12, no. 2, pp 243-258, 2017, doi: 10.1080/17449642.2017.1323425.
- [12] S. VanderLeest, "Perspectives on technology through science fiction," in *ASEE annual conference*, St. Louis, Mo, USA, 2000, pp 5.490.1-5.490.6.
- [13] S. Chan, "More than cautionary tales: The role of fiction in Bioethics," *J of Med Ethics*, vol. 35, no. 7, pp 398-399, July 2009.
- [14] D. Schon, "From Technical Rationality to Reflection-in-Action," in *The Reflective Practitioner: How Professionals Think in Action*, New York, NY, USA: Basic Books, 1982, ch. 2, pp 21-69
- [15] R. Marples, "Art, knowledge and moral understanding," *Ethics and Educ*, vol. 12, no. 2, pp. 243-258, May 2017, doi: 10.1080/17449642.2017.1323425.

- [16] E. Kennedy and L. Lawton, "Business ethics in fiction," *J Bus Ethics*, vol. 11, no. 3, pp 187-195, Mar 1992.
- [17] M. Shelly, *Frankenstein; or, The Modern Prometheus*. London, England: Lackington, Hughes, Harding, Mavor & Jones, 1818.
- [18] D. Schon, "The Structure of Reflection in Action," *The Reflective Practitioner: How Professionals Think in Action*, New York, NY, USA: Basic Books, 1982, ch. 5, pp 128-167
- [19] Q. Zhu, "Engineering ethics education, ethical leadership, and Confucian ethics," *J of Ethics Educ*, vol. 3, pp 169-179, Apr 2018, doi: 10.1007/s40889-018-0054-6.
- [20] R. Silverberg, "Science fiction as prophesy," in *Visions of tomorrow: science fiction predictions that came true*, T. Easton and J. Dial, Eds., New York, NY, USA: Skyhorse Publishing, 2010, pp. ix-xvii.
- [21] V. Cassidy, "Literary Works as Case Studies for Teaching Human Experimentation Ethics," *J of Nursing Educ*, vol. 35, no. 3, pp 142-144, Mar 1996.
- [22] A. Lesnick, "Forms of engagement: the ethical significance of literacy teaching," *Ethics and Educ*, vol. 1, no. 1, pp 29-45, Mar 2006, doi: 10.1080/17449640600584953.
- [23] R. Bates, "AI & SciFi: Teaching writing, history, technology, literature and ethics," in *ASEE Annual Conference*, Vancouver, British Columbia, Canada, 2011, pp 22.152.1-22.152.13.
- [24] R. Ulseth, J. Froyd, T. Litzinger, D. Ewert, and B. Johnson, "A New Model of Project-Based Learning in Engineering Education," in *ASEE Annual Conference*, Vancouver, British Columbia, Canada, 2011, pp 22.781-22.78.13.
- [25] E. Cline, *Ready Player One*. New York, NY, USA: Ballantine Books, 2011.
- [26] W. Gibson, *Neuromancer*. New York, NY, USA: Ace, 1984.
- [27] J. Saldaña, "First cycle coding methods," in *The Coding Manual for Qualitative Researchers*, London, England: Sage, 2016, ch. 3, pp. 130-136.
- [28] J. Saldaña, "Second cycle coding methods," in *The Coding Manual for Qualitative Researchers*, London, England: Sage, 2016, ch. 5, pp. 233-272.
- [29] V. Summet and R. A. Bates, "Science Fiction as an Entry Point for Ethical Frameworks in Engineering and Computer Science Education", in *ASEE Annual Conference*, Virtual Conference, 2020.