HOT TOPIC 13

Ethical Reflection as a Part of Creative Problem-solving

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Key Take-Aways

- Broad reflection on morality and social responsibility is essential in the creative problem-solving process.
- Ethical reflection can be incorporated into creative problem-solving and design thinking through the *moral imagination* framework.
- Ethical reflection in the form of moral imagination can be a source of creativity and improvement.

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"Ethics" and "creativity" may seem like an odd pairing. In the way we often think about ethics, it is about *restricting options*, about forbidding certain actions and requiring others. Ethical principles like "do no harm," "do unto others …," and "procure the greatest happiness for the greatest number" proscribe and prescribe specific actions. Creativity, on the other hand, seems to be about, or at least to require, *multiplying options*, allowing thought to flow freely into new channels. These common presuppositions suggest a common approach to ethics and creativity: creative thinking first, ethical reflection afterwards, to rule out some innovations, some lines of inquiry as impermissible, or select others as most beneficent. In this common view, there is no role for ethical reflection *in* creative problem-solving, as it could only hamper the process. But this common perspective is mistaken, in two directions. First, a key component of ethical reflection is the exercise of *moral imagination*, which includes a kind of creative problem-solving (Brown, 2020; Fesmire, 2003; Johnson, 1993, 2014; Weston, 1992, 2007). Second, and more relevant here, ethical reflection *within* the creative problem-solving process can improve rather than restrict creativity. The relationship between ethical reflection and creative thinking ought to be a two-way street of mutual improvement (for a discussion of ethics and creativity, see Moran et al., 2014)

In 2013, a colleague from the Department of Electrical Engineering approached us with an interesting challenge worthy of a team of researchers comprising a philosopher, a cognitive psychologist, and a science educator: How could they engage engineering students in conversations about ethics while they worked on their senior design projects? We found out that while many engineering schools require a formal course in engineering ethics, those courses often focus on ethical and legal principles, codes, and skills for recognizing, reflecting on, and resolving ethical issues (Fischer & Arnold, 1994; Harris et al., 1996; Li & Fu, 2012; Newberry, 2004). These approaches typified the problematic view of ethics described earlier. We also realized that a broader understanding of ethics, which includes humanitarian good or moral responsibility, was given little or no formal consideration, and that ethics problems were often treated like design problems to be straightforwardly solved after major technical decisions had already been made, rather than teaching engineers to think in value-driven modes from the start (Newberry, 2004). In response to our colleague's challenge and to the state of affairs in engineering ethics education, we designed and carried out a three-year study combining philosophical analysis, cognitive ethnography, pedagogical interventions, and psychological surveys, in order to better understand how engineering students engage in ethical considerations while working on projects.

In this chapter, we will argue that reflecting broadly on morality and social responsibility from the beginning is essential to creative problem-solving.

Then we will identify problems in the teaching and implementation of creative problem-solving and design thinking based on our work with engineering students. Finally, we will articulate some potential solutions for those problems that are inspired by our empirical work and grounded in theoretical ideas about ethics and creativity.

The Need for Broad Ethical Reflection

Our research into students' engagement in ethical reflection helped elucidate the ways ethics is framed in the context of engineering design. One of the key results showed that the students shared a rather narrow understanding of engineering ethics, limited mostly to technical aspects of the design. For example, some student engineering teams declared that designing a safe product is their responsibility, but safe use of the product is users' responsibility, not theirs. As the teams of engineering students moved along the design timeline, this narrow understanding of engineering ethics became even more apparent. Even when team members were inclined to take seriously the broader impacts of their projects on users or society, they had difficulty integrating these considerations into their design decisions; in the end, many teams simply dismissed the concerns as beyond the scope of their responsibility (see Grohman et al., 2020; Lee et al., 2015, 2017, 2019, 2020).

Such framing of ethics, as restricted to technical aspects of the design, with broader social and ethical issues outside the scope of engineers' responsibility, is hard to defend against recent rapid technological development. Today, the advancements in new technologies such as artificial intelligence (AI) and machine-learning systems (MLS) blur the boundary between engineers' professional and social responsibility – in these situations, engineering design and its social implications become inseparable. In other words, ethical principles, social values, and the goals and interests of various stakeholders are relevant throughout research and design processes (Brown, 2020; Douglas 2009; Mitcham, 1997), and engineers need to show an understanding of technical, commercial, and human aspects of the design (Brown, 2009). One of the most notable examples of the changing focus of engineering ethics include identification of bias in face recognition technology (Castelvecchi, 2020; Raji & Buolamwini, 2019), which led to the formation of an organization that "combines art and research to illuminate the social implications and harms of artificial intelligence" (Algorithmic Justice League, n.d.). More recently, as a result of the aforementioned studies on bias in face recognition technology, IBM, Microsoft, and Facebook either restricted use of their facial recognition technology to police or pulled away from it. The studies reported by Raji and

Buolamwini (2019), and many other examples of biases in AI, have led us to a question: Are engineering students ready to address and reflect on ethical issues stemming from the designer–user relationship?

These considerations are by no means unique to the practices and profession of engineering. We live in a complex, interconnected world, and problem-solving in many domains – engineering, science, medicine, policy, regulation, and many aspects of everyday life – requires us to reflect broadly on the ethical consequences of our actions (Schön, 1983). This can be seen clearly in the COVID-19 pandemic situation, which clearly demonstrated the complex ways, in which our collective welfare depends on individual decisions. Ethical reflection is not only an essential part of finding betters solutions to problems; it can actually act as a spur to creative problem-solving (Brown, 2020).

