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Storying Science: Preparing STEM Students to Engage with Discipline-Specific and Public Audiences through the TED(x) Genre

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Storying Science: Preparing STEM Students to Engage with Discipline-Specific and Public Audiences through the TED(x) Genre

Erica M. Stone and Sarah E. Austin

Abstract: *Communicating about science with public audiences is becoming increasingly important for STEM students, both during their studies and once they enter a specific scientific workplace. Using two different general education writing courses as case examples, one at Middle Tennessee State University and one at the United States Air Force Academy Preparatory School, this article offers a model for how the rhetorical structure of the TED(x) presentation genre can be used to prepare STEM-focused students to better engage with non-expert audiences. Through narrative reflection and assignment examples, we build on Joshua Schimel's framework for communicating science and provide a replicable model for general education writing faculty to ensure STEM students understand how to 1) Compel audiences to listen/read through engaging content; 2) Compose writing and speech genres in memorable structures; 3) Communicate with non-expert audiences with accessible language.*

Introduction

Recent trends in the production and dissemination of STEM research make it imperative that students of these disciplines are equipped to utilize, critique, and communicate scientific research in accessible and transparent ways.¹ Over the last two decades, approaches to STEM research and teaching have slowly shifted from siloed, discipline-specific publications in prestigious academic journals to interdisciplinary conversations in a variety of media. This onto-epistemological shift in value is due, in part, to stakeholders renewed interest in public impact and engagement. For example, organizations like the National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA) now require the primary investigators on their funded projects to develop a plan for public engagement. Unfortunately, the result is often less than robust, with researchers meeting the requirement with an afterthought hybrid genre like a blog translation, or a non-linear Twitter thread. Since newcomers to scientific fields largely overlook how technologies and sciences are unequally prescribed, controlled, and delegated (Haas and Eble), teaching communication to STEM students requires a multifaceted approach that enables students to comfortably bridge disparate onto-epistemological traditions (Cagle).

Using case examples from our STEM-populated, undergraduate classes at Middle Tennessee State University (MTSU) and the United States Air Force Academy Prepara-

1. At the time of this essay's authoring, Erica was serving as an assistant professor of English and Associate Director of General Education English at Middle Tennessee State University. At the time of publication, she is a content designer and independent scholar.

tory School (USAFAPS), we outline one strategy for teaching STEM students how to communicate with non-expert audiences using the rhetorical structure of the TED(x) genre. Through narrative reflection and an assignment example, we build on Joshua Schimel's work and provide a replicable model for general education writing faculty to ensure STEM students can:

1. Compel audiences to listen/read through engaging content
1. Compose writing and speech genres in memorable structures
1. Communicate with non-expert audiences with accessible language

In the sections below, we summarize the General Education Writing Curricula at each of our institutions, so readers are better able to understand the parameters of our case examples and apply our portable assignment model to their own institutions. Notably, each of our writing sequences utilizes a rhetorical approach to teaching writing, where students are introduced to key rhetorical concepts such as rhetorical situation (audience, context, culture, purpose, author), genre, and rhetorical appeals. Later in our chapter, we share an assignment that offers guidance for how to teach students about the rhetorical structure of a TED(x) talk and how it can be used to discuss complex ideas.

Institutional Profiles

Middle Tennessee State University

Middle Tennessee State University (MTSU) is one of six locally governed public universities in the state of Tennessee and has consistently been ranked as one of the best universities in the nation by the Princeton Review. Founded on September 11, 1911 as a normal school dedicated to teacher training and the public good, MTSU has quickly grown into one of the largest universities in the state with over 80 degree programs, approximately 35 departments, and an annual undergraduate enrollment of approximately 20,000. As a comprehensive university, MTSU's mission focuses on serving Middle Tennessee through research, teaching, and service projects that "develop and sustain academic partnerships, entrepreneurial activities, and public service to support instruction, research, and communities throughout the region" (Mission Statement). Because of its central location and proximity to Nashville, MTSU offers students a wealth of opportunities to pursue careers in the recording and entertainment industries as well as science and technology fields.

