The Power of Playful Learning - Ethical Decision-Making in a Narrative-Driven, Fictional, Choose-Your-Own Adventure [Work In Progress]

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Abstract
We contend a better way to teach ethics to freshman engineering students would be to address engineering ethics not solely in the abstract of philosophy or moral development, but as situated in the everyday decisions of engineers. Since everyday decisions are not typically a part of university courses, our approach in large lecture classes is to simulate engineering decision-making situations using the role-playing mechanic and narrative structure of a fictional choose-your-own-adventure. Drawing on the contemporary learning theory of situated learning [1], [2], such playful learning may enable instructors to create assignments that induce students to break free of the typical student mindset of finding the "right" answer.

Mars: An Ethical Expedition! is an interactive, 12 week, narrative game about the colonization of Mars by various engineering specialists. Students take on the role of a head engineer and are presented with situations that require high-stakes decision-making. Various game mechanics induce students to act as they would on-the-fly, within a real engineering project context, using personal reasoning and richly context-dependent justifications, rather than simply right/wrong answers. Each segment of the game is presented in audio and text that ends with a binary decision that determines what will happen next in the story. Historically, this game had been led by an instructor and played weekly, as a whole-class assignment, completed at the beginning of class. The class votes and the majority option is presented next. In addition to the central decision, there are also follow-up questions at the end of each week that provoke deeper analysis of the situation and reflection on the ethical principles involved.

This prototype was initially developed within a learning management system, then supported by the *Twine*™ game engine, and studied in use in our 2021 NSF EETHICS grant. In 2022-23 the game was redesigned and extended using the *Godot*™ game engine. In addition to streamlining the gameplay loop and reducing the set-up and data management required by instructors, this redesign supported instructors with an option to allow the game to be student-paced and played by individual students or to keep the instructor-led 12 week whole-class playstyle.

Our proposed driving research question is "In what ways does individual student play differ from whole class instructor-led play with regard to learning that ethical behavior is situated?" In the next phase of our ongoing investigation, we plan to further evaluate the use of playful assessment to estimate its validity and reliability in comparison to current best practices of engineering ethics assessment.

Introduction

As technology advances, future engineers may be faced with increasingly complex ethical dilemmas, and current undergraduate engineering courses must prepare engineers to deal with these complexities. Issues of how to program the judgment of self-driving cars and the issues of how to protect individual privacy while advancing AI and machine learning algorithms are among the current list of such ethical issues. Central to the preparation of the next generation of engineers is instruction that goes beyond simple rote knowledge of codes of ethics, but instead

challenges undergraduate engineering students to wrestle with the complexities of realistic situations in which rules and guidelines are at odds with higher ethical goals. This leaves engineering faculty with the question of how best to prepare engineers to both understand the ethical dimensions of their work and to be ethical actors. While one approach to the ethics education of engineers involves separate courses in philosophy of ethical decision making, we contend a better way to teach ethics to first-year engineering students might be to situate it in the everyday decisions of engineers as they do their work in realistic scenarios while considering the personal and social consequences of their decisions by role-playing.

Richly contextualized cases have been used to supplement the more purely philosophical approaches to engineering ethics education, but are often presented as third-person narratives rather than as active first-person role-playing scenarios. Educational games have been shown to be an effective teaching tool for complex subjects that introduce more active first-person decision making into the curriculum. Educational games provide a unique and social learning environment that can be engaging and interactive for some learners, allowing players to learn through exploration and discovery [3]. Drawing on the contemporary learning theory of situated learning [1], [2], such playful learning may aid instructors in creating assignments that enable students to break free of the typical student mindset of finding the "right" answer and engage in authentic consideration of how they might act ethically or make trade-offs in ethical goals.

Undergraduate engineering students need to begin to develop a sense of the complexity of their careers that includes social and interpersonal issues beyond their technical content. As such, ethics education plays a crucial role in engineering licensure. The Accreditation Board for Engineering and Technology (ABET) requirements in 2022-2023 require that students have: "an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts" [4].

