The Science of Storytelling: Middle Schoolers Engaging with Socioscientific Issues through Multimodal Science Fictions

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During the Project Imagine the Future (Project IF) summer academy, a small group of middle school students brainstormed how to effectively integrate visuals, sounds, and text into the conclusion of their science fiction (sci-fi) narrative, "A Turtle Tale":

Claudia: At the end we can have a part called "Our voice!" Like a call to action . . . humans can save cute turtles together.

Brian: Sounds great!

Claudia: We can explain a little bit that sea turtles are in danger.

Rachel: We can have pictures to show that.

Claudia: Also, some music to show something in danger? Like a nervous music?

Claudia, Brian, and Rachel's final multimodal sci-fi narrative detailed how a sea turtle traveled in a spaceship back in time to Earth to enlist the help of humans in saving his species from endangerment. They interwove written narrative with photographs of sea turtles and their habitat, Pixton comics depicting key events, sound effects, and music into a creative and engaging interactive flipbook that was shared online.

This article explores how collaborative multimodal composing centered on sci-fi narratives offered students a unique and impactful platform for exploring relevant socioscientific issues. First, we share research focused on the opportunities for sci-fi narratives and collaborative multimodal composing. Next, we detail the Project IF curriculum, and illustrate how students engaged with socioscientific issues, embodied different collaborative roles, and infused elements of their identities into their multimodal sci-fi narratives. After sharing a variety of student examples, we conclude by discussing strategies for integrating similar multimodal projects into different classroom contexts.

Relevant Research

Sci-fi narratives are a literary genre that incorporates imaginative content, including futuristic technology and scientific discoveries. Beach, Share, and Webb (2017) explain how having students read and create sci-fi narratives about climate change (i.e., "cli-fi") "can help students to think ecologically, to better understand the complex and dynamic relationship between organisms and their environment, and to care about their relationship to nature" (68). Narrative offers opportunities for students to explore important issues that affect their everyday experiences by taking risks, designing creative solutions, and envisioning their future selves (Dubeck, Moshier, & Boss, 2006; Ritchie, Tomas, & Tones, 2011).

Additionally, research emphasizes how digital multimodal composing is an engaging and collaborative process for adolescents (Ito et al., 2010). A growing body of studies demonstrate how adolescents work together on a wide range of multimodal projects (e.g., digital videos, podcasts, webpages) and at all stages of the composing processes—including brainstorming ideas, composing with digital tools, editing, and presenting final products (Bruce, 2008; Smith, 2019). The multifaceted nature of multimodal projects allows for the distribution of tasks. Students often tackle a piece of a project individually and then collaborate with peers to integrate their contribution within the shared composition (Wikan, Mølster, Faugli, & Hope, 2010). Through this process, students build upon each other's strengths and learn new technical and design skills from their peers (Beach & O'Brien, 2015; Ito et al., 2010).

Project Design

Project IF was designed to support young adolescents (grades 5–8) in developing disciplinary expertise and

identities while working with peers to create multimodal sci-fi narratives. Through a design-based research approach (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003), Project IF has involved multiple iterations as both an after-school program for middle schoolers and a sixth grade elective course. The program is currently offered as a summer academy with an extension during one Saturday each month in the fall semester.

The culminating project for Project IF is a sci-fi narrative constructed through multiple modes (text, visuals, sound, and animation) and digital formats (e.g., hyperlinked text, Scratch animations, Pixton comics, infographics, and interactive flipbook). The project challenges students to choose a relevant socioscientific issue to explore and suggest solutions through their narrative. *Socioscientific issues* are controversial, ill-structured social problems with multiple solutions and perspectives (e.g., decisions on practices and policies related to climate change) (Sadler, 2009).

During Project IF, students participate in a scaffolded workshop sequence (Smith & Shen, 2017). First, they experience disciplinary sessions to learn more about various socioscientific issues, including web-based science units, hands-on activities (e.g., design a "cool" house using paper and cardboard), and field trips (e.g., university science labs and botanical garden). Second, students read and analyze sci-fi mentor texts to understand the genre and gain inspiration for their own narratives. Third, students participate in a variety of sessions where they learn from "experts"—ranging from practicing scientists (e.g., marine biologists, geophysicist, medical scientist) to sci-fi authors, filmmakers, and professional game designers. Fourth, many sessions include a short tech tutorial where students learn how to use new digital tools or programs (e.g., Pixton, Scratch, MovieMaker, and iKOS).