United States Air Force Academy Preparatory School

USAFAPS is housed on the same campus as the United States Air Force Academy (USAFA) in Colorado Springs, Colorado. Founded in May of 1961, the Prep School each year enrolls around 240 direct high school graduates and enlisted service members between the ages of 17 and 22. These students are called cadet-candidates (C/Cs). The Prep School program is a ten-month academic, military, and athletic program that prepares promising individuals for the rigors of the USAFA and, ultimately, to be leaders of character and officers in the U.S. Air and Space Forces. The Prep School's most

important purpose is to diversify the Air Force officer corps so that it more accurately represents the men and women it leads, as well as the citizens of the United States. The Prep School's academic curricula focuses largely on STEM since the USAFA's curriculum is STEM-specific: all students, regardless of major, graduate with a Bachelor of Science degree.

Filling the Gap in Science Communication Education

Traditionally, science research has been written for scientific audiences (Bazerman). As a result, STEM writing classes have a responsibility to teach students how to consume, critique, and communicate scientific research in accessible and transparent ways. If we ignore this responsibility, we aren't fully educating STEM students for the kind of communication situations they are likely to encounter. While there aren't many models for how to train STEM students to engage with discipline-specific (expert) and public (non-expert) audiences, the rhetorical structure of TED(x) talks offers science communication educators a foundation for thinking about how to shift our writing pedagogies toward a more responsive approach for science communication that values navigating between discipline-specific and public-facing discourse. Based on our lived experiences as both faculty and administrators at MTSU and USAFAPS, we aim to move the current conversation about science communication and STEM-focused writing curricula forward by offering a portable model for engaging STEM students in critical thinking, audience analysis, and rhetorical engagement. Because the American National Academies of Science, Engineering, and Medicine (NASEM) suggests that science communicators need to be prepared to "share the findings and excitement of science," and "increase knowledge and understanding of science" (National Academies 2), we argue that the TED(x) genre provides an ideal rhetorical structure for teaching STEM students to communicate subject-specific ideas and processes with non-expert audiences in an accessible format.

Teacher-scholars across disciplines use TED(x) talks to encourage students to consider the rhetorical structures of the genre (Kendrowicz & Taylor, 2016; Lui, 2017; Masi, 2020) or to locate models for exemplary oral communication (Chang & Huang, 2015; Ludewig, 2017). Within our own discipline of Technical and Professional Communication (TPC), Michele Simmons reminds us that citizens are not necessarily non-experts and should be included in policy decisions. Similarly, scientific research approaches and traditional research publication practices juxtapose with feminist epistemologies, which accept "that knowledge is always provisional, open-ended and relational." This post-structuralist feminist position suggests that we cannot claim single-strategy pedagogies of empowerment, emancipation, and liberation (Luke and Gore 7) particularly within the context of STEM classrooms. Since technologies and sciences are unequally prescribed, controlled, and delegated, a reality that is largely overlooked by newcomers to scientific fields (Haas and Eble), teaching communication to STEM students requires a multifaceted approach that enables students to comfortably bridge disparate ontoepistemological traditions. As we embark on pedagogical practices that seek to teach students how to interrogate, influence, and interject in their communication, we (as educators) need to provide STEM students the support and tools to negotiate the cogni-

tive dissonances that will inevitably arise as they shift among communication purposes and audiences.

Engaging students in open dialogue between science and citizens makes information more transparent and knowledge exchange possible. Using case examples from our STEM-populated general education writing classes at MTSU and the USAFAPS, we narrate the possibilities for teaching students to engage with non-expert audiences on environmental science and responsible reuse practices. In order to teach STEM students how to “transition into professionals that realize and uphold ‘scientific citizenship’” (Irwin, qtd. in Nerlich) and value public audiences, we apply the rhetorical structure of TED(x) talks to teaching scientific writing and public engagement. We discuss the rhetorical structure of TED(x) talks further in the next section. In each of our writing classes, students wrote and delivered TED(x) talks followed by conversational critiques that mimic the kind of reciprocal journalism (Lewis, Holton, and Coddington) that occurs in the comments sections of many TED(x) talks and science translation articles. We argue that these types of assignments prepare STEM students to communicate through both discipline-specific and public-facing genres.

