

## The STS Futures Lab at James Madison University: Integrating Design Fiction, Experimental Pedagogy, and Anticipatory Research into STEM Education and Outreach

*By Emily York, Shannon N. Conley and Samuel Kodua*



How can we creatively engage STEM students in reflecting on what it means to be a responsible innovator? How can we make responsible innovation, ethical thinking, and problem-solving hands on, interesting, and relevant for our students? How can we encourage them to recognize and challenge their own assumptions about progress? These are questions that we, as faculty in the School of Integrated Sciences (SIS) at James Madison University in Harrisonburg, Virginia, are constantly grappling with. Our primary appointments are in the bachelor's degree program in Integrated Science and Technology (ISAT) within SIS, and our role, specifically, is to engage students in reflecting on the "social contexts" of technology and science. ISAT is a unique, interdisciplinary, ABET-accredited applied science and technology program that trains students to analyze and address complex sociotechnical problems with a systems-thinking mindset. Our holistic problem-solving curriculum builds on a broad foundation of fundamental

knowledge in the natural sciences, computing, and social sciences, and includes a "spine" set of courses that teach students how to integrate multiple kinds of expertise to address problems, and to integrate the social and technical aspects of problems and solutions. It is a key goal to make the social contexts portion of the curriculum well-integrated into students' applied science and technology coursework. The challenges of doing this are also opportunities to re-think our pedagogical approaches. For example, we established the STS Futures Lab to embrace *doing* social contexts as part of *doing* science and technology—an approach that leverages the lab setting and hands-on project-based coursework students were familiar with in their STEM classes and applies it to social contexts. The STS Futures Lab supports our endeavors in the classroom, provides opportunities for us and our colleagues and students to experiment and innovate, and further legitimizes the social contexts curriculum.

### The STS Futures Lab

Envisioned as a space for research and teaching, the STS Futures Lab is a fun, interdisciplinary, and intellectually stimulating environment where faculty and students can explore tools and practices that help us to plausibly anticipate the social, ethical, and political dimensions of high tech innovation. Aimed at building our capacities for responding to and reasoning about the fast-paced and impactful changes that confront society through science and technology, we believe that we urgently need more robust methods for the democratic governance of emerging technologies. Learning how to identify and examine varied aspects of sociotechnical change will benefit STEM students, whether they expect to work in R&D, policy, education, or business.

Our work as advisors in the Autonomous Vehicle Capstone team in SIS led us to regular summer meetings with two of our students in preparation for a fall conference presentation. As our students moved back and forth between the computer lab where they worked on prototyping a 1/8 scale autonomous vehicle and our meetings where we discussed readings and examined the ethical dimensions of autonomous vehicles, they began to refer to our meetings as the "STS lab"—that is, the Science, Technology, & Society Lab. We began to work with our students on incorporating two tools—scenario analysis and design fiction—to facilitate our thinking about the potential futures of autonomous vehicles. We found these tools to be extremely useful and thought provoking. Chase Collins, one of our students and now a recent alumnus who co-founded the STS Futures Lab with us, helped us to experiment with gamifying our scenario analysis, and he ultimately led a workshop with the rest of the Autonomous Vehicles Capstone team that became part of their capstone project. Building on this experience, we launched the STS Futures Lab with an associated small independent study course and an initial cohort of five ISAT student members meeting weekly to develop research, engage in STS dialogue, and form a supportive community. While not limited to scenario analysis and design fiction, these methodologies form the backbone of much of the futures-oriented work we do in the lab engaging anticipatory ethics and anticipatory governance.

### What is scenario analysis?

Scenario analysis refers to a method primarily used in business consulting for analyzing plausible mid- to long-term scenarios relevant to a specific domain in order to anticipate and manage uncertainty. Scenario analysis facilitators lead groups through a series of steps, usually over the course of some months, to identify, analyze, and plan for plausible scenarios. Used in profit, non-profit, and governmental organizations, it has been widely recognized as a tool that helps leaders avoid the assumption that the future will be a steady, smooth continuation of the most obvious trends of today—an assumption that can lead to major failures! More recently, researchers in Science, Technology, and Society and Science and Technology Policy fields have begun to recognize the usefulness of this tool for technology governance. In the STS Futures Lab, we have adapted this method to suit different learning objectives and learning environments for applying critical thinking toward socio-technical change.

