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Game Over: Reframing Ethical Decision-Making through Failure for Engineering Education

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I. Introduction

"Arise now, ye Tarnished.
Ye dead, who yet live. . . ."

In this paper, we introduce failure as we define it and how it is currently approached in engineering. We present the current state of the art in teaching engineering ethics and the ethical understanding of engineering from a Philosophy of Technology approach. We then utilize the intersection of queer theory and video game studies to present how the understanding of failure can help us reshape how it is approached in engineering. Finally, to illustrate the use of these ideas, we present two theoretical examples of how failure can be enacted in the classroom for a better understanding of engineering ethics.

II. Failing at Games, a Brief Introduction

The initial quote, from the 2023 Game of the Year, Elden Ring [1], serves as a call to action, a start to an adventure, the beginning of a quest that we hope will change the world (at least the one within the game. . .). Video games can act as a world within a world: a space where another world and another story that becomes entangled with our own, but provide stability through finite choices and boundaries in the form of rules and possibilities. As Jane McGonigal remarks [2], reality is sometimes hard to get into due to fear of failure or embarrassment. Games allow people to participate in their quests more fully and shamelessly. So what if you perish two hundred times while trying to beat a boss? That's part of the fun! Failure, when embarrassed and designed for, can be an excellent strategy for teaching ethics, collaboration, and humility. What better place to start this quest than by examining failure in video games?

One game type that relies upon failure as a feature are Soulslike games, a category in which Elden Ring can be situated. Named after the Dark Souls, one of the defining features of this game type is that you fail. A lot. More specifically, the challenges in these games are structured such that you are very likely to experience your player character dying many times, but each time you learn and improve, develop skills and knowledge that helps you progress and eventually complete the game. In fact, failure is even required in certain parts of the game. When the player begins the game they are in an area that is much beyond their skill level, they encounter a boss and inevitably die on their first attempt. Through this loss, the player progresses to the tutorial/introduction section of the game. The failure here teaches the player

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that failing in the game is not something to be punished, but that it is necessary to learn and progress through the game. It is an expected part of the experience.

The parallels to be drawn here may be too on-the-nose: "failures are an expected part of life" and "you should always pick yourself back up and try again", most folks would agree that these are important life lessons. However, we take this to a very specific comparison, to engineering education and specifically the teaching of engineering ethics. Despite use of design iteration and trial-and-error in engineering practice and projects, engineering instruction broadly does not seem to leave much room for failure as part of the learning experience. In classes, students can be instructed only on how to find the right answer, and then be punished, through low marks or exclusion from opportunities, for failure. Even in classes that cultivate intuition, innovation and creativity, there is usually a right answer and thus a specific, predetermined pathway to success that, unlike Elden Ring, does not repeatedly endure failure. This may be a practical position for more introductory, knowledge and theory based courses (although still debatable), but one area that this approach wanes is in teaching engineering ethics. When encountering ethical problems, there is no clearly defined pathway for success, no theory that can always determine the best decision down to two decimal places. Indeed, by treating ethics as a definitive and static series of rules and guidelines, engineers can unintentionally cause large problems with the implementation of the technologies they create. Philosophy of Technology, as a field, has long examined these mechanisms and the interplay between the people behind engineering and the effects of their technologies. The disconnect, then, occurs not through a lack of understanding, or how engineers might deal with ethical conundrums, but rather in how engineers are (or are not) taught to think about ethical decision-making. To connect these important approaches from the Philosophy of Technology to Engineering, we propose embracing a playful approach to engineering education, specifically the queer art of failure, to expand the strategies and tools available for engineering educators in conveying complicated practice of teaching ethics to engineering students.

III. Teaching Engineering Ethics: The State of the Craft

Presently, the incentives that American engineering programs currently have to teach ethics is to meet hard requirements, such as those set out by ABET Accreditation [3], which are accreditation bodies within the educational system that judge engineering curricula across all institutions and verify that they are consistent and sufficient to teach students all the skills that we (society, or just the accrediting body, who decides this) have decided engineers must know. The issue here is twofold. First, the only requirement that such crediting bodies usually have are classes on professional ethics, referred to as the rules and codes approach to engineering ethics [4].

This approach centers engineering ethics on one's professional obligations to employers, clients, and society as defined in established professional codes associated with the various engineering disciplines. In [5], the authors identified a trend among engineering ethics education which assumes that simply providing information on what is (or is not) ethical will lead to ethical actions. However, this is not necessarily true. This highlights the second problem of motivating an ethics education on accreditation requirements, which is that it frames ethics as separable from technology. It primes students to view ethics as merely another subject that a student must take a class in, a box that must be checked for an engineering student's bachelor education. This leads to the conceptualization that ethics is just one tool among many, on par with subjects learned in other courses, such as solid mechanics or fluid dynamics. When presented with a problem, an engineer will pull the theoretical tools out that need to be used, such as fluid mechanics for a fluids problem, but if ethics is just another tool, then without an explicit reason they see to use it, they won't.

There have been recent changes in to two discipline's codes of ethics – IEEE (Institute of Electrical and Electronics Engineers) and ASCE (American Society of Civil Engineers) to infuse equity into engineering by adding non-discrimination and fair treatment clauses to their respective codes [6], [7], [4], however, this progress is slow and incremental, resulting in professional codes of ethics not fully capturing the ideas of equity and justice at the forefront of contemporary engineering ethics issues. More recent work has asserted that engineering ethics should go well beyond ensuring students are aware of engineering guidelines and codes of ethics, integrating ethics into situated everyday decisions that engineers make as they do their work [8]. Thus, the rules and codes approach falls short of the full education engineers require to make ethical decisions in their workplace [9] – a general problem of checklist approaches to ethics broadly noted within the philosophy of technology [10].