Engaging the TED(x) Rhetorical Structure in STEM Writing Assignments

TED (Technology, Entertainment, and Design) is a nonprofit that aims to foster a “global community, welcoming people from every discipline and culture who seek a deeper understanding of the world” that believes “passionately in the power of ideas to change attitudes, lives and, ultimately, the world.” Secondary to the global network of intellectuals and artists, TED is working to build TED.com into “a clearinghouse of free knowledge from the world’s most inspired thinkers—and a community of curious souls to engage with ideas and each other, both online and at TED and TEDx events around the world” (“How TEDx Started”). TED Conferences are large events held once per year and sponsored by the TED franchise, whereas TEDx events are independently organized and financed by smaller organizations, often nonprofits or universities. Even though TED(x) conferences and events occur all over the world, most people know TED by the short video talks they produce. While these talks are almost always recorded during TED conferences where speakers present their ideas to a live audience, most TED talk fans know the brand and genre by its recorded talks and online presence on YouTube, Facebook, Twitter, Netflix, and of course, TED.com.

By design, the TED(x) genre adheres to a particular cadence and organizational pattern that has become ubiquitous among scholars, entertainers, and advocates. In recent years, TED(x) talks have become a popular media outlet for three groups: public intellectuals, scientists, and academics who want to translate their research for a broader audience; artists who have a unique art form that lends itself to a stage and a time constraint; and people who have experienced trauma and have a universal lesson to share from their lives. When a listener presses play on a recorded TED(x) talk, they have certain expectations: the talk will be between 5-18 minutes long; the speaker will be (somewhat of) an expert on their topic; and, more than likely, the talk will begin with a narrative, a personal story. Because human beings have “always been storytellers

or homo narrans” (Young 4), the rhetorical structure of a TED(x) talk offers comforting patterns and predictability. Similarly, TED(x) Talks pay attention to rhetorical style. They “collapse the distance between intellectuals and broader publics” by making information accessible through narratives and a specific organizational pattern (Young 7). By adhering to a predictable pattern, TED(x) has built a brand and genre that is internationally recognized and serves as a venue sharing complicated ideas in plain language using accessible media.

Building on Joshua Schimel’s impactful book, *Writing Science*, we argue that a storied approach to communicating science through the rhetorical structure of TED(x) talks offers STEM students a low-stakes opportunity to practice communicating outside of the narrow confines of their disciplines and “become better storytellers” (Schimel 10). Because scientists are often trained to engage technical and subject-specific guidance who are most interested in the results of a study, they often forget to engage in audience analysis and responsive writing practices like anticipating questions or even posing rhetorical questions to provide inquiry and further discussion. TED(x) talks offer a rhetorical structure that encourages students to experiment with data analysis and presentation in a way that is engaging and transparent, two key factors in successful science communication, according to Schimel (12-13). Following Schimel’s suggestions, we ask our STEM writing students to “consider the three aspects to effective storytelling: 1) content, 2) structure, and 3) language” (14). First, students are asked to translate their content for a non-expert audience using simpler terminology, metaphors, images, and narrative examples. Next, students model their presentations after TED(x) talks that resonate with them; since TED(x) has a vast repository of scientific and/or disciplinary talks to choose from, the models for students are legion. Last, students are given a lesson in how to draft, edit, and use plain language to describe their ideas. We use examples from Russell Willerton’s *Plain Language and Ethical Response: A Dialogic Approach to Technical Content in the 21st Century* and Anna Young’s *Prophets, Gurus, and Pundits: Rhetorical Styles and Public Engagement*.

Designing a Replicable TED(x) Assignment Model for STEM Students

Through narrative reflection and an assignment example (see Appendix A), we designed a replicable model for general education writing faculty to ensure STEM students can accomplish the following goals and objectives:

1. Compel audiences to listen/read through engaging content

SLO 1: Students will be able to use the rhetorical structures of a TEDx talk to engage peer and faculty audiences.

2. Compose writing and speech genres in memorable structures

SLO 2: Students will be able to accurately write and perform a TEDx speech based on the genre conventions.

3. Communicate with non-expert audiences with accessible language

SLO 3: Students will be able to translate complicated information into legible and user-friendly language that follows the patterns of TEDx.