Engineers are responsible for designing and building structures, systems, and products that are safe and effective, and they must do so in a manner that is ethical and responsible [5]. As a result, engineering licensure boards require applicants to demonstrate a thorough understanding of ethical principles and practices, and to demonstrate their ability to apply these principles in real-world engineering scenarios [4], but not necessarily demonstrate that they can and will act ethically.

Ethics education is also important for ensuring that engineers are able to make sound decisions that prioritize the safety and well-being of the public [5]. Engineers must be able to recognize and address ethical dilemmas that may arise in their work, and to make and act on decisions that are consistent with the ethical principles of their profession. Through ethics education, engineers can develop the skills and knowledge necessary to make responsible and ethical decisions throughout their careers.

The Engineering Ethics Reasoning Instrument (EERI) is a standardized assessment tool designed to evaluate engineering students' ethical reasoning skills. The EERI was developed by a team at Purdue and is based on the NSPE Code of Ethics for Engineers [6], [5].

The EERI consists of a series of ethical dilemmas that assess students' understanding of ethical principles and their ability to apply these principles to real-world situations. The questions are based on actual case studies and are designed to reflect the types of ethical dilemmas that engineers may encounter in practice. The EERI was developed as a tool for engineering ethics researchers to gain a snapshot into engineering students' moral reasoning abilities. It was structured similarly to the DIT-2, but situated in engineering [6], [7]. The EERI quantifies students' moral reasoning by using frameworks for moral decision-making similar to Kohlberg's theory of moral development [8].

Kohlberg [8] proposed that individuals' moral reasoning abilities develop and evolve over time in a series of stages. According to this theory, moral development is influenced by a combination of biological and social factors and is characterized by increasing levels of abstraction and complexity.

Kohlberg's theory identified six stages of moral development, which are organized into three levels: pre-conventional, conventional, and post-conventional. The pre-conventional level is characterized by an emphasis on self-interest and a focus on external rewards and punishments. The conventional level is marked by a concern for social norms and expectations. And the post-conventional level is characterized by a focus on abstract principles and values.
At the pre-conventional level, the first two stages of moral development are focused on the individual's own needs and desires. In the first stage, the individual is motivated by the avoidance of punishment and the pursuit of immediate rewards. In the second stage, the individual begins to consider the expectations and approval of others, but still primarily focuses on their own interests. The third and fourth stages make up the conventional level of moral development and involve a greater concern for social norms and expectations. In the third stage, the individual begins to value the approval of others and conform to social norms in order to gain acceptance and avoid social disapproval. In the fourth stage, the individual develops a sense of responsibility to others and begins to value the importance of maintaining social order and upholding the law. At the post-conventional level, the fifth and sixth stages of moral development involve a shift towards more abstract and universal principles. The individual begins to recognize the value of individual rights and the importance of respecting the autonomy of others in the fifth stage. And lastly, in the sixth stage, the individual develops a sense of universal ethical principles and values, and is able to make moral judgments based on these principles, regardless of social norms or laws [8].

Literature Review

We have used the EERI as a pre- and posttest to assess where students are in terms of their moral development and to identify how innovative game-based educational practices could be used to better support all engineering students in the development of their ethical reasoning skills. For example, if at the start of their first year many students' responses on the EERI indicate that they are at the pre-conventional level of moral development, this may suggest that our engineering students are primarily motivated by self-interest and external rewards and punishments [8]. In this case, an ethics education program may focus on helping students move beyond this stage and develop a greater concern for social norms and expectations. If students' responses on the EERI indicate that they are at the post-conventional level of moral development, this may suggest that they are able to make moral judgments based on abstract principles and values [8]. In this case,

an ethics education program may focus on helping students to deepen their understanding of these principles and apply them in a variety of different contexts.

To assess our current ethics education curriculum, we used the EERI as a pre-test and a post-test. The pre-test was intended to assess students' baseline knowledge and understanding of ethical principles, while the post-test was administered after students completed an ethics education program. We used the EERI to assess students' growth in engineering ethics understanding at both the course and program level to evaluate the ethics interventions' effectiveness. Preliminary data suggest students' ethical reasoning abilities (as measured by the EERI) do not change much over either the length of a course (one semester) or an entire four-year undergraduate program. This suggests either our ethics curriculum is entirely ineffective and students truly have not developed their moral reasoning skills throughout our program or the EERI was unable to capture the growth that we suspect is happening in their situated understanding and ability to reason and take first-person action in authentic situations.

