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Using student-led case studies in engineering to build cultural awareness, self-knowledge, and ethical engagement

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Abstract

The purpose of this practice paper is to share initial reflections and several samples of student work from a newly developed activity sequence for engineering courses in which sociotechnical case study development is student-led. Case study engagement is a valuable way to ground engineering technologies in real-life contexts so students can examine the social implications of engineering work [1]. Currently, the integration of case studies in engineering classrooms is almost entirely teacher-led, where a prepared study is given to the students for discussion and evaluation. The work explored in this paper takes this approach a step further by centering students in case study selection and development. With this new approach, we aimed to:

1. Center the students' voices, as of members of a particular cultural community, in narratives about the ways in which technology impacts different communities
2. Challenge students to consider the nuances of power, identity, and positionality within those narratives
3. Generate a more authentic exchange wherein peers of different cultural identities collectively develop critical understandings of expertise, engineering history, and technological development.

In a series of scaffolded assignments, we asked students to choose an instance where technological design or engineering innovation has impacted people in communities or identity groups to which they, the students, also belong. The students insert themselves in the analysis, reflecting on how technology and design have impacted their lives, for better or worse. We have integrated this approach in our classrooms not necessarily as a replacement for the prepared, instructor-led case studies but as a supplement to better prime students to empathize with communities impacted by design. This approach is rooted in culturally sustaining [8], culturally relevant [9], and critical pedagogies [10].

The student-led approach also offers a robust opportunity for critical self-reflection and self-knowledge, and this work can be tied to ethical engagement or establishing a personal code of ethics grounded in lived experience and cultural values. Additionally, we feel that this activity shapes the classroom as a terrain of struggle and a site of possibility by placing emphasis and value on students' lived experiences and cultural histories as valid forms of knowledge–they are authorities on the topic and are treated as such. They are encouraged to question predominating narratives that uncritically present technology and tech companies as forces for "good." We often teach engineering ethics in the context of one's professional responsibility, but these lessons are

not typically attuned to cultural difference. The student-led case study offers a heuristic for self-knowledge that we feel is essential for establishing relational responsibility across differences and also centers equity and empathy in communication and design.

Introduction

Case study engagement is a valuable way to ground engineering technologies in real life contexts so students can examine the social implications of engineering work [1] and is a teaching practice already well established in engineering education. Currently, the integration of case studies in engineering classrooms is almost entirely teacher-led, where a prepared study is given to the students for discussion and analysis. Particularly in courses where case studies are included as a related lesson but not necessarily integrated as part of a sustained sociotechnical approach and scaffolded assignment series, students perceive a disconnect between the case study content and its applicability to their learning and lived experiences [2-3]. At our home institution, the University of Michigan, and other engineering schools, there has been a renewed emphasis on nurturing our engineers-in-training to be "people-first" engineers. To better achieve that goal, we have developed a different approach to teaching case studies, one that begins with centering student identity and lived experience as a starting point for fostering the sense of relational responsibility needed for meaningful case study engagement.

An underlying premise of this assignment sequence is that technologies are not neutral. Social scientists and philosophers of technology have long argued that technologies have politics and are imbued with the values, beliefs, and perceptions of their designers [4-6]. More recent work traces the ways (the myth of) technological neutrality perpetuates systems of power and inequity that shape nearly every aspect of our lives. Who gets to be a designer of technology is a critical question to ask; equally important are questions about who decides the problems technologies seek to solve and what counts as a problem in the first place [7]. Bringing case studies into engineering education grounds these kinds of challenges and questions in the course curriculum; by making the case studies student-led, students must think for themselves about the ways technologies have shaped their lives, for better and for worse.

This work is also grounded in culturally relevant and culturally sustaining pedagogies, with the aim of creating opportunities for students to bring their languages, cultures, and experiences into their coursework in meaningful ways [8-10]. Following this pedagogical thread, the goal is to call out the ways that technology shapes and is shaped by culture; and at the same time, make visible the cultures, languages, and experiences that are deemed irrelevant, non-technological, or otherwise unimportant in engineering contexts.

With funding from a University of Michigan College of Engineering Enhancing Engineering Education (E3) grant, we developed and implemented our new approach to integrating case studies in multiple sections of the University of Michigan's introductory engineering course

called ENGR 100. Our goals were to:

1. center the students' voices, as of members of a particular cultural community, in narratives about the ways in which technology impacts different communities;
2. challenge students to consider the nuances of power, identity, and positionality within those narratives; and
3. generate a more authentic exchange wherein peers of different cultural identities collectively develop critical understandings of expertise, engineering history, and technological development.

The sections below provide an overview of practice, including initial reflections, student samples, and directions for future development.