Following Schimel's process for thinking about science writing as storytelling, our model assignment asks students to conduct primary research to find exemplar TED(x) talks that communicate scientific ideas through engaging content, memorable rhetorical structures, and accessible language. After locating several exemplars, STEM students in our writing courses are required to map the three-part rhetorical structure of each TED(x) talk: 1) personal story, 2) fact-based lesson, 3) call to action using a visual organizer like Figure 1: Mapping the Rhetorical Structure of TED(x) Talks.

TED(x) Talk	Rhetorical Structures		
	Personal Story	Fact-based Lesson	Call to Action
Bill Gates' (2014) "The next outbreak? We're not ready" is a TED(x) genre model for thinking about engaging graphics and video in addition to simplifying and (<i>accurately!</i>) summarizing what might happen if the world were to encounter a deadly respiratory virus that was both airborne and highly contagious.	Bill Gates begins his TED(x) talk with a short, personal anecdote comparing his primary worry about a nuclear war as a kid instead to our current concerns about a global pandemic.	After his anecdote, Gates retrospectively examines the 2013 Ebola outbreak, outlining examples of how governments and healthcare systems failed and discussing the challenges that epidemiologies might face in another pandemic like the Spanish Flu of 1918.	Finally, Gates closes his talk with a call to action and a look toward the future, asking his audience members to we, namely developed, first-world countries, might prepare our local and national budgets, vaccine distribution plans, and healthcare systems to handle a future contagious disease outbreaks or pandemics (e.g., the COVID-19 outbreak and the 2020-2021 vaccine distribution process).

Fig. 1 Mapping the Rhetorical Structure of TED(x) Talks: An Exemplar

Recognizing it as an exemplar for all three areas of the rhetorical structure, one student at USAFA referenced Bill Gates' "The next outbreak? We're not ready" as a TED(x) genre model for thinking about engaging graphics and video in addition to simplifying and (*accurately!*) summarizing what might happen if the world were to encounter a deadly respiratory virus that was both airborne and highly contagious. Since TED(x) talks often begin with a storied introduction, students are easily able to understand the role of storytelling within science communication. Not only does storytelling break down terminology and disciplinary barriers, but it also encourages students to begin to see the intersection between the humanities and the sciences. For example, Bill Gates begins his TED(x) talk with a short, personal anecdote comparing his primary worry about a nuclear war as a kid to current societal concerns about a global pandemic. After

about a nuclear war as a kid to current societal concerns about a global pandemic. After his anecdote, Gates retrospectively examines the 2013 Ebola outbreak, outlines examples of how governments and healthcare systems failed, and discusses the challenges that epidemiologists might face in another pandemic like the Spanish Flu of 1918. Finally, Gates closes his talk with a call to action and a look toward the future, asking his audience members, namely developed, first-world countries, how they might prepare local and national budgets, vaccine distribution plans, and healthcare systems to handle a future contagious disease outbreaks or pandemics (e.g., the COVID-19 outbreak and the 2020-2021 vaccine distribution process). Gates' three-part rhetorical structure (personal story, fact-based lesson, call to action) offers STEM students a replicable model for composing their own speech scripts and accompanying media (e.g., slide decks, videos, music) for their TED(x) assignments (see Appendix A: Assignment Sheet).

At the USAFA Prep School the initial assignment in the course Academic Research asks students to identify a current problem that needs solving. All enrolled students have already taken a prerequisite course on Academic Argumentation that outlines Aristotelian rhetoric (to include the rhetorical situation and the rhetorical triangle), Burke's Parlor, and the notion of academic conversations. Students are required to pursue a problem-solution that is academic in nature, rather than philosophical or ethical, exigent, and narrow. That is, they identify an issue that is currently problematic for a specific group of people in a specific place (specific places, demographics, and contexts work best given that our courses are only 9 weeks long).

