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Engineering Judgment and Education: An Arendtian Account

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ABSTRACT
This article discusses the meaning of judgment in engineering and engineering education, and it does so by introducing the work of political thinker Hannah Arendt. The argument presents Arendt's non-cognitivist account of judgment as a counterpoint to prevailing conceptions of engineering judgment. Moreover, it suggests that Arendt's unique perspective on what it means to be human in the context of modern technoscience is relevant to the discussion on the place of the humanities and liberal arts in engineering education.

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1. Introduction: education for judgment

The question of judgment – what it is and whether it can be taught – is a common concern within the discussion on professional training in higher education. In engineering education, the promotion of judgment is seen as key,[1] and this is not least due to the emphasis that professional associations and accreditation bodies place on the concept.[2] For such bodies, judgment implies a cognitive capacity that captures the essence of engineering: For instance, the UK Engineering Council defines engineering as a matter of deploying 'judgment and experience to solve problems'.[3]

The notion of judgment is also paramount in other forms of professional training, notably management education. In the teaching of managerial decision-making, the use of teaching cases is highly prevalent – not least popularized through Harvard Business School's case study-assisted 'discussion teaching' or 'participant-centered learning' – and this practice is ultimately tied to the proposition of teaching judgment. Indeed, the landmark text on such pedagogy is titled *Education for Judgment*.[4]

Whether in engineering or management, the capacity to exercise good judgment is in part construed as subject to cognitive limitations, notably behavioral biases in processing information.[5] Therefore, engineering training must imply that students use 'engineering judgment to work with information that may be uncertain or incomplete'.[6] The notion of cognitive bias is also mentioned in the literature that highlights the need for critical thinking in engineering education; critical thinking is then described as 'being sensitive to one's own cognitive biases'.[7] In other words, a key aspect of educating for judgment entails making students aware of how professional judgment and reason may be obstructed by such cognitive shortcomings.

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A classic teaching case widely used to illustrate the problem of judgment and cognitive biases is the 'Carter Racing' exercise. Originally presented in 1987 by Jack Brittain and Sim Sitkin, it quickly gained considerable traction among educators.[8] While presenting itself as a dilemma on whether or not to start in a car racing competition, the case study replicates the decision-making scenario presented to NASA engineers prior to the disastrous 1986 launch of the Challenger space shuttle. The exercise lures students into making the same fateful decision as the NASA professionals, and the implied take-away is that professional judgment is plagued by our tendency to rely too heavily on incomplete information.

Still, as I teach this case study in my 'Technology and Society' class and introduce the unexpected twist – that the majority of the students have in effect given the go-ahead for the launch of the Challenger shuttle – there is always the odd student that objects. Surely, the student points out, context matters. There is a significant difference between sending astronauts into space and deciding whether to start in a motor race. This student has a point: However much we teachers want our teaching to drive towards general, abstract take-aways, we must also recognize that actual judgments are specific and situational. This problematizes the very premise of the 'Carter Racing' case study: Can judgments about rocket launches and car racing somehow be equivalent?

The German-American political thinker Hannah Arendt would respond in the negative, as she makes a strict separation between abstract *thought*, on the one hand, and specific, situated *judgments*, on the other. Moreover, she would object to the proposition that good judgment is a matter of eliminating biases that cloud rationality. This article will introduce Arendt's theory of judgment, applying it in the context of engineering education. In doing so, it will complicate the above-mentioned tendency to construe judgment as a cognitive problem of rationality and bias. Moreover, the text will show how an Arendtian perspective contrasts with the definition of engineering judgment recently proposed in this journal by Hector Giuliano and colleagues.[9] Given that Arendt was also deeply invested in the issue of the humanities' place in the context of modern technoscience, the article will also engage with the calls for introducing the liberal arts in engineering education.[10]

Arendt's interest in judgment became more pronounced at the later stages of her career. Having risen to academic fame in 1951 through her influential study of totalitarianism,[11] she became known to a broader audience though reporting on the 1961 trial of the German-Austrian Nazi party official Adolf Eichmann.[12] That experience had a profound impact on her. For one, it became the source of her most famous concept; the 'banality of evil'. Moreover, the episode caused her to focus increasingly on questions of thinking and judgment. As Judith Butler notes, 'we can understand much of Arendt's later work, including her work on willing, judgment, and responsibility, as an extended debate with Eichmann'.[13]

In introducing the work of Arendt in the context of engineering education, the article will interrogate three research questions: *What is judgment? Can it be taught? What is the place of the humanities and liberal arts in efforts to teach judgment?* It will argue that pursuing these questions from an Arendt-inspired position is productive, precisely because she represents a theory of judgment which clearly demarcates it from the process of thinking. Therefore, her ideas provide a way to distinguish between propositions about education being either about teaching judgment, or about teaching students 'how to think'.[14] Moreover, Arendt's work is relevant as she also wrote about education and technoscience. Given that her work has yet to be discussed in this journal – and that her ideas on judgment have barely figured in the broader literature on engineering judgment and education – the

main contribution of the article is to introduce her work on these topics to the engineering studies community.[15]

The argument will run as follows: Section 2 will review the literature on judgment in engineering, on teaching judgment, and on the place of the liberal arts in engineering education. Section 3 will introduce the work of Hannah Arendt, outlining her general position on technoscience, judgment, and education. Section 4 will transpose Arendt's ideas onto current discussions on judgment in engineering education. In responding to the three questions stated above, the article also outlines how her work problematizes notions of 'professional judgment', how her ideas on 'dark times' may inform engineering education, and whether engineers can aspire to retain a human understanding of the world. The argument ends with a conclusion that articulates how the argument resonates with Arendt's conception of the active life; *vita activa*.

2. Judgment in engineering education

This section provides a brief overview of the literature on the promotion of judgment in engineering education, delving somewhat deeper into the domains and topics introduced above. First, it explores judgment as it is discussed and defined in the context of engineering education. It then turns to the practice of teaching judgment in such settings – through case study discussions, and through bringing the humanities and liberal arts into engineering education.

2.1. Defining engineering judgment

The concept of engineering judgment tends to be described as a cognitive capacity that defines the very essence of engineering. It is deployed when engineers solve problems and design artifacts. It entails diagnosing problems and collecting evidence, as well as interpreting 'meaning and context'.[16]

Based on her ethnographic studies of the work of structural engineers, Julie Gainsburg takes an empirical approach to engineering judgment.[17] Thus, she describes it with reference to particular situations: When engineers determine whether a calculation or estimation is good or precise enough; when they make assumptions or simplifications which form the basis for mathematical models; when they override mathematically 'proven' results. For Gainsburg, then, judgment implies a capacity to second-guess the formal rationalities – that is, the pre-existing cognitive schemas – of engineering work. Similarly, Henry Petroski states: 'It is judgment that separates the significant from the insignificant detail, and it is judgment that catches analysis from going astray'.[18] In these accounts, judgment is described as a check on the use of pre-existing mental categories.

