

EDITORIAL

Engineering philosophy for engineering education: Cultivating philosophical self-Consciousness in an age of transformative change

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More than a quarter century ago, Carl Mitcham issued a stirring call to the engineering community: "Engineers of the world philosophize! You have nothing to lose but your silence!" (Mitcham, 1998). At the time this was a radical provocation, an invitation for a profession defined by doing to embrace the power of philosophical inquiry. Today, in an era of dissolving boundaries and planetary-scale engineering systems, his challenge has become an urgent necessity. Yet many engineering educators remain skeptical, suspecting that philosophy is an optional embellishment or even a distraction from technical problem-solving. We can no longer afford that view. Effective engineering education must cultivate philosophical self-consciousness—the capacity to reflect critically on what engineering is, to grasp one's role within larger systems, and to exercise judgment with wisdom and responsibility.

This conviction finds systematic articulation in *Philosophy and Engineering Education: New Perspectives* (Heywood *et al.*, 2022), where the editors argue that "it is from a philosophy of engineering that a philosophy of engineering education is drawn." Without an adequate philosophical base, they remind us, desirable changes in policy and practice remain elusive. The same conviction resonates through research published in this journal, which has charted the global evolution of engineering education as a discipline and illuminated the cultural shaping of engineering excellence. We build on these foundations to argue for a renewed educational orientation: one that

deliberately brings philosophical insight to bear on how we form engineers.

I focus on three interconnected levels of philosophical self-consciousness that every engineer and educator needs: self-consciousness about engineering itself, about the engineer's role, and about engineering education's mission. These are not separate topics but a unified field of inquiry—the philosophical compass without which even highly proficient graduates risk drifting.

SELF-CONSCIOUSNESS ABOUT ENGINEERING ITSELF

What is this enterprise into which we are initiating students? For too long, engineering has been mistaken as mere applied science, a value-neutral instrument, or a purely technical activity. These misconceptions have quietly shaped—and distorted—engineering education. When engineering is reduced to applied science, curricula tilt toward abstract analysis at the expense of design synthesis. When it is seen as value-neutral, graduates are poorly prepared to recognize the value judgments embedded in every technical choice. A robust philosophy of engineering is therefore not an academic luxury; it is the foundational clarity that makes educational coherence possible.

Chinese philosophers of engineering have systematically articulated a "five-theory framework" that reveals engin-

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eering as a distinctive mode of productive activity, with its own ontology, epistemology, methodology, and evolutionary dynamics, rather than a derivative of science (Yin *et al.*, 2022). Building on this foundation, Chinese scholars have continued to innovate at the intersection of philosophy and engineering education. For instance, Wang has proposed a tripartite framework—imaginary, knowledge, and norms—arguing that authentic engineering education must cultivate not only analytical knowledge but also the capacity to imagine what does not yet exist and the ethical sensitivity to ask what should be done (Wang, 2023). These philosophical inquiries serve as a propaedeutic to educational design: it is from understanding what engineering is that we can determine what education should seek to cultivate. Every curriculum embodies a conception of engineering; the choice is never whether to have a philosophy, but whether it is examined or unexamined.

SELF-CONSCIOUSNESS ABOUT THE ENGINEER'S ROLE

What does it mean to be an engineer? This question has gained urgency as research exposes the fragility of engineering identity. Lique and colleagues find that roughly 35% of new graduates—disproportionately women and ethnic minorities—leave the profession, making identity formation a strategic priority for educators (Lique *et al.*, 2025). The question of identity is inseparable from responsibility. Martin provides a four-level framework that distinguishes responsibilities at the individual, organizational, professional, and societal levels, showing that an engineer prepared only for personal accountability is only partially formed (Martin, 2026). To this we must add what Pleasants calls "technoskeptical thinking", the capacity to question technologies as more than neutral tools and to analyze their entanglements with power and values (Pleasants, 2024). Cultivating such thinking requires sustained pedagogical attention, not a single ethics course.

These dimensions converge in the concept of "engineer spirit," an urgent cross-disciplinary research field as Li and Wang have argued (Li & Wang, 2025). This spirit is no optional add-on to technical competence; it is precisely what transforms a technician into a professional capable of exercising judgment and shouldering responsibility. The engineer's role, therefore, demands virtues that transcend technical skill: the judgment to ask not only "Can I do this?" but "Should I do this? For whom? At whose expense?"

SELF-CONSCIOUSNESS ABOUT ENGINEERING EDUCATION'S MISSION

The third level concerns education itself. We stand at a

moment when artificial intelligence (AI) is eroding boundaries that once seemed fixed: between human and machine, between the technical and the social, between the local and the global. Engineers are becoming hyper-agents whose decisions ripple across societies and ecosystems. Drawing on Hannah Arendt, Palmás reconceptualizes engineering judgment as irreducibly situated, relational, and human, precisely the qualities that cannot be automated (Palmás, 2024). If AI can execute many technical tasks, the distinctly human dimensions of judgment become more, not less, crucial to cultivate.

This transformation demands a corresponding transformation in how we educate. But change encounters deeply embedded cultural norms. Patrick and colleagues, through six years of ethnographic engagement with a major reform initiative, illuminate the invisible "groundwork"—mental, social, cultural, and political labor—that makes interdisciplinary culture change possible (Patrick *et al.*, 2023). Their work confirms that embedding philosophical self-consciousness into curricula is not accomplished by adding a module; it requires a reorientation of how existing content is taught. When students learn thermodynamics, they can also learn about the social contexts in which that knowledge developed. When they undertake design projects, they can reflect on the nature of design and the responsibilities of designers. Philosophical self-consciousness is a way of approaching every subject, not a standalone subject.

WHY THIS MATTERS AT THIS MOMENT

The skeptic might ask: is this not asking too much of already crowded curricula? The answer is that philosophical self-consciousness is not an overload but a reorientation. It equips engineers to see the bigger picture, navigate complexity, weigh competing values, and exercise leadership in shaping a future that is not merely technically feasible but genuinely worthwhile. It transforms engineers from silent doers into reflective practitioners who understand what they do and why it matters. In a world where "all that is solid melts into air," inherited routines will not suffice. Engineers need the capacity to question assumptions, to collaborate across cultures, and to govern their expertise rather than be governed by it.

This response may provoke a deeper doubt—the suspicion that philosophy, however framed, has nothing meaningful to offer engineering. Such a skeptic has misunderstood both. Philosophy is not a set of doctrines to be memorized but a practice of critical inquiry; and engineering, at its best, is nothing if not a form of critical inquiry into how the world can be reshaped to serve human purposes. The two belong together.

If philosophy and engineering indeed belong together, then the task of embedding philosophical self-consciousness in engineering education is a global one. Whether in Beijing, Berlin, Bangalore or Boston, the engineers being formed today will jointly shape the systems of tomorrow. Their education must therefore go beyond technical transmission to form professionals capable of ethical reasoning and wise judgment. This editorial is a call to approach that work with philosophical intention—to embed the insights of engineering philosophy into the fabric of pedagogy, curriculum design, and faculty development. Twenty-five years after Mitcham's provocation, silence is no longer an option. It is time for engineering education to embrace philosophical self-consciousness not as a marginal interest but as the core of its mission.

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