Students develop individualized roles within their collaborative teams to complete their multimodal sci-fi narratives. On the first day of workshops, three main roles are presented for students to potentially represent: The *scientist* contributes by integrating all scientific content into the project, the *writer* develops the narrative, and the *designer* creates the multimedia that drive and enhance the story. After reflecting on the roles, students form groups ranging from three to five members and select roles that highlight their interests, skills, and past experiences. Although the process is focused on three main roles, many groups develop their own unique role structures. For example, some groups have greater participation from particular roles (e.g., three designers, one writer, one scientist), others design hybrid roles (e.g., scientist/designer), and a few groups create new roles altogether (e.g., manager, engineer). The goal of this collaborative process is to approximate the negotiations and self-marketing tactics that many experts utilize when working on interdisciplinary teams.

To promote interest-driven composing (Ito et al., 2010), students have the freedom to select which digital tools and online programs to use for creating their projects. Students also share their sci-fi narratives with multiple audiences. They participate in peer workshops and in-process presentations to gain feedback on their work at different stages. Students' final projects are shared with a broader audience; they are posted online and students present their work at a local sci-fi film festival.

In the following section, we present examples of the three main ways students engaged with socioscientific issues through their collaborative multimodal composing processes.

Problem Solving through Multimodal Science Fictions

The genre of multimodal sci-fi narratives offered students compositional freedom for exploring their socioscientific issue and offering unique solutions. Situated in Miami, many students participating in Project IF chose locally relevant climate change issues to tackle in their sci-fi narratives, from global warming to sea level rise, flooding, and superstorms. Each group found creative ways to engage with their issue through narrative, including integrating their interests, popular culture (e.g., movies, video games, anime), and innovative plot twists. For example, Maddie's group explored issues of climate change through remixing the powers of Disney princesses in their written narrative and comics:

> We decided what princesses to include, and you know like Elsa [from the movie, *Frozen*]? She has the power to freeze things, so we decided why not heat things up, like make her be reversed, like everything is reversed. She'd be able to have heat powers which could cause global warming. Or if like Ariel [from the movie, *Little Mermaid*] was evil she could have bubble powers that could be like the greenhouse gases, you know how they're trapped in the atmosphere. (Maddie, student interview)

This type of multimodal composition offered students multiple points of entry for leveraging their interests when interweaving science concepts into their narratives.

In narratives like Maddie's, students fused scientific information they learned with elements of fantasy. This type of multimodal composition offered students multiple points of entry for leveraging their interests when interweaving science concepts into their narratives. Their products also demonstrated creative solutions for socioscientific issues, including using giant sponges to sop up water to save people in the path of a tsunami to designing a machine that could generate oxygen to combat increased carbon dioxide from burning fossil fuels. Students' solutions were not always realistic, but the sci-fi genre provided freedom to investigate important issues, stretch their imaginations, and take risks (Dubeck, Moshier, & Boss, 2006).

Along with offering openness to explore issues through the genre of science fiction, students also leveraged multiple modes (e.g., visuals, sounds, text, animation) in complex ways to construct their narratives. Almost all students incorporated comics to develop characters and illustrate important scenes in their projects. Many students included photographs or embedded videos that made connections to science concepts (e.g., showing research evidence on how deforestation has an impact on human health) or elaborated on the action in their narratives. For example, one group of students included a video of a view of Earth from space to represent what characters saw while leaving on a spaceship (Figure 1). Some groups created and embedded Scratch (https://scratch.mit.edu) animations and games, as well as a variety of music and sound effects to enhance their sci-fi narrative. A few groups also created infographics and data visualizations with the program Venngage (https://venngage.com) to provide data for key science concepts connected to their projects. Overall, students constructed multidimensional digital sci-fi narratives where different media and modes contributed unique aspects, including illustrating science concepts, providing different perspectives, and extending their story.