Jon Alan Schmidt suggests that in engineering, judgment is a practical capacity that sits alongside formal technical rationality.[19] Helen Atkinson – chair of the education and skills committee at the UK Royal Academy of Engineering – suggests that the faculty of judgment complements what the academy has called the 'core' engineering habits of mind,[20] such as Systems thinking, Adapting, Problem-finding, Creative problem-solving, Visualizing, and Improving.[21]

Often, the faculty of judgment is located in the nexus between formal technical knowledge and ethical reflection. On the one hand, engineering judgment implies possessing

the requisite knowledge and technical skill to make well-informed design decisions; on the other, it also implies making decisions that are in alignment with broader social expectations regarding ethical, social and environmental responsibility. As Michael Davis suggests: 'There is no good engineering, no good science, and so on without good judgment and no good judgment in these disciplines without ethics'.[22] Indeed, Scott Weedon suggests that the scholarly literature predominantly associates engineering judgment not with mundane technical decision-making, but with ethical conduct.[23]

In the US context, the discussion on the meaning of judgment been given further impetus due to the fact that the Accreditation Board for Engineering and Technology (ABET) defines engineering with reference to the concept of judgment. In this journal, Giuliano et.al. seizes upon this reference, noting that the accreditation body also states that engineering should utilize the materials and forces of nature 'for the benefit of mankind'.[24] This, they point out, opens the space for a definition of engineering judgment that straddles technical rationality and critical thinking. In opening their argument, they situate judgment in relation to rationality, but do not present it as a check on the use of pre-given rationalities. Instead, they start from the following formal definition: 'An agent A uses judgment if and only if, when given a space of possible courses of action C, agent A chooses course of action Ci, where Ci is the best according to rationality R'.[25]

However, this definition is complicated in situations where several, non-aligned rationalities are at play. In such cases, 'it is possible that different agent rationalities conflict with each other by pointing toward different decision alternatives'.[26] It is here – in making judgment among conflicting rationalities (in the plural) – that critical thinking must be introduced in the conception of engineering judgment. First, this implies that 'each engineer acknowledges her own rationality in order to be able to recognize that in her positioning, whatever it may be, there is always a valorative anchor, an individual standpoint'. Second, critical thinking also implies 'being careful, taking as many different aspects as possible into consideration while also being sensitive to one's own cognitive biases'.[27] Through this conception of critical thinking – in which thought is not only applied *within* engineering practice, but also *to* engineering and its place in society[28] – they arrive at the following definition of engineering judgment:

> An agent A uses judgment if and only if, given a space of possible courses of action C, agent A chooses course of action Ci, where Ci is satisfactory according to rationality Rj; and Rj is the rationality that agent A considers the most suitable to reach the ends E, selected within a space of rationalities R by means of critical thinking.[29]

Again, rather than describing judgment as that which second-guesses pre-existing rationalities, Giuliano et.al suggest that judgment is a matter of selecting a suitable rationality among a host of competing pre-existing cognitive schemas. The article will return to this account, comparing it to Arendt's conception of judgment. The argument will first, in the remainder of this section, survey the literature on how to train judgment in engineering education.

2.2. Judgment through case study teaching

In Atkinson's discussion on engineering judgment, she acknowledges that judgment is difficult to teach formally.[30] Judgment is different than knowledge – it can really only be

acquired through experience – but technical universities should still seek to simulate the exercising of judgment. Michael Davis suggests that this implies something other than book knowledge; 'to learn the discipline, we must solve problems, participate in discussions, work in labs, write reports, and otherwise practice the discipline'.[31] Similarly, Atkinson describes how judgment is taught at University of Leicester, citing teamwork and design challenges as activities that simulate the kinds of experiences that foster good judgment among practicing engineers. However, the primary approach that she singles out is the use of teaching cases.

As mentioned in the introduction, case studies are indeed commonly used as judgment-training exercises in both technical universities and business schools. The real-life episode mentioned in the introduction, that of the Challenger disaster, is a common topic of discussion in engineering ethics, written up as case studies,[32] monographs[33], and used as specific examples in engineering ethics textbooks.[34] However, it should be said that this mode of teaching is not uncontroversial. For instance, Michael Lynch and Ronald Kline point to problem of presenting students with 'all-or-nothing dilemmas', in which the only modes of actions are extreme ones.[35] Langdon Winner laments how courses on ethics in the engineering profession 'tend to focus upon relatively rare, narrowly bounded crises portrayed against an otherwise happy background of business as usual'.[36] Thus, Winner is particularly skeptical towards the case study approach to making pedagogical sense out of such crises:

> Indeed, it is a property of the case study approach to education in business, law, and engineering that the contexts that underlie particular cases are never themselves called into question. By failing to analyze and criticize these contexts, case studies tend to legitimate and reinforce the status quo.[37]

Here, Winner's analysis is resonates with Lionel Claris and Donna Riley's suggestion that future engineers need to think more broadly about the place of engineering in society.[38] However, there is a further potential problem inherent in case study teaching as it pertains to the issue of judgment. This problem was briefly sketched in the introduction, and involves the ways in which specific cases are meant to illuminate broader issues. This tendency is visible in the pedagogical literature on case-based teaching, as it has emerged from institutions like Harvard Business School.

In *Education for Judgment*, David Garvin describes how HBS formalized the approach internally in the late 1960s, and externally in the 1980s, through a an international colloquium that taught the approach to academic teachers across the world.[39] Today, the case study teaching approach[40] has congealed to a reasonably stabilized package: Aside from the text read by students, there are also associated teaching notes that support the teacher in preparing for the case discussion. Both of these elements are 'designed with two goals in mind: a substantive lesson and effective pedagogy'.[41] In other words, case study discussions are not completely open-ended discussions, but are generally oriented towards substantive 'take-aways' that transcend the individual case.

The 'Carter Racing' exercise discussed in the introduction is no exception. Brittain and Sitkin describe their case study as illuminating general points about organizational behavior,[42] and its use tends to be oriented towards discussing behavioral biases.[43] Thus, after the tutor reveals the connection to the Challenger disaster, there is usually a debrief in which students learn about the perils of group think, about overconfidence in one's decision-making capacity, and about specific forms of behavioral biases.[44] As such, the

specific case of 'Carter Racing' is presented as equal to the specific case of the Challenger disaster; both are instantiations of the more general phenomenon of how bias clouds judgment. Again, this article will return to this theme in the next section.