The development of this narrative ethics game is, in part, a response to our concerns that the EERI was not optimized to measure the near and far term transfer from ethics interventions on students' ethical decision-making. Our students have consistently scored high on the EERI, which seems to suggest even first-year engineering students possess an abstract understanding of moral reasoning at the post-conventional level [8]. In response, we hypothesized that the EERI might not be for purposes of assessing classroom interventions. There is a difference between the knowledge of what should be done in an ethical dilemma (third person knowledge) and what one would actually do (first person action) in a particular situation. The emerging field of behavioral ethics examines the behavior of people in the face of ethical dilemmas [9]. When people recognize an explicit ethical dilemma, they are able to make decisions that follow their ethical code, but in time-constrained real life, people often act on-the-fly in ways contrary to their abstract ethical beliefs [9]. Knowledge of ethics is not the same as acting ethically. The EERI may be measuring students' ethical knowledge, but may not be capturing what they would actually do when presented with a similar ethical dilemma in real life. Students may not have fully internalized the ethical principles and values that they have been taught. While they may be able to provide answers on the EERI that suggest high moral-reasoning abilities, they may not have a deep understanding of why these answers are considered ethical and may not actually represent what students would really do in any given scenario. Their answers might also reflect a social desirability bias in that students may select responses that they think researchers would want them to select, rather than what they would actually select. To address this dilemma, our team began developing a highly-contextualized narrative in which students must act in-the-moment to progress the choose-your-own-adventure story.

The use of educational games has become a popular approach for teaching complex concepts [10]. Educational narrative games, in particular, have been gaining attention as a way to engage players in discussions through interactive storytelling. Educational narrative games incorporate elements of storytelling and character development and are designed to educate individual or social groups of players through the use of an immersive and interactive story. The narrative provides context and meaning to the learning experience, allowing players to engage with the subject matter on a deeper level and make connections between the game and real-life situations. These games have the potential to be a valuable tool for educators. Games can provide a rich and

engaging learning environment, allowing players to explore complex ideas and learn through experience.

However, not all educational games are equally effective at engaging players and promoting learning. The design and implementation of the game are important factors in determining its educational effectiveness. Games with a strong narrative and well-developed characters are more likely to engage players and support learning [3].

Mars: An Ethical Expedition! (*Mars!*) is an interactive, 12-week, narrative game about the human settlement of Mars. Students take on the role of a head engineer and are presented with situations that involve high-stakes decision-making. In the second episode, players discover a plot to undermine the progress of the emerging Mars settlement. A bridge necessary for transporting supplies from the northern to the southern colony is discovered to be sabotaged. Players begin an investigation to discover the culprit. As they move through their investigation, players encounter characters and situations in which they are required to make ethical decisions and select various actions to take. For example, when the player's assistant, Jonathan, is bitten by a suspicious animal and is trapped in an airlock with it, the player must decide whether to go against regulations and try to get Jonathan to the medical bay or to keep Jonathan in the airlock with the biting animal for the mandatory quarantine period. Various game mechanics induce students to choose how they would act on-the-fly within a real engineering project context, using personal reasoning and richly context-dependent justifications, rather than simply presenting right or wrong answers to be considered abstractly. Each segment of the game ends with a binary decision that determines what will happen next in the story and ultimately which of several conclusions the story will have.

While the EERI and *Mars!* have disparate goals, they do share certain ethical frameworks and variables of interest. Both the EERI and *Mars!* use scenarios designed to initiate ethical decision-making. However, the EERI presents six short separate scenarios with little contextualization, while *Mars!* presents 12 scenarios, woven together in a choose-your-own-adventure style narrative with rich character development and back story. While the scenarios in the EERI and *Mars!* are not identical, they cover many of the same types of ethical dilemmas that engineering students might be required to address in their future careers. For example, in one scenario of the EERI students must decide if they should report a factory for polluting a nearby creek. The factory employs many local workers and may need to layoff employees if they are fined for the pollution, potentially devastating the local economy. In the *Mars!* adventure, players must decide where a new water purification plant should go relative to the colony. Through dialogue, the players discover the desperate need for a new water purification plant. The players decide between building the plant far from the colony (which would make water transportation and plant upkeep more time-consuming and costly), near the waste facility (which is much closer to the colony, but risks contamination of the water supply), or not to build the plant at all, as there is no current authorization for a new plant.