Within the classes themselves, ethical issues are often taught by splitting into two parts: micro-ethics, referring to individual practitioner's ethical responsibilities, and macro-ethics, referring to the collective social responsibility of the engineering profession and socio-political consequences of engineering design principles [11]. Micro-ethics contextualize moral decision making through a technical exercise and focus on the values and virtues a professional engineer should uphold in a given scenario. Macro-ethics help students place their actions in the broader context of their discipline and its effects on society [12]. These approaches are most frequently taught to students using a variety of case studies designed to place them in situations that require ethical consideration. This is meant to give students the opportunity to practice moral decision making, illustrate the potential consequences of engineering designs, and make sociotechnical issues more immediate to them in the design process. [13], [14], [4]. However, even these case studies only focus on a narrow range of ethical frameworks, primarily deontology and utilitarianism [14]and fail to capture the complexity and reality of the workplace and professional environment [13].[1] Thus, students are left with a limited toolkit for appraising the moral landscape and making ethical decisions and increasingly high expectations for moral accountability and awareness. Additionally, when societal or macro-ethical issues challenge these approaches, it becomes easy for class discussions to devolve into a "freedom-for-all" viewpoint when selecting between conflicting ethical principles. It is difficult for students to internalize ethical frameworks and more broadly relate them to their own experiences and the experiences of others beyond the classroom and provided scenario.

In consideration of recent trends in engineering education, a shift from micro to macro level

[1]We recognize that failure studies, particularly within Civil and Environmental engineering, are common methods for teaching focused on failure. However, these approaches are still often grounded in case studies and on the singular dimension of failure as inherently bad. While we agree that there certainly are many cases in which failure is harmful, or even lethal, and ought to be avoided, that is not *always* the case, as this paper argues. Sometimes, failing to comply with unethical demands or an oppressive system can be helpful and save lives. The experience of failure can also be a useful pedagogical tool. From this perspective, failure studies would still encounter many of the same issues as case study approaches to ethics

cases in ethical education for engineers is in progress [14]. Problematically, micro cases are designed to be more relatable to students, but macro-ethical issues are rarely presented in a similarly relatable context. Engineers are not provided sufficient epistemological tools for critically thinking about macro ethics to permit them to navigate moral decision making in a wide variety of socio-technical contexts. This has led to a recent call to find ways to bridge the micro and macro issues, incorporating the personal ethical responsibility of engineers with the consequences their actions will have on society [15], [4], [12].

To better pursue this integration, there have been proposals of creating more immersive ethical education experiences that allow students to explore a variety of approaches to moral decision making and better communicate to students how all engineering decisions should be made within the broader moral landscape, as opposed to a select few decisions. An engineering education integrated with ethics as a way to make longer-lasting systemic change [13], [12]. Incorporating experiences such as community outreach and guest speakers helps, in part, to frame an education in the ethical issues beyond the workplace [16]; however, this is just an extension, albeit a very valuable one, of the current education strategy. More recent papers have proposed game-based learning experiences, or 'playful learning' as a way for students to immerse themselves in ethical issues and consider them from new perspectives [9], [8]. These strategies provide an alternative solution to the problem of how to break down the disciplinary barriers between ethics and engineering.

IV. Approaching Ethics from the Philosophy of Technology

Within his book The Social Control of Technology (1982) [17], David Collingridge outlines some of the key difficulties to guiding creation of technologies to avoid undesirable social consequences and to enhance the desirable outcomes. In other words, how do we ensure that technologies are developed and designed to promote positive social aims and reduce or remove their potential for harm? The heart of this issue is what Collingridge terms "the dilemma of control" or what is widely called "the Collingridge Dilemma". In his words: "Attempting to control a technology is difficult, and not rarely impossible, because during its early stages, when it can be controlled, not enough can be known about its harmful social consequences to warrant controlling its development; but by the time these consequences are apparent, control has become costly and slow" (p.19). Thus, a double-bind is presented: the anticipatory bind and the control bind. The anticipatory bind illuminates that adequately accounting for the social, cultural, ethical, or political consequences of a technology ahead of its release and adoption in the public sphere is nearly impossible. The control bind presents that once a technology is adopted amongst users, it is costly, at best, to steer away from negative consequences. In other words, by the time it becomes apparent that a technology needs to be controlled to avoid causing harm to society, it is too late for efficient and effective interventions.

Collingridge then argues that the social steering of technology is made easier by making decisions about technologies that are 1. Easy to change, 2. Accompanied by systems that are easily controlled, and 3. Open to future changes (p.38). Several critiques have been leveled by authors in response on these three grounds. On the first, corrigibility is expensive and difficult to confidently anticipate. On the second, there are vast possibilities for any technology, and it is unclear how designers and engineers can best navigate these complex webs of decisions predictively. On the third, controllability is often reduced to recognizing the inevitability of mistakes without also taking into consideration the number and severity of mistakes [18]. Thus, scholars have since been seeking more comprehensive solutions that offer more nuanced solutions and recognition to the complexity of the Collingridge Dilemma.