2.3. Judgment through the humanities and liberal arts

As mentioned above, Giuliano et.al. argue that engineering judgment requires critical thinking, as it enables the judging subject to weigh different rationalities against each other. This may be trained 'by means of adequate study of the humanities', which 'develops the bases for critical thinking such that it allows her to identify, select or create a rational system directed towards the "benefit of mankind"'.[45] Here, they align themselves with the concerns stated by Louis Bucciarelli and David Drew in their design plan[46] for a program on Liberal Studies in Engineering.[47] In the editorial introduction to the special issue on such a program, the issue at hand was formulated as follows: Can the liberal arts offer 'alternative images and practices [that] the dominant image of engineering-science-problem-solving-for-technological-design tends to hide'?[48]

Beside the question of how to implement such a program,[49] there is the more fundamental question of what the liberal arts may bring to engineering education. First, there is the benefit of adding context to engineering. Bucciarelli and Drew point to the distinction between engineering science and engineering design – while the former may be a solitary activity, the latter is a socio-political pursuit.[50] This implies that a design assignment in civil engineering may lend itself well to contextualizing – perhaps through 'schooling in certain 'fundamentals' […] in political philosophy and social theory, for example, Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Marx, and Tocqueville'.[51] Thus, the broader curriculum of the liberal arts may contribute to the training of judgment: The said fundamentals in social theory provide the students with a broader 'horizon' of references, putting the student in a better position to think critically.

Second, the liberal arts may train the judgment of students by emphasizing cross-disciplinary encounters between different branches of science. The course content of Bucciarelli and Drew's design plan leverages the fact that the 'liberal arts trains the seeing of connections'[52] by showing how philosophy, history, literature and engineering science are 'conjoined'.[53] Therefore, the teaching is not separated into 'a philosophy unit, a historical unit, a "great books" unit, or an engineering unit'. Instead, 'there is educational value in contrasting the different approaches', seeking common tropes and metaphors in different branches of knowledge.[54]

Nevertheless, this agenda also raises concerns about instrumentalizing the liberal arts.[55] For Peter Kroes, the introduction of liberal arts must ultimately be about intrinsic values – about the personal growth and individual empowerment of students – and not about producing better engineering.[56] For Brad Kallenberg, mobilizing the liberal arts as mere 'context' may also cause the liberal arts mindset to be relegated to a subordinate position in relation to more 'core' engineering modes of thought.[57] Section four will revisit these tensions between engineering and the humanities through the work of Arendt.

3. Arendt on technoscience, judgment, education

Hannah Arendt's work on judgment and education is not written in the context of either engineering judgment or engineering education. So, in order to prepare the ground for an

Arendt-inspired reading of those two concepts, this section will first outline what she saw as the stakes of science and technology. Having done so, the section will then discuss her work on judgment, and finally describe her views on education.

3.1. Arendt on technoscience

Arendt's 1958 *The Human Condition* is generally regarded as the most comprehensive statement of her thought. Although the book not only deals with science and technology, it starts with a prologue about the place of technology in modern mass society. This, in turn, serves as an entry point to the broader themes of the book.[58] The first sentence reads as follows:

> In 1957, an earth-born object made by man was launched into the universe, where for some weeks it circled the earth according to the same laws of gravitation that swing and keep in motion the celestial bodies—the sun, the moon, and the stars.[59]

This event, the launching of the Soviet satellite Sputnik, is 'second in importance to no other, not even to the splitting of the atom'. It signifies, on one level, the fact that man-made artifacts are entering the world of the heavens, thus disrupting the old separation between divine heavens and the human earth. Moreover, the growth of modern technology means that we are increasingly surrounded exclusively by artifice, thus 'cutting the last tie' that used to remind us that we belong 'among the children of nature'.[60] The construction of a world colonized by artefacts also dovetails with other themes of the book: The lament that political *imagination* (what Arendt calls 'action') tends to get usurped by political *machinery* (what she calls 'work'). She notes that the machines that replicate human thought – computers – focus on calculative rationality, not imagination, which in turn demonstrates that modernity has misconstrued what it means to be human.[61]

Most of all, however, the event of Sputnik shows how science and technology implies a distancing from what it means to be human, not least as 'earth is the very quintessence of the human condition'.[62] Arendt partly conceives of this distancing in geographical terms, with mankind physically traveling into space, but also in terms of a distancing from human sensibility through abstraction. She invokes the notion of an Archimedean point – the theoretical point which Archimedes sought to use as a point of leverage, thus being able to make the earth move. The human search for this point, through the conquest of space, is essentially a search for universal knowledge about our world. This entails the development of scientific knowledge and technical contraptions that we use to arrive at new truths. However, the further we go to find that point, we realize that we must travel even further to find it. 'In other words, man can only get lost in the immensity of the universe, for the only true Archimedean point would be the absolute void behind the universe'.[63]

According to Arendt, the space race – and the whole technoscientific endeavor – diminishes the stature of humans. This human diminishing has geographical connotations: 'Seen from a sufficient distance', it will look as if humans 'disappear into some kind of mutation of the human race' in which we merge with 'the whole of technology'.[64] When observed from a great height, human intentionality and meaning will fade out of view. However, there is also the idea of a distancing through abstraction. The capital-T Truths about the universe provided by science, she suggests, run counter to the immediacy of the human experience of the world. These truths are, in turn, produced by machines that also escape

our everyday understanding. Through the advance of the technosciences, we 'will forever be unable to understand, that is, to think and speak about the things which nevertheless we are able to do'.[65] Ultimately, the very understanding of ourselves as human slips through our fingers.

Thus, Arendt sees the advance of the technosciences as a development that is at odds with a humanist worldview. For Arendt, the 'true humanist' is someone who 'exerts a faculty of judgment', but this is undermined by the 'verities of the scientist',[66] who in turn is aided by the instrumentalist 'plumber' (engineer) who constructs the machines for the scientist.[67] Ultimately, what is at stake is the capacity to make human judgments about common futures, and the human freedom to choose our destiny. Having surveyed Arendt's dire assessment of the technosciences, we now turn to her conception of judgment.

3.2. Arendt on judgment

When Arendt passed away in 1975, she was working on the three-volume project *The Life of the Mind*. Having finalized the two first parts – on thinking[68] and willing[69] – she was just about to write the third and final part, on judgment. Consequently, there is a debate on what this final statement on judgment would amount to, and whether it deviates significantly from her previous work.[70] Nevertheless, in the texts that are indeed finalized, a clear view of judgment appears.