In previous versions of *Mars!,* students were approximately equally as likely to break the rules (disregard engineering guidelines laid out in the scenario) in the EERI and the third scenario of *Mars!* As students continue through the game, however, they become increasingly likely to break

the rules. At the tenth week of *Mars!*, 67% of students choose actions that break the rules and do not follow engineering guidelines (see Figure 1).

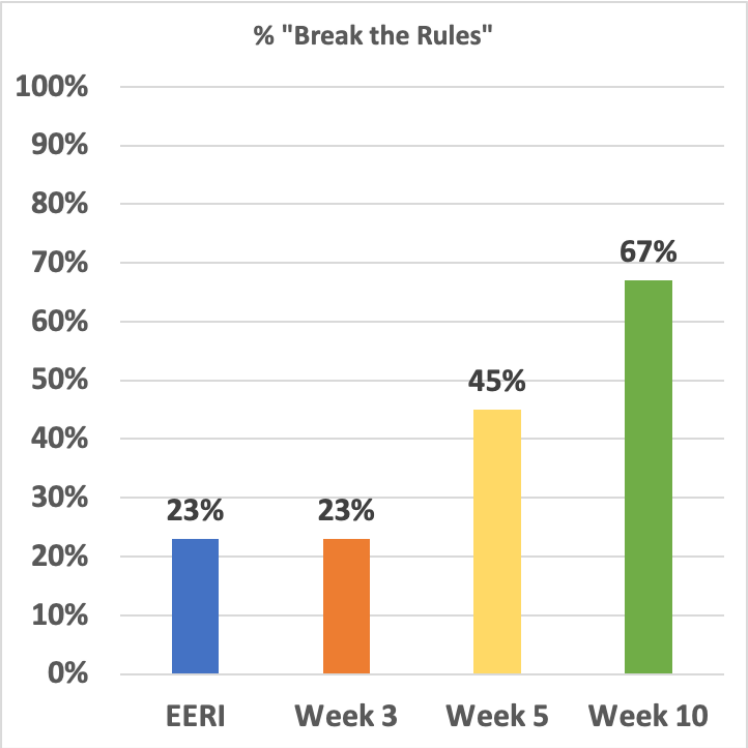

Figure 1 - Comparison of EERI and *Mars!*: Percentage of Students who Break the Rules [11]

Even when students are prepared in activities designed to enhance their ethical decision-making, prospective engineers regress to breaking the ethical rules while playing *Mars!*. For example, in episode 10, players discover one of their subordinates is pregnant, which is strictly against the rules of the settlement and in violation of astronaut agreements for being sent to Mars. Players must decide between breaking the rules to help their subordinate or follow the rules and immediately send her back to Earth, a space flight that might endanger her pregnancy. This is the episode in which the research team observed students break the rules and help their subordinate 67% of the time [11]. There seems to be a correlation between how contextualized a scenario is and how likely students are to break the rules.

Theoretical Framework

Mars! An Ethical Expedition was developed using the framework of situated cognition as a theoretical foundation. Situated cognition [1] is a theory that emphasizes the role of context and experience in shaping cognition and learning. It posits learning is a function of the whole body (not just the brain) interacting with the social and cultural environment [2]. Situated cognition can be used to understand students' decisions while playing the game and how these decisions are influenced by the virtual environment created by game's design and implementation [12].

From the situated cognition framework, ethical decisions are co-determined by the goals of the engineers (in this case for playing the game and completing the story) and information available in The *Mars!* narrative and characters. Engagement with a rich narrative and characters may also

draw players into scenarios and keep them motivated to continue playing and make more authentic choices, at least compared to a typical case study presentation. On the other hand, a poorly designed game with weak narrative and uninteresting characters may not be able to engage players and may cause them to display an inauthentic decision-making process. Poorly designed games reduce player engagement with the story and may not provide the level of detailed contextualization needed to induce a realistic ethical decision-making process reflective of the choices they would make in real life.