One of the most widespread responses to the Collingridge Dilemma was the creation of the field of RRI (Responsible Research and Innovation). The primary goals of RRI focus on stakeholder-driven decision-making and collaborative learning citizen science / participatory science), addressing pressing socio-ecological problems and needs, anticipating potential problems ((ethical) Constructive Technology Assessment), and a willingness for participants of RRI to adopt and act in accordance with these principles [19]. Numerous critiques have emerged in response to this approach to addressing the Collingridge Dilemma from STS (science, technology, and society or science and technology studies). The primary concerns being that RRI does not clearly acknowledge power flows between various stakeholders, institutions, and experts; afford epistemic plurality and challenge hegemony, or account for co-configurative relationships between technology and society [19]. Approaches were desired that present numerous perspectives for assessing emerging technologies from power and control to the good life beyond legal and institutional requirements [20].

Another approach to addressing the Collingridge Dilemma has been Value Sensitive Design (VSD). VSD focuses on training engineers and designers to recognize and the interplay between societal values and technology more broadly and understand that technologies are also capable of embodying certain values or nudging society towards the social good (and, ideally, away from harm) [21], [22], [23], [24]. This approach would address the Collingridge Dilemma by ensuring that the individuals who are highly involved with the technology throughout its creation-cycle are able to more effectively scan the moral landscape and guide the technology before it is even released unto the wider public. Flanagan and colleagues writing:

> A pragmatic turn from this largely descriptive posture sets forth values as a design aspiration, exhorting designers and producers to include values, purposefully, in the set of criteria by which the excellence of technologies is judged. If an ideal world is one in which technologies promote not only instrumental values such as functional efficiency, safety, reliability, and ease of use, but also the substantive social, moral, and political values to which societies and their peoples subscribe, then those who design systems have a responsibility to take these latter values as well as the former into consideration as they work. ([23] p. 322, my emphasis)

The authors denote that some such values for liberal, western democracies might be things like liberty, justice, privacy, friendship, autonomy, and trust (ibid.). We would also add that more recent approaches to VSD also seem to prioritize transparency, consent, fairness, and accessibility) [21].

Using VSD as a basis and seeking to address shortcomings in RRI, post-phenomenological researchers have been using Verbeek's Mediation Theory to communicate the way that engineers and designers materialize morality. This occurs when engineers and designers create technologies that, inevitably, co-constitute actions, experiences, and embody particular intentionality, values, and desires through use-scripts ([24] p. 361). Modern combinations of

VSD and Mediation Theory call this particular phenomenon the problem of value dynamism, a hidden dimension of the Collingridge Dilemma: “when we develop technologies on the basis of specific value frameworks, we do not know their social implications yet, but once we know these implications, the technologies might have already changed the value frameworks to evaluate these implications” ([25] p.293). Morals and values do not exist in a vacuum; as social conditions change, so does the way we experience and exist in the world [26].

These approaches are still not without sticking points: Firstly, if we accept the post-phenomenological thesis that technologies, humans, and the world are co-created, this also determines that the moral landscape is constantly shifting. Further, human-technology-world relations not only rearrange the existing morals and values at play, but they also have the potential to introduce new ones or deconstruct old ones. Even if an engineering or design program teaches Mediation Theory or VSD, it is unclear if a single course on the topic would be substantive enough to provide technology-creators with the epistemic skills they need to truly create technologies that are ethical-by-design. This challenge is also illuminated by Flanagan and colleagues in response to VSD when successfully integrating values into one’s way of seeing, experiencing, and creating the world requires “...the need to incorporate diverse and frequently far-flung areas of knowledge and know-how into the design process that are not normally conceived as elements of the design toolkit. Design teams that commit to taking values seriously might even need to innovate in these unfamiliar terrains” ([23] p.323). As such, educators attempting to address the Collingridge Dilemma by better training engineers and designers in ethics need to take a more comprehensive approach to ethics beyond one-off courses in professional ethics or generic humanities ‘liberal arts’ curriculum requirements (i.e. ethics is nonfungible with language, history, religion, etc.).

Additionally, to account for value dynamism, an approach to ethics is needed that is not only focused on legal standards, regulatory guidelines, or ethical checklists. These approaches often grow stagnant if they are not updated regularly, uphold hegemonic societal values and dominant images of user groups (see [27] for additional examples), inhibit critical reflection, and settle for very narrow definitions and applications of ethics [25]. Expanding on these critiques, Verbeek writes that engineering ethics often only focuses on the instrumental values of technologies – working to design technologies to fulfill “the normative aspects of the goals for which technologies are designed or the quality of the way in which the technologies function (risk assessment)” [24] (p.362). Meaning that engineers are usually focused on creating technologies that perform the task required and adhere to ethical standards outlined by institutions or regulatory boards, but there is little time or space for reflections and critical attention on the way in which technologies and human experiences are co-created and the way these relationships reconfigure the moral landscape.

To emphasize, the importance of epistemic pluralism cannot be understated. This critique is something that all of the above approaches to the Collingridge Dilemma often struggle to address. The values that are often emphasized as ‘desirable’ are often steeped in western, white, cis-hetero, abled, masculine ways of knowing, being, and experiencing the world. While designing technologies for the ‘social good’ may very mean designing technologies that are equitable, just, transparent, secure, and accessible, there is further value in designing technologies that are interdependent, maintainable, caring, unruly, peculiar, antagonistic, or design for fantastic failure. Further, taking dispositional stances towards engineering and design that do not run on Western, colonial notions of success, progress, and fixing/solving may further challenge hidden hegemonic conceptualizations that implicitly co-shape and enframe technological creation– a potential that seems increasingly likely given STEM's continued oversaturation of hegemonic worldsenses [28].