Thinking, she states (following Plato), is the 'silent' or 'soundless' dialogue 'between me and myself'; a 'two-in-one'.[71] This, however, requires a dialogue in which one challenges oneself, and holds oneself to account. Thinking proper has a paralyzing effect, causing oneself to stop what one is doing in the everyday, and think about what one is in fact doing.[72] As such, thinking cuts through the '[c]lichés, stock phrases, adherence to conventional, standardized codes of expression and conduct [which] have the socially recognized function of protecting us against reality'.[73] So, while the notion of being unable to think is modeled upon Eichmann (mentioned in the introduction), this condition can be 'an ever-present possibility for everybody – scientists, scholars, and other specialists in mental enterprises not excluded – to shun that intercourse with oneself'.[74]

Judging, however, is distinct from thinking: 'Thinking deals with invisibles, with representations of things that are absent; judging always concerns particulars and things close at hand'.[75] Nevertheless, it can be understood as 'the by-product of the liberating effect of thinking' as it 'realizes thinking, makes it manifest in the world of appearances, where I am never alone and always much too busy to be able to think'.

Moreover, judging, as opposed to thinking, is a public affair: Rather than internal dialogue, it is an act that places itself in the light of the public. Instead of subordinating the particular to a general rule, judgment is validated by the perspectives of others; by a 'whole sphere of judging subjects'.[76] Sometimes, this may emerge through actual discussions in the public realm. Other times, such acts of persuasion are imagined: Even if the judging subject is alone, that subject is 'in an anticipated communication with others' because the subject knows that one must 'finally come to some agreement' with these others.[77] This is what Arendt calls an 'enlarged mentality'.

Borrowing from Kant, Arendt distinguishes 'determinative judgments' – assessments where the specific is subsumed under a general rule – from the 'reflective judgment' of particulars. In Kant's original account, reflective judgments are restricted to the domain of

aesthetics. However, Arendt's conceptual innovation is to propose that all judgments of matters social and political are reflective ones. In her mind, the totalitarianisms of the twentieth century rendered Kant's 'determinative judgments' obsolete. After 'the total collapse of all established moral standards in public and private life during the nineteen-thirties and -forties',[78] there are no longer reasonable norms under which particulars can be subsumed. Since then, we are forced to judge the social and political world without such conceptual 'banisters'.

In other words, she suggests that political judgments are no different from aesthetic judgments, inasmuch as they can never follow from an objective rational truth. Neither are they wholly subjective, since they are formed through an enlarged mentality. Still, even though this enlarged mentality involves political debate and acts of persuasion, judgments cannot be subsumed under principles of reason. This is a point of contention: For Jürgen Habermas, Arendt's rejection of the idea of a 'cognitive foundation' for political judgments means she fails to explain how legitimate agreement can be attained trough reasoned arguments.[79] Ronald Beiner suggests that Arendt's position 'renders one incapable of speaking of "uninformed" judgment'.[80] Similarly, commentators have lamented that Arendt's theory of judgment 'presents no obstacles to a certain kind of intellectual anarchy',[81] because her 'aesthetic conception of political judgment lacks precisely the sort of norms and standards which might serve as foundations or limits for making judgments'.[82]

Thus, Arendt's work spawned a debate between 'cognitivists' and 'non-cognitivists'.[83] The former argue that judgments cannot be made without pre-existing mental constructs (such as general principles and norms); the latter see merit in how Arendt '"lifts" Kant's theory of aesthetic judgment from the aesthetic realm to the political realm'.[84] For instance, Linda Zerelli supports an Arendtian position, pointing out that Arendt's message is not 'never make a cognitive judgment when you judge politically', but rather 'do not confuse a cognitive judgment with judging politically'.[85] Zerelli continues:

> In this process of judging reflectively we refuse to limit ourselves to proofs based on concepts and instead alter our sense of what is common or shared […] What we affirm in a political judgment is experienced not as a cognitive commitment to a set of rationally agreed upon precepts […] but as pleasure, as shared sensibility.[86]

Similarly, in a recent monograph, D.N. Rodowick finds that Arendt's account of judgment, 'as modeled by aesthetic experience', is summoned 'in singular circumstances where determinate judgments fail'.[87] As such, he finds that Arendt's view of judgment captures what a humanistic education should aspire to – that of being an 'education in judgment'. In view of that, we now turn to Arendt's own conception of education.

3.3. Arendt on education

Rodowick's recent book on Arendt is titled *An Education in Judgment*. Still, he – just like Atkinson[88] and Davis,[89] discussed in above (Section 2.2) – acknowledges that the proposition of teaching judgment is a problematic one. This idea goes back to Kant's original views on the matter: 'Judgment is a particular talent which can be practiced only, and cannot be taught'.[90] A student may learn rules of thumb, but the wise application of such heuristics are always contingent upon the situation at hand. A teacher can merely pass on rules, but the 'power of employing the rules' invariably rests with the student.[91] Arendt, in turn, followed

Kant in this regard: Indeed, as Stacy Smith suggests, the term 'education for judgment' can be seen as an 'Arendtian oxymoron' – especially given Arendt's 'strict distinction between the domain of education and that of politics'.[92]

This strict separation can, in part, be understood in the context of Arendt's earlier ideas on totalitarianism. If a teaching institution seeks to introduce a particular brand of politics in the curriculum, you are on a slippery slope towards the proposition of using authority to forge minds. In Korsgaard's reading of Arendt's view on education,[93] there is also a broader problem with instrumentalist uses of education: Education should not be used as a means to ends that lie outside of education – regardless of the fact that this proposition has a long and venerable history, going back to Plato's Academy.

However, Arendt's separation between politics and education warrants a somewhat lengthier explanation. In the essay 'The crisis in education', she outlines a particular perspective on the stakes of education. Ultimately, education exists in the interface between a new *life* and an existing *world*, and both of these need protection from each other. The new life – the child, the student – 'requires special protection and care so that nothing destructive may happen'. However, the world – the earthly civilization that is our home – likewise 'needs protection from being overrun and destroyed by the onslaught of the new that bursts upon it with each new generation'.[94] Education is ultimately a reflection of the love that we have for *both* the new humans born into our community (what she elsewhere describes as 'natality'), and the love that we have for the world (*amor mundi*).

Therefore, she concludes, 'conservatism, in the sense of conservation, is of the essence of the educational activity, whose task it is always to cherish and protect something'.[95] This educational conservatism is to be distinguished from political conservatism: Arendt recognizes that the world can only be preserved if we allow it to change.