The individual, social, and cultural context in which the game is played may also influence players' experiences and motivations [2]. If the game is played in a classroom setting, the instructor's facilitation and guidance may impact how players engage with the game and what they take away from it. If the game is played in a more informal setting, such as at home with friends, the social dynamics among the players may also shape their experiences and motivations.

Additionally, *Mars!* was designed to provide students with the opportunity to role-play a more central position in an engineering community, managing teams and directing centers that are beyond the reach of first-year college student. The EERI often uses scenarios in which students must decide whether or not to report a situation to a professor or team-lead. They take on a role at the periphery of the engineering profession. Students, interns or other early-career engineers are more likely to only need to report ethics issues up the chain of command. By placing players' in the shoes of a head engineer in *Mars!*, they take a central role that requires them to be responsible for large-scale ethical decision-making. Through a situated cognition lens, *Mars!* attempts to move players from the periphery to a more central participation, enabling them to make the types of decisions they may be required to make throughout their careers.

Situated cognition provides a useful foundation for building interactive narrative ethics games. By considering the role of the game's design and implementation, as well as the social and cultural context in which the game is played, this framework can help to shed light on the factors that influence player motivation and the educational value of these games.

Previous Implementations

Mars! An Ethical Expedition has been an ongoing project since 2018. Following the iterative design suggested in the ADDIE model [13], after each implementation, the game has been evaluated and continuously improved.

During the 2017-2018 Academic Year the initial narrative was developed and implemented in an instructor-led format. A teaching assistant read the game scenarios aloud each week to a large lecture class of freshman engineering students. The students then individually voted for scenario options via a *Qualtrics*™ survey form. The most frequently selected answer was taken as the class response that determined the branch in the narrative. For the next two years, the narrative was refined to provide as richly contextual scenarios as possible.

In the original format individual students did not get to hear the result of their personal choice if it differed from the majority's decision. During the 2020-2021 school year *Mars!* was rewritten in the text-based game engine *Twine*™. While players could now explore the branching narrative

of *Mars!* on an individual basis, researchers were unable to collect log files of student responses to scenario questions directly through the *Twine*™ game, which necessitated the use of *Qualtrics*™ surveys again. Additionally, while *Twine*™ allows for audio to be played, the user interface and programming language are ineffective for full-audio radio-show style games. For all these reasons, the *Twine*™ version of *Mars!* was never fully implemented with students.

In order to increase immersion within the game scenario and to contend with the switch to an online class structure necessitated by COVID-19, during the 2021-2022 school year our design team recorded audio files of each scenario and presented them as a "radio show" weekly on their class learning management system. Each character was attributed a unique voice and sound effects and music were added to further immerse the player. After listening to each episode, students responded to scenario questions via a *Qualtrics*™ survey. Again, faculty compiled whole-class data and determined which scenario to include the following week. This required quite a bit of instructor management, which faculty implementers at other institutions found overly time consuming. Additionally, students were still not exploring the branching narrative of *Mars!* on an individual level and again were not able to experience the branch they picked if it differed from the class majority's decision.

Current Implementation

In order to allow for the additional contextualization of voice acted narrative, exploration of the branching narratives at the individual level, and seamless collection of log file data of individual player responses, in 2022-23 *Mars! An Ethical Expedition* was rebuilt in the game engine *Godot*™. Previously recorded voice acted audio scenarios were built into the game and players answered scenario questions directly in the game. There was no longer a need for instructors to analyze player data weekly to select which audio file to play the following week. Students entered an individualized code to begin their playthrough independently. Instructors had access to a key that matched student names with their game codes. When a student completed a weekly episode, students' decisions and timestamps were sent directly to the instructor in a spreadsheet.