Lastly, while both VSD and Mediation Theory theorize possible approaches to the Collingridge Dilemma that focus on the humans behind the technologies, these approaches are primarily limited towards the realm of theory and are directed at practitioners of STS in engineering and design consultancy or advisorship. While we are becoming increasingly well informed on what options exist to address the Collingridge Dilemma, the question of how remains convoluted – especially from a pedagogical perspective – which is particularly problematic if we ought to be integrating these approaches into the classroom in the form of tactics, techniques, and projects to cultivate engineers and designers that are capable of thinking Other-wise and traversing ambiguous, entangled, evanescent moral landscapes.

V. Encountering Failure in Engineering

Within their chapter, "Playing to Lose: The Queer Art of Failing at Video Games" [29], Bo Ruberg makes the case for the importance of failure in resisting games, and systems, that have narrowly defined parameters for success and winning that rest, ultimately, on heterosexual (often masculine) norms and standards . To educate the reader on these specifics, Ruberg relies upon what we call 'the normative logic of failure', outlined in Jesper Juul's work The Art of Failure [30], that depicts failure as something bad, painful, and devastating, while success is defined as something desirable, validating, and good. Ruberg remarking that this logic works when "Players who lose feel rotten, and loss jolts them out of the game with such a nauseating punch to their self-esteem that they contemplate giving up entirely. Yet, players' drive to win pushes them forward past failure, inspiring them to walk over the emotional broken glass of lost levels in a rush of determination, pride, and testosterone" ([30] p.201). In play, failure is crucial, and inevitable, to the full experience of the game [30].

Despite a consistent and longstanding insistence from engineering and engineering ethics that failure is a necessary component of a 'good' engineering process and embracing failure is paramount to success in engineering [31], [32], [33], [34], engineering course and program design rarely integrate this value. Instead, 40% and 50% student failure rates in engineering are often explained as not meant to be, unready for rigorous education, or poor work ethic [35], [36]. However, Brandi Geisinger and Raj Raman's work on understanding attrition rates identify "classroom and academic climate," "grades and conceptual understanding," and "self-efficacy and self-confidence" as the three leading reasons students report leaving engineering disciplines ([36] p.914). Of these issues, recent investigations into the relationship between these factors have marked "weed-out" courses as a common denominator in fostering a negative classroom environment that hyper-fixates on student grades as a measure of success and learning which ultimately harms students' confidence in themselves and their sense of 'belonging' in engineering [37], [38], [39].

Rather 'walking over the emotional broken glass' of failure – as this particularly masculine approach to engineering demands – students will stick to safely performing 'engineering' within these narrow bounds of success to pass classes and develop a fear of failure. Ultimately, this move will discipline students into a very rigid performance of engineering norms and standards, often grounded in white, cis-hetero, abled masculinity, and smother iterative processes, collaboration, and belonging in engineering. These intersections, at least partially, can further contextualize the generally poor retention rates– especially for students with disabilities, LGBTQ+ (Lesbian, Gay, Bisexual, Transgender, Queer) students, students of color– and add to the chorus of voices pointing at systemic issues in engineers' education as primary factors in students leaving engineering, rather than personal failings [40], [41], [42]. Accordingly, one potential avenue to address these issues in engineering is by flipping the script, and putting the pedagogy and structure of engineering education back into dialogue with the purported value of failure in engineering.

VI. Reconfiguring Failure in Engineering

We identify the current approach to failure in engineering ethics as a particular way in which the practice of teaching engineers in general, and engineering ethics specifically, could be immediately improved.[2] We know that the static, determinate rules-based approaches to ethics do not succeed in teaching engineers how to navigate complex, dynamic sociotechnical systems and ethical problems. In order to convey and preserve the complicated interconnectedness of peoples, places, and things, students must be able to try to implement solutions. Doing is the best way of learning in this case because early, intuitive attempts without guidelines or knowledge are destined to fail. Experiencing failure in an environment where learning and cultivating growth can be prioritized can help students embrace failure as an opportunity to address gaps in understanding and knowledge and emphasize the importance of ethics as an iterative, interdependent, and dynamic process rather than a pre-scripted solution [43]. We wish to encourage developing ethical intuition, interpersonal understanding, and empathy in approaches to sociotechnical problems. To start our investigation on how to teach this approach to ethics, we rely upon Ruberg's queer approach to failure in video games. Several similarities between triple-A games and current engineering practices emerge: particularly, the desire to push players to succeed in only the ways that are approved by the system and punish failure (forfeiture of time, abilities, experience, favor, or progress) and the design for an intended audience of cis-hetero, abled, white men. While both video games and engineering are slowly making progress in these areas, thanks to the unwavering demands of scholars, activists, and other humans who care, there remains many opportunities for intervention, particularly at the structural level.

Before turning to games, Ruberg draws our attention to the importance of understanding "queer" as a double meaning as sexually nonnormative and strange, bizarre, or peculiar. They denote that "queerness" is not only a mode of desiring differently, but also of being differently. Embodied, queerness is played out by individuals who defy heterosexual norms in a plurality of ways: sexuality, gender, non-dominant relationship modalities, and on it goes. Abstractly,

[2]We urge fellow instructors to recognize that weeding out students does not ensure that the ones who remain will not cause harm, as every engineering failure study can also be seen as certified engineers, who were deemed "successful" in their studies, failing personally or via their creations. Providing a supportive classroom environment to navigate failure is crucial to encouraging students to expand their epistemological tools and tactics and learn how to remedy harm when caused, rather than fearing failure so much they also avoid accountability and willingness to make things right.

queerness is an act of resistance to hegemonic structures, an embracing of the strange, and a desire to live otherwise ([29] p.200). When we look at play, to play games queerly means "to play the wrong way around, to jump our unsuspecting, pixelated avatars into pits instead of over them, to choreograph the most unfortunate disasters… It is a playful art, a ludic art, which makes a game of dying" ([29] p.203).