### What is design fiction?

Design fiction refers to a practice that spans science, science fiction, and prototype design, to create media artifacts that help facilitate conversations about the social context within which a technology might be embedded. The most sophisticated examples of design fiction that we might frequently encounter come from Hollywood science-fiction films—scenes which show future technologies in the context of story, seamlessly challenging us to rethink what it means to be human in a future world in which the technologies shown are commonplace and ordinary. In the STS Futures Lab, we have adapted this practice to use a range of tools that we have access to—from traditional art supplies to digital media—to build on scenario analysis by creating an artifact that can be used to start a conversation and engage in ethical reasoning about a potential future in which our chosen high tech innovation is already ordinary. Shifting our gaze from the shiny tech object to the everyday context in which this object might live enables us to interrogate the social, ethical, and political dimensions of this technology beyond what we had originally anticipated. This “detour into the future” may even inform our contemporary design and policy choices. We are currently writing grants to support engagement with a variety of augmented reality and virtuality reality tools to expand the set of options for creating design fiction.

### Adapting Scenario Analysis and Design Fiction In the Classroom

We have found that scenario analysis and design fiction is extremely flexible, and that it can be adapted to meet different learning objectives, course structures, and constraints. It is possible to do an abbreviated version in just one 75-minute class period that can still serve as a meaningful and engaging activity—particularly if students are already established in groups and have been working with one case study or research topic for some time prior to the activity.

However, with more time the scenario analysis and design fiction can be more deeply integrated into a module or research topic. In a course introducing students to science, technology, and society, we experimented with a multi-class engagement that

adapted the gamified version of the scenario analysis and design fiction activity developed by our student Chase Collins. Applied STEM students in Shannon Conley's sections participated in a multi-week interactive and hands-on case study focusing on the anticipatory governance and ethical implications of emerging autonomous vehicles (AV). Students were tasked with serving as consultants to a fictional state senator who required a briefing in multiple knowledge domains related to the technological, societal, and ethical aspects of the technology. Student groups were assigned different "knowledge domains" in which they were expected to conduct in-depth research and gain a robust working expertise within their particular domain. Prior to the students' final presentations, and equipped with the research from their knowledge domain, student teams participated in an adapted version of the gamified scenario analysis and design fiction activity, analysing issues related to AVs in regards to stakeholders, infrastructure, and social and ethical dimensions. Students had to create a 2D drawn representation of a "slice of life," imagining a world in which AVs were commonplace. The final design fictions varied based on the factors and stakeholder perspectives students received from the scenario analysis game. Following completion of the design fiction, students then had to analyze their 2D artwork using an ethical analysis framework. Students integrated their analysis and design fiction in their final briefing presentations to the fictional senator.

Similarly, students in Emily York's sections took the gamified scenario analysis and adapted it to their own case studies on a variety of topics and, over the course of two weeks, created design fictions that juxtaposed 2D and 3D elements to start a conversation about one of the plausible futures related to their case study. Using arts and craft materials, found objects, and digital media, they worked in groups to create multimodal design fictions. Then, in a poster-session style final exam session, they presented their design fictions to each of the other groups, engaging in dialogue about what made the future plausible or not, and finally applied ethical reasoning to examine their design fiction futures in individual reflections.

### **Adapting Scenario Analysis and Design Fiction for a Middle School STEM Engagement: An STS Future Lab Member's Perspective**

These tools can also be adapted for a younger audience—and the process of adapting these tools is itself a great learning engagement for undergraduate students. Samuel Kodua is a third-year Integrated Science and Technology student at James Madison University focusing on sustainable energy and information and knowledge management and is a member of the STS Futures Lab. He is also the community service chair of an engineering/applied sciences fraternity at JMU.

One of their first community service projects was a collaboration with an after-school program and they were tasked with holding various STEM workshops that help students connect with STEM principles. As a member of the STS Futures Lab, Sam had been working on modifying the gamified scenario analysis/design fiction approach for different audiences. He focused on how these tools could be used to interpret burgeoning technologies through different situational contexts and stakeholder perspectives, and to approach philosophical inquiry into socio-technical change. Initially,

he modified the game process by stripping down the complexity of each step and choosing a technology that would be familiar to the students. He demoed this iteration in an STS Lab meeting, where Lab members served as participants and provided insights into the aspects of the activity that were especially engaging/interactive and criticisms about the parts that might not be applicable to middle school students. Sam took this feedback and further modified the game to reflect a “make your own comic book” approach, further simplifying the game design model and making it more interactive.