> Basically we are always educating for a world that is or is becoming out of joint […] The problem is simply to educate in such a way that a setting-right remains actually possible, even though it can, of course, never be assured. Our hope always hangs on the new which every generation brings; but precisely because we can base our hope only on this, we destroy everything if we so try to control the new that we, the old, can dictate how it will look.[96]

Thus, paradoxically, Arendt suggests that educational conservatism is the only thing that can protect the revolutionary potential of the new generation. For her, teachers invariably have the role of representing the old, the established and the existing – their teaching should teach students 'what the world is like', but conversely 'not instruct in the art of living'.[97] In other words, Arendt maintains that an educational hierarchy – or at least separation of roles – must be retained between teachers and students. Politics must be a meeting of equals, and since education cannot be such a meeting, politics and education must be separated.

In response to this argument, Smith nevertheless maintains that the faculty of judgment should not be out of bounds for educators, suggesting that some of Arendt's claims are primarily valid for younger learners.[98] As students approach adulthood – as in the case of higher education – Arendt's strict separations (teachers vs students, education vs politics) are less valid. Indeed, Arendt herself points out that

> professional training in universities or technical high schools […] no longer aims to introduce the young person to the world as a whole, but rather to a particular, limited segment of it.[99]

While this may be the case, Arendt's ideas on education do nevertheless raise interesting questions regarding engineering education. What would it mean to see such education as a matter of not only preparing future engineers from professional life, but also protecting the world from future engineers? Equally, her approach to technoscience and judgment may also be productively applied to the question of engineering judgment and the prospect of teaching it. These issues will be discussed with in the next section.

4. Discussion: Arendt and contemporary engineering education

The previous section introduced Arendt's ideas on the challenges for humanism raised by modern technoscience, her non-cognitive account of judgment, and her 'conservationist' approach to education. This section will place Arendt in dialogue with the literature on judgment and education presented in Section 2. It will do so by reviewing the questions raised in the introduction: What is engineering judgment, can it be taught, and if so what is the role of the humanities and liberal arts? Each of these three questions will be addressed in a manner that raises a wider issue that emerges from Arendt's work.

4.1. Engineering judgment and the problem of professionalism

Section 2.1 showed how engineering judgment tends to be described as a cognitive capacity that relates to rationality in decision-making. In some accounts, judgment is discussed in relation to cognitive biases that cloud rationality. In other accounts, judgment acts as a check on the use of pre-given rationalities. The definition of engineering judgment proposed by Giuliano et.al., introduces critical thinking as a means to deal with multiple conflicting rationalities,[100] putting the judging subject in the position to be able to select a suitable rationality. This account is broadly in line with the literature on critical thinking in engineering education, which tends to mobilize critical thinking as a cognitive faculty in the service of problem-solving.[101]

In contrast, Arendt's view of judgment (Section 3.2) points in another direction, which complements the account of Giuliano and colleagues. For Arendt, judgment is not a matter of using, relating to, or balancing one or several rationalities. Rather, judgment is exercised in situations when pre-existing rationales must be placed to the side. In other words, judgment is not exercised when a decision-maker weighs economic imperatives (e.g. return on investment) against ecological imperatives (e.g. emissions target compliance) against each other. Nor is it exercised when a decision-maker applies a particular social-scientific or critical approach to analyzing a particular technological situation. Judgment is exercised when the judging subject attends to the particular situation at hand, seeking not to reduce it to pre-existing cognitive precepts. Letting go of such banisters, the judging subject instead seeks validation by using an 'enlarged mentality' that mobilizes or anticipates the perspectives of other judging subjects.

The introduction of this article states that Arendt's work on judgment has 'barely figured in the broader literature on engineering judgment'. In fact, Diane Vaughan does reference Arendt in her discussion of the Challenger launch – but only with reference to the work on Eichmann.[102] This is unfortunate, because any comparison between the specific cases is ridden with problems. Moreover, the notion of the 'banality of evil' may misdirect the gaze

of the analyst of mundane organizational life. Arendt's theory of judgment is a more suitable entry point for discussing the everyday problems of professionalism in engineering.

Indeed, the Arendtian approach to judgment complements previous accounts (such as that of Guiliano et al.) by problematizing notions of professional judgment. In professional settings, the professional is expected to shed personal, subjective convictions, and instead point to clear, objective and pre-existing rationales for the decisions made.[103] This, in turn, can be traced back to the rise of the modern corporation, which saw ownership being separated from management, and the emergence of an administrative hierarchy populated by cadres of salaried professionals.[104] From an Arendt-inspired perspective, 'professional judgment' is a contradiction in terms: While acting professionally implies being able to account for decisions on the basis of pre-accepted rationales; judgment implies the opposite – that is, side-stepping pre-existing rationales. Nevertheless, this does not mean that Arendtian judgment is never exercised inside large corporations. There is sometimes space for professionals to act without regard to the accepted rationales (say, profit-maximization) – though one scarcely does so officially.[105]

Thus, the Arendtian notion of judgment may complement not only previous accounts of judgment, but also the broader literature on engineering culture and practice. As we shall see, it also offers complementary views on how to conduct engineering education.

4.2. Teaching and practicing judgment

Can engineering judgment, as reconstructed through Arendt's work, be taught? One way to approach this issue is to continue the above discussion on professionalism in engineering. While the basic Kantian proposition that judgment cannot be taught may be true, it is certainly the case that students may benefit from being prepared for what professional life holds in store. This is in accordance with the idea of protecting the new life from the existing world.

So, on the one hand, students need to know that professional life involves making decisions following given and accepted rationalities. On the other hand, students should also know that there may be instances that cannot be reduced to pre-given rules, or subsumed under general frameworks. Further, there may also be situations when you use judgment – following your 'enlarged mentality' – and choose to act against accepted corporate reason. In such situations, 'in the rare moments when the chips are down',[106] an Arendtian understanding of judgment is imperative.

As hinted in the introduction, case study pedagogy may sometimes misrepresent such rare moments. From this perspective, the problem with case studies is not – *pace* Winner[107] – that they project a reality in which a comfortable technoscientific status quo is occasionally punctuated by the odd exceptional crisis. The problem, rather, is that we teachers are all too eager to reduce the exceptional crisis into something we already know – something we can rationalize for the class. This point dovetails with the point that made by Bucciarelli regarding engineering textbook exercises that strip down actual cases to mathematical abstractions. Through such abstractions, we teach students 'not to see'[108] – and this point holds true not only for mathematical abstractions, but also for abstract generic take-aways.

In terms of practical case study teaching, this requires us to suspend our own assessments of what is 'really' at stake in a case study or design challenge exercise. Resisting

the temptation to tell the class why they did the exercise – providing them with the clear, no-nonsense take-away – we should be attentive to and supportive of the students' own conceptions of what is at stake. The same goes for the temptation to orchestrate all too lavish case study performances. Students quickly recognize the game that is being played – the teacher puts on the spontaneous routine, but in the end, the discussion will boil down to carefully planned conclusions.[109] The exercise degenerates into a game in which the precocious student seeks to figure out the teacher's intended meaning, and then articulate that in class.