Obstacles to Engaging in Broad Ethical Reflection

Based on our work with engineering students, we identified some obstacles that prevent problem-solvers from fully engaging in ethical reflection. One aspect of the problem is the nature of technical education and professional work processes that exclude ethical reflection and narrow the scope of design and problem-solving processes. A second aspect of the problem is that the way design, engineering, and problem-solving processes are conceived does not make sufficient room for ethical reflection and its benefits. Third, the way those processes are taught fails to encourage ethical reflection.

When we observed engineering students in their senior design projects, in most cases they received pre-defined engineering problems they needed to solve within two semesters. This type of structural constraint leads to prioritizing the generation of solutions to technical problems rather than defining the problems more robustly (Abdulla et al., 2020; Cross, 2011). This practice among the engineering students, but also among engineers and designers, reflects the view that ethics and social values are relatively external constraints on the design process (Cropley, 2014), when in fact, broad ethical reflections are essential.

Engineering students often learn about a few major approaches that focus on "human-centered design" or "empathic design" (IDEO Design Thinking, Ullman's Mechanical Engineering 6-step model, Howard's 8-step model, and the Perdue model; for references, see Howard, et al., 2008). At the core of such approaches is the process of empathizing with the clients' needs and understanding what they want and why. While empathizing is explicitly mentioned

in the problem-finding stage of the design/problem-solving process, it is often assumed that it will be iterated through the entire design/problem-solving cycle. So, theoretically speaking, the design stages and processes engineering students learn to apply afford intellectual space for reflection, reformulation, and construction of the problem/design. However, our observations suggest that students conceive of the design process as revolving around the development of solutions, prototyping, and testing, and rarely involving reflection on the initial problem statement, let alone reflection on its ethical ramifications.

This brings us to the third obstacle in incorporating ethical reflection into the design and problem-solving process. We posit that the way the design and problem-solving process is taught does not encourage ethical reflection and decision-making. To give an example about the way engineering students are taught design thinking, early in the semester the students we observed were walked through a compilation of design thinking models based on the IDEO (Brown, 2009), Purdue, or Ullman approaches. They learned about various processes required in a given phase of the design. They were also taught a couple of useful problem-solving techniques (SCAMPER, brainstorming) for use during the generative phases of the design process. It appears, then, that instruction may lack hands-on experience with explicitly stated steps one should take in each phase of the design process. If the steps are defined, the instructors may not stress the importance of going back to earlier phases; thus, students may perceive iterating an earlier phase – such as defining a problem – as a failure.

Eliminating the Obstacles

To address the obstacles described in the previous section requires a reconceptualization of ethics and of the creative process as mutually informing and involving. On the one hand, ethical reflection itself incorporates creative problem-solving as a key component. On the other hand, we need to adopt an approach to creative problem-solving that makes greater room for ethical reflection *in situ*, in part through greater emphasis on the specifying of aims or goals, task specification, problem-finding, and the multiplication of options. In terms of pedagogical implications, this reconceptualization suggests a two-stage approach to engineering ethics education. First, students need to be exposed to diverse perspectives regarding ethical and social issues in engineering and need more opportunities to discuss them. Second, students need to have practical learning experiences of ethical decision-making tied to their actual engineering work, not simply reviewing ethical decisions in separate settings focused on extreme cases.

The moral imagination framework developed by Brown (2020) on the basis of work by Dewey (1922), Weston (1992, 2007), and Johnson (1993; 2014) offers one approach to such a reconceptualization. For each decision in research and design processes, judgments involving values of various kinds and the interests of various stakeholders should be made. The moral imagination framework provides a tool for making such value judgments, requiring problem-solvers to define the aim and goal behind the decision they are making, to articulate the stakeholders and values that are relevant, and to multiply options until a satisfactory integration of values and interests is reached (see Brown, 2020, pp. 185–99, 222–23, 225–29).

This moral imagination approach requires the use of empathetic imagination, creative generation of new options, and dramatic rehearsal of proposed solutions in order to judge their potential for integration. Naturally, this can combine with creative problem-solving (CPS) approaches such as Isaksen et al.'s (2011), which emphasizes an interplay between ideation and critical reflection. CPS encourages students to find fresh perspectives, understand challenges, generate ideas, and come up with innovative solutions; it also emphasizes critical thinking and reflection at each step (Treffinger et al., 2013). The iterative nature of CPS and its focus on reflection fits well with the tenets of the moral imagination framework that requires problem-solvers to consider value judgment at each step of the problem-solving process.

According to the moral imagination framework, there are four tasks scientists and engineers should perform in the course of their decision-making in order to fulfill their ethical duties: (1) identify and clarify the goal or task at hand, (2) identify and creatively multiply options for how to carry out the task, (3) determine the standards and values that are relevant to the decision situation, and (4) identify the stakeholders who ought to be considered, and identify their interests and values. These four elements should be revisited in light of each other in an iterative process until a satisfactory decision can be made on their basis.

Conclusions

Far from being a detriment to the creative problem-solving process, ethical reflection is a boon. It helps us widen the scope of factors (aims, values, stakeholders, interests) we use to judge the worth of solutions. It also requires us to exercise our moral imagination, and in that process, further multiply possible solutions. When obstacles to including ethical reflection in the problem-solving and design thinking processes are eliminated, ethical reflection

in the form of moral imagination ceases to be a source of restrictions and becomes an opportunity for creativity and improvement.

Although our examples have been drawn from work on engineering ethics education, we believe they apply broadly to any problem-solving situations where the interests and values of others are affected. Therefore, education in any domain should encourage students to incorporate ethical considerations into their problem-solving practices and to approach problem-solving or the design process in a way that allows for flexibility in iterating any step along the way. Finally, we recommend the moral imagination framework to ethics educators as a tool for teaching students to practice ethical reflection.

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