Eyes in the Sky: Using immersive simulations to teach the ethico-political aspects of drone technology

Proposal to the Andrew W. Mellon Grant for Evidence-Based Teaching Innovations

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We are investigating the merit of a highly interactive in-class simulation activity as compared to other pedagogical tools (less realistic simulation or solely watching a relevant film) that could be utilized for conveying concepts related to the political nature of technology.

In Fall 2017 and Fall 2018, Amy Banzaert and Catia Confortini co-taught ENGR/PEAC 305, a seminar entitled "Intersections of Technology, Social Justice, and Conflict," in which students explore the social justice implications of various technologies using social justice, design thinking, and mathematical modeling lenses. Together with Jordan Tynes, we developed the "Eyes in the Sky" exercise, and incorporated it in both iterations of the class. We anticipate running it during even years in the Fall semester for the foreseeable future. The LTS funded a summer student internship in 2018 to develop training materials for the simulation. In addition, the Blended Learning Initiative awarded us some summer funds for the same purpose. We are currently applying for an additional BLI grant in conjunction with this application to EBTI.

After running the exercise twice in class, we were pleasantly surprised by how much students seemed to get out of the full-scale simulation. Running the exercise is time-intensive, but the student reflection was striking. As such, we would like to explore some of the aspects of the game that are related to the ethics of drone operations, particularly in humanitarian and conflict-related situations. Specifically, we are interested in the added value of the simulation vis-à-vis other pedagogical tools that could be utilized for facilitating the understanding of concepts related to the political nature of technology and the dangers of 'technologizing' humanitarian settings.

With this goal in mind, we plan to hire 3 groups of 8 students each to spend 12.5 hours over the course of three weeks to engage with the materials assigned for the class in three different configurations (see table below). We expect this study will allow us to understand the efficacy of a highly immersive, hands-on experience vis-à vis a more theoretical classroom interaction, and compared to writing reflective essays on these topics.

All groups will read a series of articles, exploring the different ways in which drones can be used both for humanitarian and military security purposes and the ethical conundrums of political decision-making when drones are involved. Group A will conduct a fully immersive exercise, as we have normally done in class, with two drones and other props to simulate search and rescue scenarios. For group B the simulation will be run entirely in class, following the same scenarios, but with no physical drones or props. The intention is to assess whether the same content without the physical, subjective experience will lead to qualitatively different learning. Group C will study and discuss the same readings and video material without the added benefit of a simulation (immersive or otherwise), replacing that with a series of essay questions inspired by our simulation. Since we hypothesize that a more immersive and interactive experience improves the quality of learning, Group C will test our null hypothesis through a more traditional pedagogical experience.

Activity	**Hours**	**A**	**B**	**C**
Readings	3	x	x	x
Class / Discussion 1 (before exercise)	2.5	x	x	x
Class / Discussion 2 (after exercise)	2.5	x	x	x
Movie	1.5	x	x	x
Simulation Real - fully immersive (subjective)	3	x		
Class-based simulation (objective)	3		x	

3 hour essay-based exam inspired by issues/topics explored in our simulation	3			*x*
Total Hours		*12.5*	*12.5*	*12.5*

What specific teaching or learning challenge will this project and innovation address?

1. It's a challenge to get students to comprehend something that is not a part of their typical lived experience: drones, humanitarian efforts, warfare, all unfamiliar
    a. Creating scaffolding by giving them an in-person experience that they can use, connected to their existing knowledge of the campus, their peers, other experiences and insights into tense teamwork moments
2. How do you seamlessly integrate the political aspects and the technology aspect? Mixing the mathematical and the interpersonal
3. Analyzing the effects of the technology on human to human interactions … discussing it vs. experiencing it.
    a. Inverse relationship between drone technology and empathy
4. Teaching complexity of decision-making and teamwork with technology integrated

What will students know or be able to do as a result of this innovative approach?

Our purpose for the entire seminar has been to have a class where the ethico-political questions were an integral part, rather than an add-on, to the engineering aspects of each technology. Therefore, in addition to the assessment of a simulation as pedagogical tool vis-à-vis more traditional teaching strategies, we wish to help the students reflect on our own responsibilities as citizens in relation to a technology that is rapidly being incorporated into our everyday lives. With the proposed set of exercises we aim to incorporate humanistic values more seamlessly and more interactively into our class, as it pertains to drone technology in particular. The students are asked to address in this course module questions guided by fundamentally humanistic sensibilities, such as: 'what may be the emotional and psychological effects of drone usage for the different actors involved (e.g., aid recipients, pilots, political decision-makers)?'; 'is drone technology different — and, if so how, — from other military technologies in terms of their ethico-political implications?'; 'to what extent and how can military technologies become tools for the advancement of social justice aims or, vice versa, for promoting aims contrary to human well-being and flourishing?'; "how is decision-making affected by factors such as sufficient or insufficient knowledge of the goals, moral implications of the work, time pressures, and reporting structures?'

What is the research evidence supporting this teaching innovation?

There are two broad areas of research we engage with this experiment. First we are drawing on literature on game design as follows:

- Gameful Pedagogy from U. of Michigan (http://www.gamefulpedagogy.com/) cites "self determination theory" (Ryan and Deci 2000) as useful when considering "gameful approaches" to designing classroom experiences.
    - "in order to feel intrinsically motivated, people need to be able to make meaningful choices over what they are doing (autonomy), be challenged by a task but feel like they can succeed (competency), and feel connected to those around them (belongingness)."
- What Video Games Have to Teach Us About Learning and Literacy (Gee 2007)
    - In gameful learning, learners must: be enticed to try, even if afraid to try; be enticed to put in lots of effort, even when beginning with little motivation to do so; achieve some meaningful level of success, having expended these previous efforts.
- We would like to identify and enhance elements of our exercise that support both of these qualities of classroom engagement.