Most teachers using case studies or design challenges will know about the perils discussed above. What is proposed here is simply that through embracing Arendt's work, our emphasis may shift somewhat. As mentioned in Section 3.2, the kind of critical thinking endorsed by Arendt did not involve elaborate frameworks for describing concepts like power. Rather, she prescribed precisely on the opposite – dispensing with the prefabricated mental constructs which all too quickly deteriorate into stultifying clichés. The risk of falling prey to such thoughtlessness is particularly high for scholars. Thus, teachers must cultivate a teaching culture which refrains from falling into the teaching habits of placing matters – specifically, a situation explored in a case study or design challenge – into an all too neat cognitive order.

There is a broader issue at stake here. One of Arendt's most famous arguments concerns the issue of what it means to live in 'dark times'.[110] This concept does not, as one might think, denote a descent into totalitarianism; rather, it is a more specific diagnosis of a public realm that fails to enlighten. In the words of Roger Berkowitz, dark times are plagued by a 'black light of the public realm' that 'obscures everything' through 'chatter and talk that drown the reality of life'.[111] As such, dark times fosters a thoughtlessness where 'oversimplifications, compromises, and conventions'[112] seem impenetrable.

This critique is relevant in the context of engineering education. Some engineering graduates may well end up designing the algorithmic infrastructure for our present-day public realm, which invariably promotes oversimplifications. However, beyond that specific issue, there is also the problem that public discourse on technology at times errs towards clichés and taken-for-granted truth claims. Such conventions and pre-existing rationales have the effect of narrowing the space for freedom when it comes to collectively choosing our technological futures. Here, engineers that think and judge for themselves play a crucial role. By grasping the details of a particular technology, it may well fall on them to poke holes in oversimplified public 'truths' about matters technoscientific, and thus unfreeze technological trajectories.

Arendt's work prompts us to consider ways to foster a sense of public purpose (as well as a love for our technologically saturated world) among engineering students. This is, of course, not an easy task in an educational culture that seems to breed disengagement.[113] Nevertheless, one may still consider different ways to counter such disengagement. For Smith, fostering a sense of public purpose could involve encouraging engagement in extracurricular activities that train judgment and public engagement.[114] Placed in the context of engineering education, this proposition chimes with the notion of the engineer as citizen proposed by Winner.[115] Rodowick suggests another approach to training judgment – to learn from the critique class format used in art and design schools.[116] On that note, the next section will explore how the humanities and liberal arts may train engineering judgment.

4.3. The place of the humanities and liberal arts

Like other scholars mentioned in this text, Rodowick is broadly in agreement with the Kantian position on teaching judgment. Nevertheless, he does believe that higher education does have a purpose on this account; 'while good judgment cannot be taught, it can be practiced' in an educational setting.[117] Specifically, the critique class format used in the arts trains the enlarged mentality of the student. In this format, there is no rationality or knowledge to fall back upon, just the sharing of a collective assessment.[118] Indeed, discussions on case studies and design challenges may well benefit from such an approach; one where teachers let go of their pre-planned talking points and instead facilitate a truly open-ended assessment of the situation at hand.

Rodowick's conception of an Arendtian humanities-inspired 'education in judgment' diverges from Bucciarelli and Drew's proposition that the liberal arts may provide historical or socio-scientific context to technical knowledge[119] (see Section 2.3). It also diverges from Kallenberg's proposition that the tradition of the liberal arts trains the seeing of connections between different knowledge domains.[120] While neither of those propositions are at odds with Arendt's own conception of the value of the humanities, it is worth noting two points that emerge from Arendt's work.

First, as hinted above in relation to dark times, critical thought isn't a matter of applying 'critical perspectives' borrowed from the humanities or liberal arts. Reading history, literary criticism or social thought does not automatically make you a critical thinker. This holds particularly true if one seeks a pre-existing cognitive schema – possibly one that features the very term 'critical' – that can somehow counter the 'non-critical' schemas of engineering. Indeed, it is all too easy for teachers in technical universities to fall into the trap of construing 'critical perspective' as simply another form of rationality (or as a meta-rationality): After all, curricula tend to be structured around the idea of learning and adopting this or that 'framework', and engineering students are generally expected to diligently execute by making use of any such cognitive tools.

This point shifts the terms of the debate on the humanities and liberal arts in engineering education. First, note Kallenberg's concern that the liberal arts may be construed as 'not content but "perspective"'[121]; that it may become reduced to a tacked-on *perspective*, subordinated in relation to the 'core' engineering *content*. The argument above about critical thought prompts a different concern: The problem is not so much about 'critical perspectives' being seen as lesser rationalities in relation to core rationalities. Rather, the problem is the opposite – that critical perspectives are seen as just another rationality among others; that critical thinking can be placed in the same cognitive 'toolbox' as differential calculus, fluid dynamics or operations research. Again, an Arendtian approach implies seeing critical thought as that which stops the student from grabbing onto *any* form of simplifying, preformatted precepts. This includes mental clichés that emanate from humanities or liberal arts.

Second, there is a specific point that emerges from Arendt's concern with retaining a human understanding of the world. (See 3.1) Her critique of what modern technoscience does to the human grasp of the world constitutes a forceful indictment of the development of new technology. Indeed, her concerns are articulated in a way that generates some problems in the context of this argument: If one accepts her uncompromising critique of technoscience – which I suspect that many contemporary scholars in Science and

Technology Studies don't – one may wonder if there are any prospects for an engineering that acts 'for the benefit of mankind'.[122] This also implies that the proposition presented above – that engineers may have a role to play in dark times – may be incongruent with Arendtian sensibilities.

Nevertheless, *if* one accepts Arendt's argument about the technosciences undermining the human understanding of the world, while *also* accepting that engineering education may be better or worse at protecting the current world from the onslaught of the new, a novel perspective on the value of the humanities emerges. The value of the humanities-trained engineer lies in the possibility that the person in question can contribute to the retention of a human perspective of a techno-scientifically advancing world. Through the humanities and liberal arts, engineers may serve a role in the public sphere, bridging the widening chasm between technoscientific and humanist accounts of the world. Rather than unquestioningly participating in endeavors that destabilize the human understanding of the world, they may serve as mediators that re-activate and re-animate our understanding of the place of the human in a technologically saturated world.