Practice Overview

The student-led case study activities were integrated into three different sections of ENGR 100 (Introduction to Engineering) between January 2024 and April 2025. ENGR 100 is a writing-intensive, design-build-test course required of first-year engineering students at our university. Roughly 26 different sections offer different projects and disciplinary focuses in fall and winter semesters. All sections are co-taught by a technical communication lead instructor and a technical lead instructor from one of the other engineering departments. The course enrollment typically varies from about 40 - 80 students, who meet every week for two lectures, one lab session, and one discussion session.

McLendon taught two of the three sections discussed in this paper: Section 130: Sustainable Materials and User-centered Design in the Winter 2024 and 2025 semesters and Section 270: Next Generation Computing Hardware in the Fall 2024 semester. Snyder taught one of the three sections discussed in this paper: Section 910: Socially-Engaged Design of Nuclear Energy Systems in Fall 2024.

Section 130: Sustainable Materials and User-centered Design

Section 130 has a materials science in engineering (MSE) focus, and the semester project is designing and manufacturing a simple tool (e.g. screwdriver, claw hammer, chisel) out of a bronze alloy. Students complete these projects in teams of 3-4 people. The two lead instructors practiced an integrated lecturing approach where the technical and technical communication content wasn't discretely divided but rather interwoven and delivered as a team. The objective was to both teach and model for students that engineering is a sociotechnical practice.

Table 1 illustrates some of the content scaffolding in Section 130. As shown, explorations of bias, ethics, empathy, and cultural awareness are integrated throughout an entire semester. This

paper focuses specifically on the two scaffolded assignments: Student-led Case Study Lightning Talk and How It's Made Poster (emphasized with ** in Table 1). A sample assignment prompt for the lightning talk is available in Appendix A.

Table 1. Sample content sequence in an introduction to engineering course that illustrates sustained instruction in bias, ethics, empathy, and cultural awareness.

Week	Content/Assignment
2	Sociotechnical Survey 1: gathering students' initial perceptions of bias, ethics, empathy, and cultural awareness in engineering
4	"Social Justice is Often Invisible in Engineering" reading and jigsaw activity
5	In-class discussion about cultural communities; instructors model case study development and presentation
6	Student-led Case Study Lightning Talks and group reflection**
7	DEIJ in Engineering Case Studies in discussion (instructor-led)
12	Center for Socially Engaged Engineering & Design case study module week (guest instructor-led)
14	How It's Made Poster Presentations**
15	Sociotechnical Survey 2: gathering students' updated perceptions of bias, ethics, empathy, and cultural awareness in engineering

Before beginning to develop their case studies, students were asked to think critically about and discuss in small groups their understanding of their own cultural identities. Instructors provided framing to establish a broad notion of culture and cultural identity as a starting point for students' reflections and discussion. We acknowledged a common misunderstanding that construes cultural identity with racial or ethnic identity, and then we presented cultural identity as dynamic, intersectional, and layered, composed of additional factors like geographic location, language, socioeconomic status, religion, gender, social community, and education that individuals experience with different degrees of salience.

Knowing that most students had never done this sort of work before, both lead instructors completed the assignment and presented our own lightning talks to the class. One was about the invention of synthetic progesterone and subsequently the birth control pill and the other was about the invention and implementation of standardized testing in American education.

Section 270: Next-Generation Computing Hardware

Section 270 has an electrical and computer engineering (ECE) focus, and the semester project is designing and validating a computing system for a demanding, futuristic application. Students complete the projects in teams of 3-4 people. The two lead instructors practiced a semi-integrated lecturing approach where much but not all of the content was interwoven and delivered as a team. This section also had a strong sociotechnical core and contained the same assignments as shown in Table 1 in a slightly different progression. The other significant difference between this section and Section 130 was the narrower framing for the student-led case study sequence assignments. An example assignment sheet for the poster is available in Appendix B.

In this section, McLendon was the only instructor to model a lightning talk for the students and used the same talk on synthetic progesterone from Section 130.

Section 910: Socially Engaged Design of Nuclear Energy Systems

In this section, students were tasked with an imagined design project of collaboratively siting and designing the exterior of a nuclear energy facility in our local community. Lectures were semi-integrated, including some stand-alone lectures about nuclear engineering basics and technical communication best practices. But most lectures fell less clearly into disciplinary boxes, and for much of the semester, students were not entirely sure which of the instructors had expertise in engineering vs. communication students. We see this as a positive sign! Many of our lectures focused on the ethical, social, and cultural implications of engineering design– and we aimed to show that communication, technology, and design are deeply intertwined.

Design work in this section completed collaboratively through a series of workshops with community members invited into the design process. Virtual reality technology was used to teach nuclear reactor design basics, and help students better understand the scale and scope of a nuclear energy campus. Students wrote and presented about their design work; specifically, they also learned about relational responsibility, introductory philosophy of technology concepts, ethical teachings across several cultures, and practices in *futuring*. For this section, the student-led case studies were shaped slightly differently than the sections above, with less emphasis on identity and more emphasis on long-term impacts (across cultures) of technological design (see Appendix C for a sample assignment prompt). The reflections below describe the rationale and outcomes of these changes in greater detail.