A particular point of relevance and intersection for this paper is Ruberg's delineation between failing in a way that a game 'wants' and 'approves' of versus failing in a way that is unsanctioned and denied by the game ([29] p.204). When examining 'weed-out' courses in engineering, the course wants people to fail. It's designed to render it impossible for everyone to succeed, regardless of their aptitude or ability. In this case, to fail a weed-out course is for the course to 'succeed' and the game to work precisely as intended. Is it possible to pleasurably fail against a system that encourages failure by design, as Ruberg asks ([29] p.206)? Yes, but that process is incredibly risky and requires a strong sense of community and camaraderie – attempting to fail equally, as an entire class, and to force the system into another mechanic it does not desire: every player losing. And, particularly, failing in a way that Ruberg calls 'failing fantastically' ([29] p.203). This type of failure, from within the engineering classroom, can act as a form of resistance to these systems.

However, this take still pushes the onus and responsibility for poor system design onto the students. Unlike video games, college courses have much higher stakes for failure in reality: loss of opportunities, financial stability, passion, familial support, amongst other potential outcomes. As such, we, as educators, mentors, and advocates for our students, need to do our part to dismantle these systems and embrace failure, as it is an essential first step in queering success [29]. When we resist hegemonic forms of success, we open pathways to making and doing, being and becoming differently and also cultivate a culture of belonging, not merely through Diversity, Equity, and Inclusion (DEI) verbiage and gesturing, but by challenging and changing the systems that reproduce toxic notions of success and failure under the guise of 'rigor' whilst discouraging exploration, curiosity, and creativity.

The remainder of this paper will describe how we can transfer the lessons of queer failure we see in video games into the classroom. Specifically it will outline two potential avenues for embracing the queer art of failure by supporting ways that students can practice failure, experience failure as an opportunity for exploration, and learn the peculiar pleasures of 'failing fantastically'. First, we fail to present examples of first-year course assignments that neatly divide ethics from engineering. Second, we fail to propose a first-year pedagogical strategy that weeds students out. Although the strategies outlined here have remained largely untested in engineering, they are hopeful and playful suggestions for resistance in engineering spaces. Ultimately, we hope our joyous embrace of failure, and all of the strange and wonderful possibilities it opens, will encourage other educators and mentors to find the courage to challenge dominant systems similarly and curiously engage with different ways of being and becoming to do so.

VII. Queering Failure in the Classroom

Although playful learning has long been a model for teaching children, there are many benefits to introducing this pedagogical model to the classroom, particularly for pushing students to think differently within the boundaries of the game. As Rose Klein argues, when queer play is put into dialogue with queer pedagogy, both can enhance the experience of students and invite them to challenge normative structures that exist around them [44]. While there are certainly many queer games and games designed by queer folks, as Ruberg remarked above, it is not necessary for the games to be designed with these intentions at the top of mind to be engaged with queerly or benefit from queer readings and interpretations [29]. As we are developing an alternative approach to teaching engineering, we take inspiration from alternative structures to AAA games (the most high-budget, high-profile games). Specifically, this section will focus on the Roguelike game, Hades [45].

Classical games are structured like traditional schooling, in which you are presented with one idea or challenge at a time that you must learn and overcome in order to move on to the next. Players, or students, will slowly gain more knowledge, skills, and resources to be able to access more areas and complete more objectives until you finally win (getting a job would be traditional winning in engineering). Failure in these cases is not helpful, a delay or bump in the road that is best avoided. Roguelikes are instead a type of game that uses failure as a progression mechanism. The player starts playing, making progress and learning as in a classical game, but the attempt inevitably ends in failure, a death of your character. The player must then start over from the beginning. This sounds like the opposite of progress, but in these games failure is not the end of the story; game over does not necessarily mean that the player has lost. Rather each failure teaches you the skill to improve and do better in that situation, while gathering resources and knowledge. In the example games like Hades, each failure also weaves into a larger plot and progression in the game. Through enough attempts, a player can learn how to overcome any obstacle in the proper way, once they have learned all the ways that do not work, as well as learn more about the in-game characters and community impacted by their actions. Failure is the only path to success in these games: the player would not learn, progress, or 'win' without failure.

Transferred to engineering ethics, these approaches to failure would be a true realization of the design iteration or 'trial and error' approach that is so widely taken in engineering practice, but that many engineering ethics education programs do not use, given the focus on the 'rules and codes' approach. In an engineering education students can often be taught one 'correct' way to solve problems. They are shown how to learn and apply new things, how to perform well and attain the correct answer through hard work, but not how to fail well. Students might end up attempting a problem multiple times, but failure is never expected or included as part of the design plan, and more so is always to be avoided, despite the valuable lessons such an experience can give. With ethical problems especially, where downstream effects of engineering decisions can have many unintended consequences, failure should be expected and planned for. When designs hit the real world engineers often have to face an issue that wasn't considered or accounted for, leading to a failure of their design. However, as in Hades, this failure should not be the end of the story. Reconsideration and redesign is required, and by iterating through these issues you learn to address all the varied aspects of the problem. Additionally, as in Hades, the experience of the failure not only teaches the engineer more about the problem, but teaches about the community and people that surround the implementation of the design. It provides an opportunity to learn and improve that is only available through the failure of their previous attempt.