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Collaborative Role Taking

As mentioned, students developed individualized roles within their collaborative teams to complete their multimodal sci-fi narratives. We found that students regularly collaborated on different aspects of their projects using these designated roles, including

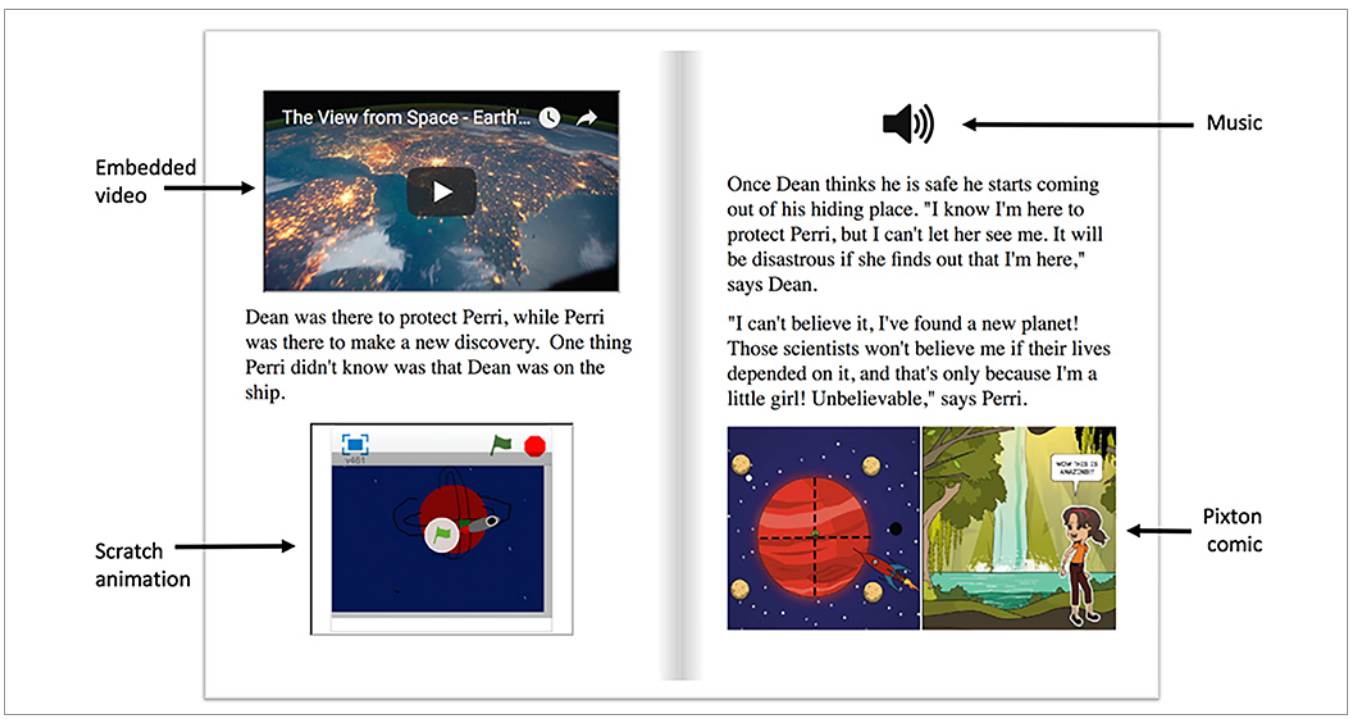

Figure 1. *Excerpt from a multimodal sci-fi narrative that included writing, embedded video, Scratch animation, music, and a comic*

constructing their plot, integrating science concepts, and providing feedback.

To illustrate, one group discussed a key moment in their sci-fi narrative, "The Big Surprise," which takes place in the year 2541 and depicts a world where vegetation could not survive because of an increase of carbon dioxide from human activities. As a solution, an astronaut, Dr. Fezz, creates a machine to generate more oxygen. However, while humans and aliens celebrate the new oxygen machine at the White House, it malfunctions. After collaboratively composing this pivotal scene, the small group discussed next steps and delegated tasks based on their roles:

Maria (writer): OK, right now we are having humans running out of oxygen.