The switch to digital game development through *Godot*™ also allowed for a more robust application of Universal Design for Learning (UDL) [14]. Instead of retroactively providing specific accommodations for individual students, *Mars!* is being designed to be universally accessible for all students. The three pillars of UDL include providing multiple means of engagement, representation, and action & expression [14]. This version of *Mars!* addresses the UDL engagement pillar in a number of ways. First, by optimizing individual choice and autonomy through the choose-your-own adventure narrative. Second, the narrative is designed to invoke relevant, valuable, and authentic decision-making. Third, the stakes of the game are low, which minimizes threats to students and provides a safe environment in which students can take academic risks. Fourth, the game sends student game log file data directly to the instructor, allowing the instructor to provide frequent, timely and specific feedback. And finally, the game has a number of free-response questions allowing students to develop self-assess and reflect on their experience. The UDL representation pillar is addressed in several ways, as well. First, by offering alternatives for the auditory information in the form of provided scripts. Second, the syntax and structure of the game is clarified via a document of thorough instructions for accessing and playing the game which is provided to each student. Third, information processing and visualization is enhanced by allowing the game to be chunked into smaller chapters.

Students playing individually can play at their own pace and when it is most convenient. Fourth, information in the game is progressively released. Characters and environments are introduced throughout the narrative instead of frontloading and overwhelming students with too much information at the beginning of the story. Finally, the game was streamlined to only include relevant contextual information and sound effects. Any unnecessary narrative or context was removed if it was deemed unessential to the goal of assessing students' behavioral ethical decision-making. The current 2023 version of *Mars!* addresses the UDL action & expression pillar as the game works with either a mouse and keyboard or it can be played entirely on a keyboard, allowing multiple means of accessing the content. While the current game design of *Mars!* addresses many of the guidelines outlined by UDL, there is still room for improvement in future versions (see Future Design Plans section for more information).

The alpha version was rolled out to 384 freshmen engineering students in January 2023 to two sections of a Foundations in Engineering course at a public R1 university. Most engineering undergraduate disciplines were represented in the sample with the exception of computer science. One section of 188 undergraduates was conducted as whole class play, similar to previous implementations of *Mars!* In the whole class version of play, the instructor played the *Godot*™ version of *Mars!* on the classroom computer with a projector. Weekly, students were given a few minutes to discuss the scenario before answering a *Qualtrics*™ survey with scenario questions. After class, the instructor analyzed the surveys and chose the answer given by a majority of students. The instructor used the "teacher-led" version of the game with built-in keyboard shortcuts to skip through the audio files and delete player data. No individual students had access to *Mars!* in the whole class section. In the other section of 196 undergraduates, students played *Mars!* individually. Each student downloaded either the Mac or Windows version of the *Godot*™ version of *Mars!*. Students were instructed to play one episode of the game outside of class each week for 13 weeks (only interrupted by Spring break).

The current rollout has had a few minor bugs and updates to be addressed in future versions of the game. One student requested closed captions for the game, which we were unable to implement before the start of this semester. Students were provided a full transcript of the audio files instead. Pacing seemed to be a bit of an issue for students in the individual play section. Contrary to the instructions to proceed one episode per week, several students completed the game within the first couple weeks of class instead of playing one episode per week as instructed. Another group of students did not log in to complete any of the game. Additionally, we identified a few bugs in the programming that are scheduled to be fixed for future iterations. As a backup for students with limited personal computer access, an option to play *Mars!* on computers in the engineering lab was provided.

Future Evaluation Plans

Much of the current data collection process had been dedicated to game design testing and software debugging. The data collected over the Spring of 2023 will aid in improving the technical and narrative design of *Mars! Version 2.0*. In the future there are several methodological paths we are interested in exploring. As transferring *Mars!* to a digital platform has allowed for individual student play, we are particularly interested in exploring the ways individual student play differs from whole class instructor-led play with regard to learning that

ethical behavior is situated. Ethics is socially constructed, and as such, we hypothesize that there will be a significant difference in response data between the individual and group-play.