This process of weaving failure and iteration throughout a design is already familiar to most engineers. The strategy is seen in design projects and technical courses, however, we posit that teaching engineering ethics especially should be structured in this way. We also go one step beyond iterative design and propose that projects should be constructed such that the students are expected and encouraged to fail, redesign and fail again, with 'success' looking like navigating failure critically, creatively, and with candor. From failure theory, experiencing failing at some of the hardest tasks that engineers do, and therefore learning what the actual impact of their work is, can convey lessons deeper than if the student only learned the wrote 'correct' way to do it from the beginning. That 'Oh No' feeling of failure is an impactful motivator for learning to address problems, but the first time this is experienced should not be in a job or real-world scenario, it should be during their education. If projects and pedagogy within the curriculum of engineering ethics provided these opportunities, students would be that much more capable at tackling the most difficult problems engineering has to offer. Moreover, as students attempt these approaches repeatedly, they hope to reach a state where they finally learn to come across new obstacles or ethical dilemmas that they can overcome without any failure at all, purely through applying the experiential skills that they have learned. This is the goal of ethical education. This is then when students can begin to learn how not to fail, and how to instead perform exceptionally, as Hades also teaches us, where victory is never final, but one finally grows powerful and skilled enough not to fail each run, but to succeed better and better.

While these ideas sound fun on the surface, a practical question is how they are realized. All well and good to say that play and failure should be introduced into the classroom, but the question that engineers have long been posing to philosophers and ethicists is: how does your work apply to me? We propose two possible strategies, both as practical parts of a curriculum that could be implemented and as inspiration for the creation of projects of all disciplines.

VIII. Project Idea: Hostile Architecture and Callous Objects

To integrate the above ideas into the classroom space, we can capitalize on some of the other more recognizable configurations of learning for engineers before asking them to venture into the more unfamiliar territory of ethics and philosophy: project-based, immersive learning. Engineers are usually comfortable working in teams and collaborating to solve complicated problems – relying on each other's expertise to fill knowledge gaps and bounce ideas. The classroom can be broken into small teams of 3 -5 students to encourage these skills and situate the game in a more comfortable structure. While this interactive lab idea has been framed with undergraduate students in mind, we encourage playful adaptation for other spaces[3].

[3] We hesitate to suggest this project for K-12 only, especially with the ongoing issue of "STEM deserts" that exist within the poorest schools in the United States [46]. Further, with the ongoing labor crisis and continuous denial of fair wages and adequate support for K-12 teachers [47], these activities would require additional time, effort, and energy that they cannot (and should not) give until these resources are made abundant.

The instructor can then present them a design brief. While this project will be presented in a format the students will be familiar with, we propose using a “Wicked Problem” as the project topic. Wicked problems are complex socio-technical problems that do not have clear definitions or solutions, with many different aspects and potential impacts of different solution approaches [48]. We recommend selecting a compatible text that covers the desired “Wicked Problem” from multiple angles or working with multiple texts that ‘slice’ [49] the problem from several perspectives: socio-economic, governance and policy, gender, race, history, geography, public health, lived-experiences. This will ensure students are able to see how different cross-sections and combinations of knowledge produce different ways of seeing and exploring a problem. Further, it will encourage engineers, who may not not have experience with many problem-solving tools beyond math, logic, and standards, to recognize the value of different types and kinds of knowledge coming from other places, peoples, and times. Ideally, it will be a case that can strongly exemplify that ”failure” looks and means different things depending upon the perspective one is adopting to examine it. For this example, we will make use of philosopher Robert Rosenberger’s excellent exploration of public artifacts in Callous Objects: Designs Against the Homeless (2017) [50].

Ideally, the students should not be primed for this project. They should be walked through the stages of the design process and asked to design for possible solutions at each stage, starting when the problem is introduced to them. Due to the nature of the problem, their attempted solutions will inevitably have drawbacks and complications and fall short of a true solution, but each time a solution fails, more is learned to approach the problem again. These iterative solutions are more than simply having more information at each stage, rather the problems outlined in each step intentionally set the students up for new kinds of failure. It is through this failure itself that they learn how to evaluate, iterate, and revalue to solve problems anew. Similarly to the rogue-like games outlined in the previous sections, with each ‘failure’ unlocking a new way of approaching the problem. For the case on Callous Objects, students can first be informed that their local area is looking to upgrade their bus infrastructure (hypothetically) and would like the design teams to create new concepts and designs for bus stops across the locality.

Once completed, the student groups can be informed with more ‘familiar’ types of data on the unhoused: demographics, statistics, cost, and additional data that city planning or urban development would find credible (the Housing and Urban Development (HUD) office can be a good resource here). The “client” (instructor) should then provide additional guidance that is sources from local ordinances, design guidelines, and best practices as possible. To use an example from Callous Objects: “If the bus stop is located in an area where there is a possibility of people using the seating for sleeping or loitering, the seat should be divided by an arm rest, planter or other form of divider so that the space is not long enough for someone to lay down on” [50] (ch. 4). The students should be encouraged to make adjustments to their design based on this additional demand from the client. The designs will likely be cruel, punitive, and uncomfortable. This is fine, even desirable, as these objects are precisely this in reality.

On round three, another slice should be presented. This might be an approach from STS or social sciences, history, lived-experiences and testimony, activist groups and nonprofits, or a combination of all of these elements. Starting with a history of sit/lie laws and ugly laws

[51], [52] might prove particularly helpful to ground the discussion in longstanding discrimination against disabled people and those deemed ‘unworthy’ or ‘unfit’ to be seen and the strategies for pushing them out of the public eye. Other examples could be introducing drivers becoming unhoused. Rosenberger introduces that domestic violence is considered a major cause of homelessness, and a disproportionate number of homeless youths (40%) identify as LGBTQ+. Race can also be analyzed, mental health, socio economic status, and disability are all relevant socio-political structures that can be ‘sliced’ and examined through this lens. Leaning into local expertise, laws, and policies here is strongly recommended to complicate the ‘simple’ solution the locality (hypothetically) has demanded and introduce students to local actors that approach unhoused in different ways.