Fabian (writer/scientist): And Dr. Fezz designs a machine that can generate oxygen.

Maria (writer): How about you [Sergio] find some information about oxygen generation? And you [Emily] can help with designing some images about the machine.

Emily (designer): Sure.

Sergio (scientist): I can try to find a video to explain how to get oxygen in chemistry.

Maria (writer): While celebrating the creation of the machine in front of White House, what's next?

Fabian (writer/scientist): Dr. Fezz tells humans and aliens the machine is broken.

Emily (designer): They need to make it work again.

Sergio (scientist): One chemical element is missing. That's the problem.

In this example, Maria, the writer, took the lead and offered tasks for her group members based on their roles. She suggested that Sergio, the scientist, find a supplemental video explaining the composition of oxygen. Maria also asked Emily, the designer, to create some visuals of the oxygen machine. In this interaction, students also offered contributions from the perspectives of their individual roles.

Students not only investigated and worked through their socioscientific issue, they also needed to work together to formulate their story and distribute the workload. Notably, we found that, although students designated specific roles at the beginning of Project IF, they regularly traversed different roles and collaborated on all aspects of their multimodal sci-fi narratives (Jiang, Shen, & Smith, 2019).

Identity Expression through Multimodal Science Fictions

Across multimodal science fictions, many students creatively infused themselves and aspects of their lives into the narratives. These examples of identity expression ranged from students designing comic characters to reflect themselves or discursively describing characters in their stories to reflect themselves and group members. In these instances, characters possessed similar physical features, interests, and ways of speaking. Additionally, some students represented themselves through different types of characters (e.g., animals, superheroes, popular culture characters). Along with students projecting themselves in their multimodal sci-fi narratives, students also portrayed their group dynamics and collaborations. Students illustrated their work styles by having some characters embody specific roles to solve problems or by even representing specific group discussions or disagreements in their final projects.

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A few students projected themselves as scientists in their narratives (Jiang, Shen, Smith, & Kibler, 2018). Maria led her team as they developed a sci-fi narrative centered on the astronaut (Dr. Fezz) who invented an oxygen machine to save the planet. During another composing workshop, she wrote a scene from Dr. Fezz's perspective in which a young girl who wants to be an astronaut defends herself:

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In this lesson, students analyze and discuss familiar superheroes and supervillains to expand their understanding of character types and conventions. Then students consider social issues that confront their everyday realities and respond by incorporating those issues into the creation of their own superheroes or supervillains as well as the settings the superheroes or supervillains operate in.

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> The want-to-be-astronaut girl stood with such disbelief and rage which astonished me in such a way I cannot imagine. She said these words, which I will never forget: "Don't judge people, Dr. Fezz. Just because you may see me on the outside as just a little girl, doesn't mean you know me from the inside. You of all people should know that." I turned pale. I was shocked to hear this.

This scene provides an illuminating window into Maria's view of herself as a strong female who wants to pursue a career in science despite perceived obstacles.

In another example, Tasha, who was the scientist for her group helped to write the conclusion of her sci-fi narrative by having "her character" become a scientist. Tasha explained later in an interview, "My role is scientist and I like the role. In the future, I want to be a forensic scientist. My character [in the sci-fi narrative] also became a scientist after saving the world from the attack of chickens." Both of these examples underscore how students agentively envisioned themselves as scientists in their stories, which also influenced their view of possible career options. These findings align with Pinkard and colleagues' (2017) research that emphasizes how envisioning oneself through narratives can facilitate middle school girls' STEM identity development while solving project-based design challenges.

Tips for Practice

No doubt, the interest-driven nature and flexibility of these projects—with students collaboratively negotiating their socioscientific issues, stories, and modes of communication—can be challenging for educators. Based on our experiences with Project IF, we offer the following suggestions for adapting similar projects in different classroom contexts.

In order for students to be actively engaged in their projects, we believe it's critical for them to become aware of socioscientific issues impacting their local communities and personal lives (Beach, Share, & Webb, 2017; Sadler, 2009). Find ways to expose students to these issues—including through hands-on activities, local news stories, online inquiry, and other media—and provide students choice in the issues they pursue. We find that one of the most impactful inspiration for students has been learning about climate change issues from invited scientists they engage with, so find ways to connect with local experts within your community.