First, given 3 to 4 options, students set up a future world in which their technology is a commonplace innovation that is widely used throughout this future world. Then participants draw the fundamental design of the technology that would allow it to operate in the future world. Second, given another 3 to 4 options, students envision a scenario in which the technology can be particularly useful in solving a problem. Then the participants are tasked with designing the technology with attributes and features that make this scenario possible. Third, they pick a unique human perspective from a choice of 3 to 4 options, and add to the previous designs of the technology in a way that enables the user to apply it to solve the problem. Finally, students are given a comic book template to create a story about their future world in relation to their technology and scenario. This adaptation of the design fiction format is especially fun for younger students to creatively come up with inventive representations while developing an understanding of technology in society and responsible innovation.

### **Adapting Scenario Analysis and Design Fiction As A Research Methodology**

We are also adapting our approaches and implementing them as a research methodology, in a scholarly project titled “Co-Imagining Futures with Scientists and Engineers.” We are using our techniques of collaborative imagination and infusing them into our ethnographic engagements with professional scientists and engineers in academia, industry, and government who are engaged in technology research and development. Thus, in addition to (and often as a part of) semi-structured interviews and observation, we work with our subjects to co-create scenario analyses and design fictions that interrogate potential futures that may emerge from their R&D work. Our goal is to not only disseminate our research collaborations via traditional outlets such as scholarly journals, but to also present these collaborations in more readily accessible and public engagement oriented contexts. We intend to create a podcast called “Weird Detours into the Future with Scientists and Engineers” and a YouTube channel recording our engagements using 360 VR video. Our hope is to establish a 2-way dialogue with members of the public, in which members of the public can collaboratively comment and experiment with us as we engage with scientists and engineers working at the bleeding edge of their disciplines.

### **Adapting Scenario Analysis and Design Fiction As a Public Engagement Strategy**

Finally, our future plans include adapting our approaches for a community and civic engagement effort working with everyday citizens, scientific experts, and K-12 communities in reflecting on the roles and responsibilities of citizens and scientists

within a democracy. For example, enabling us to take our approach outside of the classroom and into our local community, we plan to invite citizens and scientists to participate in an “Imagining Harrisonburg” exercise in a forum such as the Harrisonburg Public Library where we collaboratively explore plausible socio-technical futures and responsible citizenship in light of emerging technologies related to topics such as autonomous vehicles and smart cities. Designed for all ages, we will have options ranging from traditional art materials to virtual reality and 3D printing prototyping for the design fiction activity. Citizen design fictions and student elaborations of the design fiction artifacts would then be displayed in public spaces in downtown Harrisonburg, and be highlighted on a First Friday event. Students members of our STS Futures Lab will work with us to design and facilitate this event.

### How can I become involved?

Please contact us at [yorker@jmu.edu](mailto:yorker@jmu.edu) or [conleysn@jmu.edu](mailto:conleysn@jmu.edu), or alternatively, contact us using the contact form on [our website](https://sites.lib.jmu.edu/stsfutureslab/) (<https://sites.lib.jmu.edu/stsfutureslab/>) if:

- You are a technologist or researcher who would like to participate in our study, “Co-Imagining Futures.”
- You are interested in participating with us in the STS Futures Lab in a creative and fun way, and possibly becoming a lab affiliate.
- You would like templates and materials related to scenario analysis and design fiction to adapt for your own teaching and research purposes.
- You have other ideas for collaboration or engagement and would like to brainstorm exciting new possibilities!



Shannon N. Conley is an assistant professor in Integrated Science and Technology at James Madison University and a co-founder of the JMU STS Futures Lab.

Emily York is an assistant professor in the School of Integrated Sciences at James Madison University and a co-founder of the JMU STS Futures Lab.

Samuel Kodua is a third year in the Integrated Science and Technology program at James Madison University and a member of the JMU STS Futures Lab.