Additionally, the pattern of students' ethical decision-making we've observed suggests either students are more likely to break rules when presented with more contextualized scenarios or *Mars!* does not accurately reflect players' decision-making because their motivation in the game leads them to make decisions other than what they would actually do in that situation. For example, some students might choose to pick the funniest solutions or the solutions that they believe would hurt the colony the most, just to see what happens in the narrative. In order to determine the value-added of *Mars!* in an undergraduate engineering program, we must first determine why players are more likely to break the rules in *Mars!* by exploring players' motivations and reasoning while playing the game. Player motivation could be assessed through think-aloud sessions with researchers acting as a proxy to submit students' responses only when the student has sufficiently explained their thought process. Player motivation could also be explored via interview sessions or surveys once players have completed the game.

While we are currently focused on developing *Mars!* as an assessment tool for first-year students' current behavioral ethical reasoning abilities, further research might involve a more in-depth dive into individual ethical frameworks. Once the game format is finalized, it could be administered to teams of students, with each team member answering narrative decisions within the context of a specific ethical framework. Discussions following gameplay could allow students to see the similarities and differences of each ethical framework in the divergence of the narrative.

Future Design Plans

The UDL framework [14] will continue to be part of the design process to ensure maximum accessibility in future iterations of *Mars!* as well. To provide further means of engagement, additional opportunities for self-assessment and reflection will be built into the game. The narrative will be tweaked to maximize individual or social collaborative choice and to provide additional endings beyond the several already built into the game. Once the final dialogue and narrative branches are complete, professional voice actors will be used to further engage players with improved game quality. In alignment with providing multiple means of representation, all audio files will include closed-captions. Currently, students requesting closed-captions are provided with a hard copy of the game transcript. Art assets will be incorporated to give visual feedback of game progression to students. Portrait art will be implemented to help anchor students' relationships with characters and locations in the game. A visual queue will be created to signal to players to turn on audio. There have been several instances of students not sure the game is running because they did not realize the story takes place via audio-only stories. The game's user interface will be evaluated for accessibility including the size, color, and choice of font and the color of the buttons, background, and art. Ideally, an options menu will be available at the beginning of the game for players to manipulate accessibility settings like font size and color, game color and brightness, and speed of audio and captions. Given additional funding and time, captions and/or voice-acting will be provided in multiple languages. To provide multiple means of action & expression, the game will be optimized to work seamlessly with alternate keyboards and touch screens. With enough time, the game could also be programmed to include an option for students to provide audio recordings instead of typing responses to reflections that

require long form answers. We are confident by providing these changes to *Mars!* we will be able to meet the needs of as many students as possible.

Future design changes for potential research avenues include aligning the situations in *Mars!* more directly with the scenarios provided in the EERI for better comparison across assessments. Additionally, the environment and character backstories in the game could be altered to see how players' decisions are impacted by additional context. We are also interested in exploring outcomes for students playing in one-shot vs. students playing one episode per week.

Conclusion

Engineering students must be prepared to face complex ethical dilemmas in their future careers. It is vital that engineering preparation programs go beyond simply teaching about the code of ethics. Case studies are useful for presenting the types of ethical issues that can arrive in authentic and complex settings for career engineers. Yet case studies are generally presented about other people from a third person perspective, where first-year engineers are watching the case and judging the ethics of the case engineers. In contrast, gameplay experiences like *Mars!* can create a first-person perspective in which freshman engineers are immersed in ethical decision making and must propose courses of action in realistic contexts. *Mars! An Ethical Expedition* offers a unique and playful way for students to make ethical decisions in richly contextualized scenarios that include complex personal relationships with non-player characters as well as facts that might go beyond the operational rules and situations referenced by any code of ethics. Rooted in situated cognition, educational narrative games like *Mars!* can help students break free from the traditional mindset of finding the "right answer" that simply follows the rules and engage in a more authentic consideration of ethical decision making as complex, personal, and social. Studies on the effectiveness of games like *Mars!* as teaching or assessment tools might supplement engineering ethics assessments like the EERI with engaging and immersive experiences that activate authentic complex ethical decision making in context using an interactive first-person game narrative.