Through multiple iterations of Project IF, we've learned the importance of striking a balance between scaffolding students' processes while also providing them flexibility to collaboratively compose with multiple modes and pursue their interests (Smith & Shen, 2017). We suggest beginning workshop sessions with explicit technical mini-lessons and disciplinary content (e.g., lectures and hands-on activities); however, students should also have ample class time to collaboratively compose without too many constraints on their process or use of digital tools. The teacher can serve as facilitator during composing sessions and provide resources (e.g., informational websites and online tutorials) for students to access when needed. Many students come to the classroom with valuable technical knowledge and skills, so provide opportunities for them to share their expertise and assist their peers.

Finally, we believe it's imperative for students to have opportunities to disseminate their multimodal sci-fi narratives. Along with finding time for students to receive feedback from peers in class throughout their process, find online and offline outlets for students to try to impact others through sharing their creative solutions to important socioscientific issues.

Conclusion

Having students engage with socioscientific issues through narrative and multimodal digital formats offers powerful opportunities for problem solving, collaboration, and identity expression. We encourage readers to integrate similar multimodal sci-fi narratives in their classrooms to support students in imagining creative solutions to real-world problems while also envisioning their future selves.

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References

Beach, R., & O'Brien, D. (2015) Fostering students' science inquiry through app affordances of multimodality, collaboration, interactivity, and connectivity. *Reading & Writing Quarterly, 31*(2), 119–134.

Beach, R., Share, J., & Webb, A. (2017). *Teaching climate change to adolescents: Reading, writing, and making a difference*. New York, NY: Routledge.

Bruce, D. (2008). Visualizing literacy: Building bridges with media. *Reading & Writing Quarterly, 24*(3), 264–282.

Cobb, P., Confrey, J., diSessa, A., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. *Educational Researcher, 32*(1), 9–13.

Dubeck, L. W., Moshier, S. E., & Boss, J. E. (2006). *Fantastic voyages: Learning science through science fiction films*. New York, NY: Springer.

Ito, M., Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P., . . . Robinson, L. (2010). *Hanging out, messing around, and geeking out: Kids learning and living in new media*. Cambridge, MA: MIT Press.

Pinkard, N., Erete, S., Martin, C. K., & McKinney de Royston, M. (2017). Digital youth divas: Exploring narrative-driven curriculum to spark middle school girls' interest in computational activities. *Journal of the Learning Sciences*, *26*(3), 477–516.

Ritchie, S. M., Tomas, L., & Tones, M. (2011). Writing stories to enhance scientific literacy. *International Journal of Science Education*, *33*(5), 685–707.

Jiang, S., Shen, J., & Smith, B. E. (2019). Designing discipline-specific roles for interdisciplinary learning: Two comparative cases in an afterschool STEM+L program. *International Journal of Science Education*. Advance online version. doi: 10.1080/09500693.2019.1581958

Jiang, S., Shen, J., Smith, B. E., & Kibler, K. (2018). Examining science identity development in a disciplinary role-taking multimodal composing environment. In J. Kay & R. Luckin (Eds.). *Rethinking learning in the digital age: Making the learning sciences count, 13th International Conference of the Learning Sciences (ICLS) 2018, Volume 3* (pp. 1587–1588). London: International Society of the Learning Sciences.

Sadler, T. D. (2009). Situated learning in science education: Socio-scientific issues as contexts for practice. *Studies in Science Education, 45*, 1–42.

Smith, B. E. (2019). Collaborative multimodal composing: Tracing the unique partnerships of three pairs of adolescents composing across three digital projects. *Literacy, 53*(1), 14–21.

Smith, B. E., & Shen, J. (2017). Scaffolding digital literacies for disciplinary learning: Adolescents collaboratively composing multimodal science fictions. *Journal of Adolescent & Adult Literacy, 61,* 85–90.

Wikan, G., Mølster, T., Faugli, B., & Hope, R. (2010). Digital multimodal texts and their role in project work: Opportunities and dilemmas. *Technology, Pedagogy and Education*, *19*(2), 225–235.

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