

ACT Grant Application

Responsible Innovation and Ethical Reasoning with Design Fiction

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Design fiction is a blend of science, design, and science fiction, created using 2D and/or 3D visual media, to provoke critical thinking, reflection, and conversation about how specific technologies may be embedded in everyday human practices in near- to mid-range futures. In creating and analyzing design fiction, artistic skills and aesthetics are less important than the ways in which the design fiction promotes thoughtful reflection and discussion about the relationships between science, technology, and society. Drs. Conley and York have experimented with using design fiction in a student capstone project and have found it highly effective at promoting critical thinking and enabling ethical reasoning about technological innovation. Resources provided via an ACT Grant would enable us to scale up our experimental design fiction intervention to 125+ STEM students at JMU. As faculty responsible for teaching the social contexts of science and technology to applied science majors, between us we will be teaching five sections of a 100-level required course called Technology and Society (ISAT 131) in Spring 2018. We already have IRB approval to conduct Scholarship of Teaching and Learning (SOTL) research in our classes on the broad topic of responsible innovation. We propose to use this grant to create a SOTL project specifically studying the use of design fiction in ISAT 131 to teach students core concepts in Technology and Society, including responsible innovation and ethical reasoning.

Rationale

ISAT 131 students are primarily 1st- and 2nd-year ISAT majors who are drawn to interdisciplinary applied science. A core learning objective of the major is to teach students holistic and systems-based thinking around sociotechnical problem-solving, and within ISAT 131 we are charged with teaching students key concepts and ethical reasoning as applied to the relationships between science, technology, and society. We have previously done research on the effectiveness of incorporating science fiction into STEM spaces to build the critical capacities necessary for responsible innovation. We have additionally experimented with design fiction in the context of a student capstone project, but have not yet engaged in a systematized study of how to most effectively implement design fiction into the classroom. We hypothesize that design fiction's incorporation of science, hands-on making, and science fiction, will make it a fun and accessible way to effectively engage STEM students in critically interrogating the societal and ethical dimensions of emerging technologies. With five sections of the same course in the spring, we have an opportunity for comparing and contrasting different strategies for incorporating design fiction and studying its impact. ACT grant funds would support the purchase of a variety of materials that we could use in the classroom to support design fiction making, as well as help defray the costs of attending conferences where we intend to disseminate our findings.

Plan for design and implementation

Based on our work using science fiction and multimodal assignments in the classroom, as well as our experiments with design fiction in a capstone project, we believe that the creation of design fiction will need to be preceded by:

- Presentation and analysis of relevant course concepts through activities and case studies
- Introduction to and practice with using science fiction to think about responsible innovation
- Introduction to design fiction and analysis of popular design fiction, for example, in Hollywood science fiction films
- Time for training and/or experimental play with the materials they will be using for the assignment (e.g., if they will be drawing pictures then drawing pictures, if they will be using 3D printing or making dioramas, then experimenting with those materials and practices)
- Practice evaluating design fiction with respect to agreed-upon criteria and requirements that we would set

We would guide students in analyzing design fictions using ethical reasoning approaches such as the 8KQ to consider whether and to what extent the presented future raises ethical issues. Given the variety of skillsets students will bring to the actual design fiction portion of this assignment, we anticipate a variety of design fictions, not all of which may realize the vision that students brought to the assignment. Because much of the

learning process is in planning, making, and discussing the design fiction, this is an acceptable outcome, but we expect that requiring students to create a multimodal presentation about their design fiction project will provide opportunities for critical reflection and classroom discussion. We are interested in consulting with instructional designers on possible ways to incorporate 3D printing and other technologies available in maker spaces for the creation of design fiction, as well as on how best to gather and showcase the design fictions and multimodal presentations (possibly across the sections).

We anticipate that design fiction may be used to explore future scenarios in a variety of disciplines, including environmental humanities, medical humanities, and social sciences fields. Colleagues from a variety of institutions and disciplines, from Engineering to Business/CIS, have expressed interest in using design fiction in their classrooms. Topics as varied as criminal justice, climate change, and immigration may benefit from exercises in critically imagining the future—and design fictions in such cases might consider technologies and contexts as varied as prisons, raised/stilted pedestrian paths, etc.