Finally, one may ask – in response to Kroes – whether this proposition constitutes an instrumentalization of the liberal arts?[123] In a sense, yes. Still, in the context of Arendt's project, this may be less of a problem. Arendt's ambition in *The Human Condition* is to counter philosophers' traditional emphasis on *vita contemplativa* – the solitary contemplation of eternal, abstract truths – and instead focus on the activities of humans; *vita activa*. This shifting focus also implies a focus on engagement with the public realm. Here, education is imperative. For Arendt, education is the point 'where we decide whether we love our children enough […] to prepare them in advance for the task of renewing a common world'. It is also the 'point at which we decide whether we love the world enough to assume responsibility for it'.[124] In other words, education is not solely a process of pure self-realization[125]; it also exists as a means to care for the common world.[126]

5. Conclusions

This article has introduced the work of Hannah Arendt with a view to comment on the meaning of engineering judgment, the teaching of it, and the place of the humanities and liberal arts in this endeavor. In discussing these questions, three broader issues have heaved into view. However, before addressing those rather abstract concerns, let's return to more concrete problem of teaching judgment through case studies like 'Carter Racing'.

The article has suggested that we teachers should be careful not to overstate our case when presenting specific case studies or design challenges as instantiations of general problems, which in turn can be rationalized though pre-existing cognitive schemas. We should resist the temptation to oversell our own conceptions of what is at stake, and to provide ready-made sets of rationalities with which to make sense of the exercise. Arendt's work prompts us to encourage students to side-step pre-existing mental constructs, and instead engage in what she calls enlarged mentality. Moreover, exercises like 'Carter Racing' can serve as productive entry points to discussing the very meaning of engineering judgment. Such discussions may also involve distinguishing between different situations in which judgment is called for – for instance, the situation in which one decides whether

a calculation is sufficiently precise, as compared to the situation in which one decides on whether to be disloyal to one's employer.

As regards the broader issues that have emerged, there is first the tension between professionalism and Arendt's conception of judgment. Indeed, the notion of 'professional judgment' can be seen as an Arendtian oxymoron. Second, the argument has discussed the place of engineers in the context of 'dark times', when the public sphere is dominated by oversimplifications, clichés, and taken-for-granted truth claims regarding technological futures. Finally, a third and related issue has emerged: If technoscience tends to undermine human understandings of the world, there a need for engineers with humanist sensibilities who can bridge the chasm between technoscientific and humanist renderings of our common world.

Taken together, these three issues point towards an engineering ideal in which engineers are not solely engaged in the activities that Arendt labeled as 'work' – in the creation of a world of artifacts. Can the engineering profession become more capable in what she called 'action'? Can engineers own up to the fact that they shape social imaginaries? Can they transcend their focus on – as per the Royal Academy of Engineering – 'making "things" that work and making "things' work better"', and also engage in the public telling of stories about ourselves and the common world? Arendt herself did not expect such a development. Nevertheless, as scientists and technologists continue to probe the depths of space in search of that elusive Archimedean point, this is the challenge that her work presents to engineering education.

Notes

1. Davis, "A Plea for Judgment"; Atkinson, "The Beginnings of Wisdom"; Giuliano et al., "Critical Thinking and Judgment on Engineer's Work."
2. Accreditation Board for Engineering and Technology, *Criteria for Accrediting Engineering Programs*; Engineering Council, *The Accreditation of Higher Education*.
3. Engineering Council, *UK Standard for Professional Engineering Competence*, 3.
4. Christensen, Garvin, and Sweet, *Education for Judgment*.
5. Bazerman, *Judgment in Managerial Decision Making*.
6. Engineering Council, *The Accreditation of Higher Education*.
7. Marin, "Ethical Reflection or Critical Thinking?" 1355.
8. Brittain and Sitkin, "Facts, Figures, and Organizational Decisions," 63.
9. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work."
10. Bucciarelli and Drew, "Liberal Studies in Engineering."
11. Arendt, *The Origins of Totalitarianism*.
12. Arendt, *Eichmann in Jerusalem*.
13. Butler, "Hannah Arendt's Death Sentences," 282.
14. Foster Wallace, *This is Water*, Harford; "Learning How to Think Well"; Schwartz, "What 'Learning How to Think'" and Palmås, "*Bildung*, and How That Concept Sits with Traditional Notions".
15. While Arendt's work has yet to be discussed in the context of engineering design, it has recently informed the proximate field of design studies, notably through the *Designing in Dark Times* book series edited by Clive Dilnot and Eduardo Staszowski. That being said, this work tends not to engage specifically with Arendt's notion of judgment. See Staszowski and Tassinari, *Designing in Dark Times*.
16. Edmondson and Sherratt, "Engineering Judgement in Undergraduate Structural Design Education," 578–9.
17. Gainsburg, "The Mathematical Disposition of Structural Engineers," 486.
18. Petroski, *Design Paradigms: Case Histories of Error*, 121.

19. Schmidt, "Changing the Paradigm for Engineering Ethics."
20. Atkinson, "The Beginnings of Wisdom."
21. Royal Academy of Engineering, *Thinking Like an Engineer*, 2.
22. Davis, "A Plea for Judgment," 790.
23. Weedon, "Role of Rhetoric in Engineering Judgment," 166.
24. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work."
25. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 9.
26. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 10.
27. Marin, "Ethical Reflection or Critical Thinking?" 1355, cited in Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 11.
28. Claris and Riley, "Situation Critical: Critical Theory," 102, cited in Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 11.
29. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 12.
30. Atkinson, "The Beginnings of Wisdom."
31. Davis, "A Plea for Judgment," 790.
32. Werhane, "The Challenge of the Challenger Incident."
33. Vaugnan, *The Challenger Launch Decision*.
34. van de Poel and Royakkers, *Ethics, Technology, and Engineering*.
35. Lynch and Kline, "Engineering Practice and Engineering Ethics," 209.
36. Winner, "Engineering Ethics and the Political Imagination," 53.
37. Winner, "Engineering Ethics and the Political Imagination," 54.
38. Claris and Riley, "Situation Critical: Critical Theory."
39. Garvin, "Preface," xxi. The author has participated in the present-day colloquium; a ten-day exercise spread over two sessions.
40. To be fair, it is worth mentioning that even at places like Harvard Business School, there is a recognition of the need to complement case studies with other forms of teaching. The predefined, clearly targeted problems of case studies have recently been complemented with field-based, situation-specific teaching. See Datar, Garvin, and Cullen, *Rethinking the MBA*, and Palmås, "Rethinking the MBA."
41. Garvin, "Preface," xxii.
42. Brittain and Sitkin, "Facts, Figures, and Organizational Decisions."
43. This approach to teaching the case is outlined by, among others, Erez and Grant, "Separating Data from Intuition."
44. These include availability heuristics (relying on readily available data), anchoring bias (relying on the first pieces of data one receives), and escalation of commitment (sticking to a flawed decision even in light of new data). See Erez and Grant, "Separating Data from Intuition," 112.
45. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work," 12.
46. Bucciarelli and Drew, "Liberal Studies in Engineering."
47. This article will refer to the humanities and liberal arts as overlapping terms, in which the former is construed as tied to the European tradition of classical *Bildung* (and the lineage of German romanticism), and the latter is construed as following an Anglo-American tradition, which nevertheless shares most of the concerns with classical *Bildung*. See Sjöström et al., "Use of the Concept of *Bildung* in the International Science Education Literature."
48. Downey, "Editor's Introduction."
49. Winebrake, "The Integrative Liberal Arts and Engineering."
50. Bucciarelli and Drew, "Liberal Studies in Engineering," 116.
51. Bucciarelli and Drew, "Liberal Studies in Engineering," 117.
52. Kallenberg, "Liberal Arts is More Than 'Perspective'."
53. Bucciarelli and Drew, "Liberal Studies in Engineering," 111.
54. Bucciarelli and Drew, "Liberal Studies in Engineering," 112.
55. Riley, "Facepalms and Cringes," 139.
56. Kroes, "Critical Thinking and Liberal Studies in Engineering."
57. Kallenberg, "Liberal Arts is More Than 'Perspective'."