Ask the students to design again. After this design stage a full class debrief can be useful. Students can be asked to reflect upon the process. Here, the ethical landscape can be described with a stronger background and awareness of the contexts being discussed. The instructor can focus on who benefited from various designs and who suffered and further attention can be paid to the way that the technology embodies and enforces certain dominant images and views of unhoused people into the technology. Utilizing Rosenberger’s example and analysis:

> …antisleep features make it difficult to sleep on a bench while at the same time easy to sit. And they do these two things all while making it easy to overlook this very effort to prevent the sleep usage. That is, these designs make it easy to overlook the politics of the bench. This combination of law and design can sometimes be so effective that it renders the entire problem of homelessness—and also the unhoused people themselves—invisible to others. This invisibility has the potential to lead the larger community to grow unaware of the problem or even to mistakenly assume that the problem is less severe than it actually is. ([50] Ch.4, para.6)

Troubling the existing ways of thinking about unhoused people, and how those ideas become baked into laws, policies, and designs, encourages students to engage with ethics beyond professional guidelines and cases and look to how these relational dynamics play out throughout sociotechnical assemblages. Further, it allows the instructor to show how these ways of seeing problems format certain community members as problems to be solved rather than human beings deserving of dignity, care, and concern: homelessness as a personal failing and homeless persons as problems that need to be removed, discouraged, or hidden away.

Instead, this approach pushes the responsibility for failing unhoused members of our community on the policymakers, designers, engineers, housed community, systems, institutions, and technologies that surround us. This exercise emphasizes that failure can be institutionally embedded and difficult to see as an engineer: morally failing our fellow humans and engaging in cruel designs that frame punishment and erasure as a solution. Without accounting for a variety of perspectives and critically examining the consequences, goals, and positions of the actors within the sociotechnical system, employers can set engineers up for failure. It is important to emphasize that clients may not always be acting ethically or making ethical requests, and it is important to look at the entirety of the moral landscape before engaging with a project. This is also a great moment to teach ‘whose ethics?’ and ‘whose power?’ Even if engineers attempt neutrality, to ‘not get involved’, they are making a political and ethical decision [53].

Consequently, embracing the value of failure can offer a critical pathway for solidarity and resistance, and a way to move forward to improved designs once a failure is encountered. After the conversation and debrief, the instructor can invite the students to make a design for a bus stop that fails what the city is asking for spectacularly and joyously. Fails to design a bus stop that is hostile to others. Fails to be complicit in a project and process that asks for cruelty and callousness to be baked into the objects we design. Technology can willingly help to challenge 'what is' with 'what might be' just as easily as it can reinforce them and carry water for inhumane policies and practices. Reimagine failure as an act of rebellion while using it as a tool for education.

Shortly after this lab session, returning to the topic featuring experts from other areas, local nonprofits, and activists can be a powerful way to concretize other ways of knowing and give students practice of talking with and learning from non-engineers. Bringing these folks into the classroom also does important work of signaling that their ways of knowing are equally valuable and valid as those grounded in positivism. Further, demonstrating the potential for engineers to ally themselves with their communities can help model pathways for using fantastic failure to empower marginalized community members and challenge unethical systems while articulating the specific ways that "successful" projects, as defined by the employer, can fail to uphold human dignity, care, and compassion.

While approaches aligned with critical, community-focused ethics education in engineering is becoming more well known, it has not yet become a paradigm in teaching practices or approaches [12], [4]. As Donna Riley notes within her interview with B.R. Cohen on "Engineering, Ethics, and Social Justice", "There's a lot of people who, over time, over history, have tried to broaden that set of people whom engineers serve, and who have tried to democratize engineering, or democratize decision-making about technology. That effort is not yet finished. In fact, we have a lot of work to do before we will see a truly broad-based movement that can realize a vision of engineering by, with, and for communities, with social justice at the center" [54]. Further, while there are several experiences in STEM that attempt to use Wicked Problems as a framework to teach students the ethical or societal dimensions of design and engineering, they often omit the ambivalent, complicated, and contradictory features of Wicked problems that make them ethically dynamic [55]. The project outlined above complicates notions of failure and success, re-centering on the Wickedness of these problems, when we set students up to fail intentionally, or we ask them to fail spectacularly. The precise value of using Wicked Problems for engineering ethics is because there is not a single, right answer or right approach. However, that does not mean that the only course of action in that case is to do nothing.

IX. Complementary Pedagogical Strategy for Failing

So, how do we encourage engineers to navigate Wicked problems, despite, and perhaps even *in spite*, of these problems seemingly impossible complexity and overwhelming nature? Further, how do we encourage them to rely on ethical frameworks and values, like care, compassion, and solidarity, to do so?

As outlined at the start of the analysis, “weed out” courses in engineering are a toxic pedagogical strategy based on punishment and resilience mindsets that are not conducive to creativity, exploration, and curiosity.[4] All of these values are necessary to encourage students to take intellectual risks and explore new ways of thinking– particularly ways of thinking grounded in philosophy and ethics, which are often unfamiliar ways of engaging with the world for engineering students.