Outcome of the innovative and creative teaching

We anticipate that students will develop skills in plausible extrapolation of current technologies into the future in ways that demonstrate reflexive thinking and ethical reasoning about benefits, risks, and the multiple drivers that may lead to various future scenarios. This practice is designed to shift student perspectives from focusing on a future technological device to imagining how that device may be embedded in society in ways that enable and constrain everyday practices. We also hope to reinforce the notion that there is not one single, inevitable future but multiple plausible futures that have different social, political, and ethical implications. In working together to research, brainstorm, design, visualize, and present such a future, followed by activities that require them to analyze the societal dimensions of their future, students will identify relevant stakeholders, drivers, risks, uncertainties, benefits, and harms implicit in a particular scenario. In so doing, they will deepen their understanding of the relationships between science, technology, and society.

We will design a pre-test and post-test and collect reflections at various points in the multi-week process for analysis of the effectiveness of different strategies (see below in Research Design and Data Analysis for more detail).

Plan for result dissemination

We intend to submit a proposal to Virginia Tech's Higher Education Pedagogy conference and the International Ethics Across the Curriculum conference, where we can lead sessions that disseminate our results and stimulate conversation about how this approach can be used in multiple disciplines. As a former and current member of CFI's Engaged Teacher-Scholar program, we would also use that network to share the results of our work. Finally, we intend to produce a publication, which could be submitted to journals such as *Responsible Innovation* and *Science and Engineering Ethics*.

Budget plan: \$1998.48

3D Modelling Materials: \$379.90 + tax = approximately \$400.03

Activa CelluClay Instant Paper Mache (\$26x5): \$130

Crayola Model Magic Assorted 2 lb. Bucket, White (\$24.99x10): \$249.90

2D Canvases: \$249.90 + tax = approximately \$263.15

Canson XL Mix Media Pad 18"x24" (\$24.99x10): \$249.90

Color and Tools: \$685.28 + tax = approximately \$721.60

Fine line tip paint pen marker set by Craft Smart (\$8x5): \$40

Craft Smart Acrylic Paint Value Set (\$16x20): \$320

Craft Smart Metallic Acrylic Paint Value Set (\$10.99x10): \$109.90

Black & White Acrylic Paint Value Set By Craft Smart® (\$3.00x2): \$6.00

Craft Smart Brush Assortment (\$5x20): \$100

Craft Smart Plastic 10-Well Paint Palette with Lid (\$1.59x60): \$95.40

Prismacolor® Premier® Art Marker, Brush/Fine Black (\$6.99x2): \$13.98

Craft Storage: \$107.98 + tax = approximately \$113.70

Mobile Craft Storage Center By Ashland (\$53.99x2): \$107.98

Conference Support: \$500

Conference support for the Ethics Across the Curriculum Conference in Rochester, NY: \$250

Conference support for the Higher Education Pedagogy Conference in Blacksburg, VA: \$250

Research design and data analysis

At the end of this SOTL research project we expect to be able to compare several strategies for implementing design fiction into curricula and to evaluate the effectiveness of using design fiction to engage students in applying ethical reasoning to technological innovation. Documenting the specific strategies we implement in each section, we will also collect data from pre- and post-tests and student reflections. Below, we describe some examples of pre and post-test tools that will be used to collect data.

Students will complete a responsible innovation worksheet before and after reading the design fiction intervention, which is divided into a series of questions, listed below:

- 1) When you hear the words “responsible innovation,” what words, thoughts, feelings, and/or images come to mind? (Feel free to write as few or as many thoughts down as you can.)
- 2) How would you define “responsible innovation”? Write your definition below:
- 3) Is “responsible innovation” relevant or important to you as a student, and/or in your future career? Why or why not? Explain below:
- 4) Is there anything in the term “responsible innovation” that confuses you? Share your thoughts below:

We will also track student learning via a brainstorming worksheet that is divided into four quadrants, with the following questions:

Quadrant 1: Opportunities - *What opportunities and/or problems does this technology present?*

Quadrant 2: Considerations - *What are important factors and issues to consider? What kinds of expertise, skills, and perspectives will be needed?*

Quadrant 3: Outcomes - *Who might care? (Individuals, groups, institutions, etc.)*

Quadrant 4: Alternatives - *What are potential alternative plans of action? What are your recommendations or desired outcomes?*

Concept mapping will also be used as a learning and assessment tool. Students will have the opportunity to create concept maps iteratively throughout the course. Concept-mapping exercises are a well-established methodology that has been employed in over 500 peer-reviewed journal articles on learning outcomes. Students will be given a worksheet that shows a sample concept map not related to the subject matter and a blank space on the reverse side of the paper, and a pencil and 20 minutes.

After student responses are anonymized, they will be transcribed into the R statistics software for analysis. A text mining and text analysis package will be used for identifying trends in the responses. We will be observing the data to see if there are any, or to what extent, differences in the pre-and post worksheets.