58. The book emerged the context of a debate on technology among European intellectuals, including her former teacher Martin Heidegger. See Yaqoob, "The Archimedean Point" and Heidegger, "The Question Concerning Technology."
59. Arendt, *The Human Condition*, 1.
60. Arendt, *The Human Condition*, 2.
61. Arendt, *The Human Condition*, 172, 300.
62. Arendt, *The Human Condition*, 2.
63. Arendt, *Between Past and Future*, 272.
64. Arendt, *Between Past and Future,* 274.
65. Arendt, *The Human Condition*, 3.
66. Arendt, *Between Past and Future*, 222.
67. Arendt, *Between Past and Future*, 268.
68. Arendt, *The Life of the Mind: Thinking*.
69. Arendt, *The Life of the Mind: Willing*.
70. Beiner, "Interpretive Essay"; Benhabib, *The Reluctant Modernism of Hannah Arendt*, Taylor, "Hannah Arendt on Judgment", Zerelli, "We Feel Our Freedom"; Rodowick, *An Education in Judgment.*
71. Arendt, *The Human Condition,* 76; Arendt, *The Life of the Mind: Thinking,* 193; Arendt, *Lectures on Kant's Political Philosophy*, 40; Arendt, *Responsibility and Judgment*, 184.
72. Arendt, *Responsibility and Judgment*, 176.
73. Arendt, *Responsibility and Judgment*, 160.
74. Arendt, *Responsibility and Judgment*, 187.
75. Arendt, *Responsibility and Judgment*, 189.
76. Arendt, *Responsibility and Judgment*, 141.
77. Arendt, *Between Past and Future,* 220.
78. Arendt, *Lectures on Kant's Political Philosophy*, 52.
79. Habermas, "Hannah Arendt's Communications Concept of Power," 23.
80. Beiner, "Interpretive Essay," 36. See also Zerelli, "We Feel Our Freedom," 159.
81. Steinberger, "Hannah Arendt on Judgment," 819.
82. Biskowski, "Practical Foundations for Political Judgment," 869.
83. For the purposes of brevity, this text will focus solely on cognitivism/non-cognitivism distinction (as inherited from the Arendt literature) when describing differing accounts of judgment. This binary could productively be deconstructed or embellished further, even though there is no space to do so in this article.
84. Korsgaard, "Visiting Exemplars," 252.
85. Zerelli, "We Feel Our Freedom", 183.
86. Zerelli, "We Feel Our Freedom," 183.
87. Rodowick, *An Education in Judgment*, xvi.
88. Atkinson, "The Beginnings of Wisdom."
89. Davis, "A Plea for Judgment."
90. Hare, "The Teaching of Judgement," 243.
91. Hare, "The Teaching of Judgement," 245.
92. Smith, "Education for Judgment," 67.
93. Korsgaard, *Bearing with Strangers*.
94. Arendt, *Between Past and Future*, 186.
95. Arendt, *Between Past and Future*, 192.
96. Arendt, *Between Past and Future*, 192.
97. Arendt, *Between Past and Future*, 195. Crucially, for teachers in profession-oriented educational institutions, this also implies not telling students what professional lives to lead.
98. Smith, "Education for Judgment."
99. Arendt, *Between Past and Future*, 196.
100. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work."
101. Ahern et al., "A Literature Review of Critical Thinking."
102. Vaugnan, *The Challenger Launch Decision*, 407.
103. Granted, the debate on professionalism also includes accounts that highlight how it cannot be standardized or rationalized. See Friedson, *Professionalism: The Third Logic*, 1.

104. Chandler, *The Visible Hand*.
105. Palmås, "Innovation, Politics and the Swedish Brand."
106. Arendt, *Responsibility and Judgment*, 189.
107. Winner, "Engineering Ethics and the Political Imagination."
108. Bucciarelli, *Designing Engineers*, 107.
109. Poorly executed, the "artistry of discussion leadership" resembles the jazz soloing that Theodore Adorno despised. The precocious student may recognize that the routine "scarcely leaves any room for improvisation, what appears as spontaneity is in fact carefully planned out in advance with machinelike precision", using "well-defined tricks, formulas and clichés". See Adorno, "Perennial Fashion," 121–2.
110. Arendt, *Men in Dark Times*.
111. Berkowitz, "Thinking in Dark Times," 4.
112. Berkowitz, "Thinking in Dark Times," 8.
113. Cech, "Culture of Disengagement in Engineering Education?"
114. Smith, "Education for Judgment," 85.
115. Winner, "Engineering Ethics and the Political Imagination."
116. Rodowick, *An Education in Judgment*.
117. Rodowick, *An Education in Judgment*, 2.
118. Rodowick, *An Education in Judgment*, 155.
119. Bucciarelli and Drew, "Liberal Studies in Engineering."
120. Kallenberg, "Liberal Arts is More Than 'Perspective'."
121. Kallenberg, "Liberal Arts is More Than 'Perspective'," 133.
122. Giuliano et al., "Critical Thinking and Judgment on Engineer's Work."
123. Kroes, "Critical Thinking and Liberal Studies in Engineering."
124. Arendt, *Between Past and Future,* 196.
125. Thus, Arendt does not adhere to the European romanticist conception of *Bildung*, in which personal self-realization trumps ends like the common good. See Beiser, *The Romantic Imperative*, 91.
126. As we have seen, Arendt does nevertheless place limits on educators' care for the common world. We teachers must not instrumentalize education in the sense of promoting specific political agendas, thus undermining students' "chance of undertaking something new, something unforeseen by us". Arendt, *Between Past and Future*, 196.

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