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Appendix A: *Mars! An Ethical Expedition* Example Scenarios
Week 2: Unstable

You're jolted awake as the Mars rover comes to a rough stop. Up ahead, you see the large suspension bridge. It stands tall connecting the two hemispheres with long taut cables. The Canyon Bridge is an engineering marvel that spanned the width of Valles Marineris, the Grand Canyon of Mars. It is also a crucial roadway for a caravan of rovers from the Northern Hemisphere Colony to bring supplies to the south. The bridge looks fine, but you approach it cautiously. If someone wanted to isolate the base, they wouldn't have stopped at the radio. There!

You exit the vehicle and wander over to the spot where the bridge cables are anchored. Upon closer inspection, you notice some of the cables aren't frayed, they've been cut.

Now, the bridge has been designed with several redundant measures put in place, but as you check up on each of them, you realize that all have been tampered with. The bridge still stands, but you're not sure if it could support a live load safely. Only you and the people that came with you know of this serious predicament. It seems the Southern Colony will be on its own for a time.

You weigh your options - you need to act fast!

This blatant act of sabotage could hamper your plans, couldn't it? You were sent to the southern colony in order to make it self-sufficient. It currently relies on the northern colony too much, and that's caused a few headaches in the past. If you continue working on your project, like you were assigned to do, then the sabotage might not be as dangerous as it initially seems.

Alternatively, you could ignore your work and try to re-establish communication with the other colony. This course of action would probably help the most number of people. It would put the southern colony at ease, it would also prevent the northern colony from crossing the unstable bridge. As the current head of the colony, shouldn't you look out for everyone?

Although, even if the majority are helped, someone did this on purpose, and ignoring the sabotage could be dangerous. They can not be allowed to get away with this. That brings you to your final choice: investigate the sabotage to find out who or what is behind it. If you ignore the sabotage, then what else would you ignore during your time as head of the colony? It sets a bad precedent and could lead to chaos throughout the colony.

Questions:
What course of action do you plan to do next?
[[Attempt to re establish communication as soon as possible -> W2-1]]
[[Initiate colony self sustainability efforts->W2-2]]
[[Investigate the sabotage to figure out who or what is behind it->W2-3]]

Is it important to tell everyone onboard the colony about this predicament? Or should you keep it known among only a few of the colony leaders?

1. Tell everyone publicly
2. Tell only the other colony leaders
3. Tell no one else
4. Tell a few friends that you trust

The leader of the colony (you) should take the blame for the event.

1. Strongly Agree
2. Slightly Agree

3. Slightly Disagree
4. Strongly Disagree

The leader of the colony (you) should be responsible for fixing this predicament.

1. Strongly Agree
2. Slightly Agree
3. Slightly Disagree
4. Strongly Disagree

W2-1 Radio: You plan to establish communication with the Northern colony as soon as possible. You first decide to check in with your radio operator, Marshall. Apparently, they are working hard to restore the long range radio, but it could take some time. He assures you that his team, along with the electrical engineers, believe that they could have everything fixed in a few weeks. You believe him and consider the radio issue taken care of.With your spare time, you decide to ask around, and see what the other engineering departments might know of the situation.
[[Week 3: Investigation]]

W2-2 Self-sustainability: You decide to focus on your main mission: self-sustainability advancements. You figure that this is what the higher ups asked of you and you should do it as soon as possible. Fixing bridges and radios isn't in your field of study anyways. Your first step is to check on the botany department. They have been looking for ways to genetically modify plants so that they could survive on Mars. You walk down the hall looking for the botany department when you catch the lead researcher in the hallway. They tell you that they currently have enough seedlings of various species to be able to comfortably produce enough food for the colony. They also mention that there is a greenhouse on the southern side of the colony that is currently under construction. It should be operational in a week or so, but they lack some of the necessary soil for their plants. They usually get it in the supply caravan from the Northern Colony. With the bridge out, it's affecting more than you thought. You really need to get to the bottom of this sabotage.
[[Week 3: Investigation]]

W2-3 Sabotage: Someone tampered with that bridge on purpose and you are the head of this colony! You can't let them get away with this or it could damage the integrity of the colony leadership, not to mention the dangers of them continuing to sabotage other areas of the colony. You decide that you must focus all of your energy on finding the culprit. It's time to get this investigation started!
[[Week 3: Investigation]]