Importantly, even if the students have not encountered a design and/or ethics specific weed out course, student testimony suggests that the anxiety, stress, and fear that students experience in weed out courses remains with them throughout their academic journey [57], [58]. In our experience with mentorship and teaching, students bring these stories, experiences, and emotions with them. Even if these students survive the course, these experiences seemingly haunt them and influence how they approach new ideas and failure in other class environments. In order to begin the careful and caring work of undoing the harm caused by these pedagogical approaches, classrooms must be co-configured to support and empower students to take epistemic risks. The system of success and failure implemented in the classroom co-creates the approaches and willingness of students to find joy and knowledge through failure, as game mechanics and constraints encourage players to do the same. Returning to Ruberg’s understanding of playing games queerly as to “play the wrong way around… It is a playful art, a ludic art, which makes a game of dying” [29], we acknowledge that this can also be an approach to innovation. We only create new things and enact new ideas by trying over and over, while learning when each new idea fails. For students to make less mistakes IRL (in real life), our teaching approaches must support failure as a mechanism of learning.

The pedagogy approach that corresponds with these classroom values and aims is grounded in the critical pedagogy approach of contract grading. Specifically, Ellen C. Carillo’s work on engagement-based grading contracts [59]. Contract based grading often assures each student in the course from the start that so long as they come to class consistently, participate in some form (collective notes, emails, discussion boards, interacting in class), and submit all assignments with consideration, they will receive a ‘B’ – regardless of the feedback on an assignment or reflection. For students who consistently improve on their work, take risks and attempt concepts from the class, and show personal growth from the start to the end of the course in their reflections and way of thinking through the assignments, they will receive an ‘A’.

In this sense, students are encouraged to explore different approaches and perspectives without feeling pressured that failing to understand or apply a concept perfectly the first time it is requested will result in them failing the course or receiving a grade that might jeopardize

[4]Further, as noted above but well worth repeating, these courses really only *succeed* in weeding out underrepresented people in STEM, including people of color, women, queer folks, disabled folks, first-gen students, and students dealing with crisis [56]. They do *not* necessarily succeed in weeding out folks who are ”bad” engineers, ”bad” at engineering, or make ”bad” ethical decisions.

their GPA requirements through scholarships, loans, and other sources of funding[5]. It also helps signal to them that failure, when done within the bounds of a safety net (prototyping, play, experimentation, testing), can be accompanied with valuable critique that does not reflect upon them personally (a good engineer, a bad engineer) but offer guidance in the iterative process of creating, and failing, together. This can encourage engineers, and any other course participants, to learn how to solicit, engage with, and incorporate criticism from a variety of actors in the design process. Additionally, it allows the instructor to grade assignments honestly and accurately with feedback to help students track their performance without necessarily failing the course overall. For example, if a writing assignment seems rushed and fails to engage with class assignments, we can rate the assignment poorly and provide feedback remarking upon resources or pathways for improvement. In the next assignment or revision, if this feedback has been considered and attempted, that would contribute towards earning an A, even if the revision only receives a 70 or 75 ranking with other problems (no citations, misquotes, etc.). Such an approach will be essential in an ethics class centered around the process of failure, but we encourage its implementation in other classes as well.

Carillo's approach of engagement-based contract grading centers offering neurodivergent people flexible ways of engaging in the classroom space, which benefits the entire class by encouraging a wider variety of ways to demonstrate learning and exploration utilizing course content (reflections, essays, presentations, podcasts, designs, models, projects, etc.). This style, often described as 'Choose your Own Adventure', allows the students to engage in projects and work that is meaningful for them and still succeed in demonstrating knowledge gained from the classroom. As we can learn from the videogame *Hades*, when the player tries and fails, they are given a choice of new combinations of weapons, powers, and abilities that can lead to success the round of play. Even if this attempt fails too, as all attempts that fall short of perfection do (as measured by traditional engineering approaches), the player will have learned and can improve for the next time, both learning from the experience directly and understanding better the patterns of the game.

X. Conclusion

When considering engineering education, it is tempting to follow the same patterns and procedures that have always been used to educate students from year to year. Within engineering ethics, the pervasiveness of the 'rules and codes' approach can reveal a desire to treat all problems as logical, mathematical, and physical problems, like so many academic engineering problems are designed to be. When moving into the world outside of the academy, engineers find a need for more tools, a way to understand and progress when the direct approaches that they have learned in the academy fail. In this paper, we have presented video games and how they can be interpreted, queerly, to reimagine failure as a new approach to teaching engineering ethics. In doing so, we highlight a common failure in engineering education: failing to

[5]While we acknowledge that the use of weed out classes for design or ethics are not well documented in the literature, that does not indicate that these pedagogical approaches do not happen in these spaces. Further, it is important to distinguish that there are some classes that are designed as weed out courses where only certain numbers of As, Bs, or Cs, are distributed. There are other courses that are considered to be 'weed out' courses because they are grounded in poor pedagogical practices, self-sufficiency, and 'sink or swim' approaches. Design courses and ethics courses can both be taught in these ways.

teach student engineers how to solve problems they face that fall neatly within the bounds of rules and codes and how to embrace and respond to failure. Just as we propose teaching the students, however, we can use this shortcoming as an opportunity to learn and improve. By encouraging students to embrace and navigate failure in a way that is fun, collaborative, and creative, we can empower them to fail fantastically with others and find delight in the process of improvement, not merely the perfect outcome. Will this suggested approach to teach engineering ethics fail as well? Will we see those dreaded yet satisfying words 'Game Over' once more? Most certainly. But we will take one step forward, embrace the opportunity to create anew, and reimagine failure as a delightful journey to cultivating ethics in engineering.

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