After conducting primary research and locating at least three exemplar TED(x) talks to emulate, STEM writing students are asked to translate their problem-solution into a TED(x) talk format. We consider the TED(x) format to be part of the students' writing and thinking processes, akin to conference presentations by professors, and encourage students to provide feedback and ask questions of their peers-as-observers. Each TED(x) talk must follow TED genre conventions including an engaging story, fact-based lessons, and a call to action to encourage a paradigm shift among the listeners or readers. Students develop visual aids as well as a fully accessible transcript to accompany their TED(x) talks. The student audience members, and any attending faculty or staff (we always invite our faculty and staff to attend and participate), are asked to complete a short feedback form (see Appendix B) to emphasize the process-oriented nature of research, provide constructive criticism, ask questions, and push students to consider other angles their research might take. The presenting student is allowed to ask follow-up questions, and receives the feedback forms each audience member completes during the following class period so that s/he can utilize the comments to improve their research, their final essay, and their presentation. Many students choose to use their TED(x) story as their essay's "hook" and are able to refine their thesis, hone their problem and solution discussions, and reorganize their argument to make the final written product more effective. Student course evaluations often mention the TED(x) talk as

being the moment they really understood what they were arguing and how it should be framed for the final essay.

Adoption and Adaptation of Storying Science with the TED(x) Genre

As we reflect back on our assignment design and pedagogical narratives, we see many possible avenues for adoption and adaptation across STEM fields, digital humanities, and interdisciplinary courses. As Sarah's student demonstrates in his example, scientific problems are also humanitarian problems. When we teach students to engage with science from a rhetorical approach that engages personal story, facts and research, and calls to action, science communication education has the potential to impact students' overall learning experiences in addition to meeting university learning outcomes (ULOs). While we do consider our assignment sheet to be replicable and portable to other institutions and STEM disciplines, we do understand that some adjustments will need to be made to accommodate program outcomes and assessment expectations. To accommodate any limitations or challenges faculty may encounter when adopting or adapting our assignment sheet (see Appendix A), we suggest thinking about the assignment sheet as an editable template that can be changed to meet your own pedagogical, departmental, programmatic, and institutional needs. By using a flexible rhetorical approach, our assignment model engages STEM students with a variety of genres and an opportunity to push and polish their own knowledge of discipline-specific language and public discourse.

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Appendix A: Assignment Sheet

Purpose

The purpose of this assignment is to teach STEM students to think rhetorically about engaging with disciplinary-specific and public-facing audiences by:

1. Compel audiences to listen/read through engaging content

SLO 1: Students will be able to use the rhetorical structures of a TEDx talk to engage peer and faculty audiences.

2. Compose writing and speech genres in memorable structures

SLO 2: Students will be able to accurately write and perform a TEDx speech based on the genre conventions.

3. Communicate with non-expert audiences with accessible language

SLO 3: Students will be able to translate complicated information into legible and user-friendly language that follows the patterns of TEDx.

Description

This assignment asks students to conduct primary research to find exemplar TED(x) talks that communicate scientific ideas through engaging content, memorable rhetorical structures, and accessible language. After locating several exemplars, STEM students in our writing courses are required to map the three-part rhetorical structure of each TED(x) talk: 1) personal story, 2) fact-based lesson, 3) call to action using a visual organizer like Figure 1: Mapping the Rhetorical Structure of TED(x) Talks.

TED(x) Talk

For this assignment, you will develop a 6-8 minute TED(x) talk on an aspect of your Problem-Solution Essay. Try your best to restructure your paper into the three-part rhetorical structure of TED(x) talk, see Figure 1 for a detailed example. You should spend approximately 1 minute on a personal story, 4-5 minutes on fact-based history/problem/attempted solutions/probable causes, and 1-2 minutes on your call to action/solution.

Delivery & Visual Aids

1. Engage & Involve: Speak conversationally and passionately, and connect (directly and indirectly) with your classmates.
2. Use Visual Aids, Not Visual Crutches: Use simple, elegant, and clean visuals to enhance and illuminate your message; allow your visuals to serve as your memory prompts. Consult with your instructor if you think you'll need more than the computer and projector.

Appendix B: Audience Feedback Form

Problem student poses	
Solution offered	
Thesis/Argument	
What could be better? (Organization, hook, word-choice, flow, depth, clarity of ideas, evidence)	
What worked? (Be specific)	

Fig. 2