The second area of research on which we base our experiment is related to the exploration of the relative effectiveness of active learning (Freeman et al., 2014), as the proposed study strives to compare the impact of several different types of interactivity on student learning:

- According to Christine Harrington and Todd Zakrajsek (2017), lecture and active learning are not mutually exclusive. Content delivery by an instructor, commonly referred to as lecturing, can be effective in certain situations depending on the nature of the content (e.g., novelty, complexity) and characteristics of one's students (e.g. prior knowledge, ability, experience), and moreover, there are ways to enhance lecturing, to make it even more effective. Our small-scale experiment is in line with the assumption that dynamic lecturing is a form of active learning. The open-air drone simulation adds, however, another element to the learning experience: the involvement of the entirety of the physical body. We aim, therefore, with this experiment to compare increasingly immersive and active techniques. In particular, we ground our pedagogical assumptions on Constructionism.
- According to Brown, Roediger, and McDaniel (2014) "difficulties that resemble real-world conditions and require efforts to overcome, deepen learning and improve later performance" (https://makeitstick.net/). In this regard, the simulation is designed to have students encounter multiple challenges as they make decisions on how and when to deploy, direct, and land drones in different scenarios. Difficulties in reaching and carrying out these decisions on the grounds are compounded by communication challenges between students assigned to different roles.
    - Important note about "desirable difficulties" and their impact on learning: "Before proceeding further, we need to emphasize the importance of the word desirable. Many difficulties are undesirable during instruction and forever after. Desirable difficulties, versus the array of undesirable difficulties, are desirable because they trigger encoding and retrieval processes that support learning, comprehension, and remembering. If, however, the learner does not have the background knowledge or skills to respond to them successfully, they become undesirable difficulties." (Bjork, 2017)
    - An important learning outcome for this course is getting students to comprehend something that is not a part of their typical lived experience (e.g. drones, humanitarian efforts, warfare). The simulation is designed to be challenging in certain ways that resemble real-world conditions (e.g. working with real drones in the landscape with communication limitations; we do not equate the simulation directly to humanitarianism or warfare). In this way, the engagement with this activity will help students learn and practice thinking about this content in way that in some aspects resembles how they might encounter the topic in real life--conditions at encoding (i.e. how they are exposed to the content in class) align with retrieval (i.e. how they will be expected to recall this information in the future), and while challenging, the simulation is designed such that it is feasible for students to accomplish.
- Seymour Papert and Idit Harel's Constructionism (1991), which builds upon Constructivism, shares the "connotation of learning as 'building knowledge structures' irrespective of the circumstances of the learning. It then adds the idea that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sand castle on the beach or a theory of the universe." Further, Papert and Harel argue that a sufficiently compelling approach can hold student attention even when the topic at hand is not appealing to the students, and that "constructionist activity ... enhances the effectiveness of instruction given by a teacher."
- Considering the design of the immersive simulation experience (Condition A), Chapman, McPhee, and Proudman (1995) have outlined a series of key characteristics that define successful experiential learning environments, which can be mapped onto the student experience of the activity in the proposed study:
    1. Mixture of content and process: There must be a balance between the experiential activities and the underlying content or theory.
    2. Absence of excessive judgment: The instructor must create a safe space for students to work through their own process of self-discovery.
    3. Engagement in purposeful endeavors: In experiential learning, the learner is the self-teacher, therefore there must be "meaning for the student in the learning." The learning activities must be personally relevant to the student.
    4. Encouraging the big picture perspective: Experiential activities must allow the students to make connections between the learning they are doing and the world. Activities should build

in students the ability see relationships in complex systems and find a way to work within them.

5. The role of reflection: Students should be able to reflect on their own learning, bringing "the theory to life" and gaining insight into themselves and their interactions with the world.
6. Creating emotional investment: Students must be fully immersed in the experience; not merely doing what they feel is required of them. The "process needs to engage the learner to a point where what is being learned and experience strikes a critical, central chord within the learner."
7. The re-examination of values: By working within a space that has been made safe for self- exploration, students can begin to analyze and even alter their own values.
8. The presence of meaningful relationships: One part of getting students to see their learning in the context of the whole world is to start by showing the relationships between "learner to self, learner to teacher, and learner to learning environment."
9. Learning outside one's perceived comfort zones: "Learning is enhanced when students are given the opportunity to operate outside of their own perceived comfort zones." This doesn't refer just to physical environment, but also to the social environment. This could include, for instance, "being accountable for one's actions and owning the consequences" (Chapman, McPhee, & Proudman, 1995, p. 243).

Measures

We expect to refine and finalize our study design in early Spring 2019. Our current thinking is to conduct qualitative analysis of student writing and discussion, focused on the ways in which students make meaning and draw conclusions in the exercise. We would like to understand whether and how the simulation adds pedagogical value, comparing it to a less immersive in-class simulation, and a group that engages in only a written exploration of the topics covered. Content analysis of our discussions and pre-post survey questions (based on meta-cognition evaluation methods — see Chick n.d.**)** will be used to develop more quantitative measures of achievement of learning objectives. We seek funding for these Spring 2019 activities specifically Our longer-term goal is to use all assessment results of these exercises to refine the syllabus and class activities for ENGR/PEAC 305 in the Fall 2020 semester, as well as to inform scholarly publications and to build useful public-facing websites/blogs or similar content.

Proposal Timeline

PEAC/ENGR 305 is an existing course that will next be taught in Fall 2020, informed by the proposed study. The course enrollment is capped at 15 students for this seminar-style class. The class will be offered for the foreseeable future in even years in the fall semester. We would like to collaborate during Spring / Summer 2019, spending the Spring executing the study and the Summer to perform data analysis and interpretation.

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