Reflections

In this section, we reflect on our approaches to student-led case study design and our observations of student engagement with the assignments.

Reflections from Section 130

Overall, there was a wide variety of both the connected identities and chosen technologies students presented on during the lightning talks and poster presentations. For example, one student shared their identity as a woman and Chinese-American student pursuing a degree in biomedical engineering and presented her lightning talk on the evolution of perceptions of traditional Chinese medicine in American popular culture. Another student shared their identity as an athlete with a disability and presented on the discovery and development of synthetic human growth hormone (HGH) and connected their experience to a famous soccer player with the same condition. Yet another student shared their identity as an equestrian who grew up on a horse ranch in the American West and presented on the invention of horse saddles. Students like these, who grounded their talks in their personal connection to the topic, tended to deliver more in-depth content and make a more compelling case for the human impact of the technology.

While many students similarly engaged with the vulnerability of sharing various aspects of their identity and then choosing their presentation topic after that reflection, one or two shared that they actually selected a topic they were interested in first and then determined their personal connection to it. These presentations made a less compelling case for the direct impact/importance of the topic because the implications of the technology or innovation were presented in rather broad terms. This outcome is not surprising given that different students will have different levels of comfort engaging with the identity work, and even more so with sharing that work with other people. A consideration for future iterations is adding an ungraded short reflection activity in which students are given the time and space to think about the parts of their cultural identity that are most important to them and which of those parts they would feel comfortable sharing in the class. Another suspected reason that some of the talks and the personal connections were underdeveloped was simply time management – it was likely that a portion of the students did not prepare their lightning talks until the day before it was due. Prompting them to break the assignment down into smaller parts further in advance would likely help with this factor.

In the whole class debrief after the lightning talks, students were asked what they enjoyed most about the assignment (after being asked what was most challenging), and multiple students said that they liked learning about the things that were important to their classmates.

In the Winter 24 semester, we observed that when the students updated their lightning talks to create and deliver a formal research poster, the challenge actually shifted; the students

consistently delivered substantial social analyses and centered the cultural relevance of their selected topic, but this focus came at the cost of technical depth. For example, at least one student was unable to answer relatively surface-level questions about the material properties of their chosen topic. This was surprising, and we realized we likely overemphasized the social content after seeing those gaps in the lightning talks. To better prepare students for a truly sociotechnical analysis of their work in Winter 25 semester, we updated the assignment prompt language to emphasize the expectations for substantive knowledge of the materials involved as well as their social impact. Overall, we found the updated language and instruction resulted in much stronger and more comprehensive sociotechnical analyses.

Reflections from Section 270

In this section, it was decided that the student-led case study sequence should have a more direct connection to the semester project, so the students were asked to select and present on a technology related to computing hardware used in their selected project design. Because all students were forced to choose from a very narrow set of options first and then try to find a personal connection, both the variety of topics and the depth of students' personal connections were significantly more limited than what was observed in Section 130. Many students admitted that they struggled to find a meaningful personal connection, and that struggle was apparent in the often superficial connections made during their talks. For example, a few simply said something along the lines of, "this is relevant to me because I'm an engineering student." Similarly, when students prepared their research posters on their chosen computing technology, nearly ⅓ of the class had little-to-no social impact analysis included on their posters, despite that being an explicit expectation on the assignment sheet (see Appendix B).

The main takeaway from the experience in this section is that when the case study sequence was framed as technology-first rather than people-first, students had a harder time connecting the identity work to the assignments and appeared to see the human impact analysis as secondary, even optional.

Reflections from Section 910

Probably the most important part of this reflection is examining the "why" of the assignment redesign. In particular, why remove the focus on cultural identity and shift to thinking about historical and future cultural impacts of technological innovation. The change was largely tied to time constraints and concern that content about cultural identity should be shared thoughtfully, with time for students to process and reflect on what they are learning. Also, this kind of content is probably best taught after building some rapport with students–perhaps not ideal to implement this in week one (notice in Table 1 that it is not introduced until week five)! Given the constraints of the course, this activity needed to be placed earlier in the semester. This early time slot also

prevented us from including much of the sequence McLendon shared above. What this brings up for me is the real challenge of doing deep work (like cultural identity-centered work) – in a multifaceted class like this one. Students and faculty are asked to be fairly vulnerable – both with one another and with themselves. Establishing a strong sense of community, trust, and care is really central to doing the work well.

Reviewing samples of student work, it is clear that some were more interested in taking risks (in terms of vulnerability) than others. One student, for example, researched the history of tampons, noting that this was a technology that was particularly important to her and of course to many others who menstruate. In her historical timeline, she notes that the tampon applicator was developing because of cultural stigma and/or discomfort with touching one's own vagina. These are important cultural forces to unpack from an engineering standpoint because they so clearly impact how we approach design (what we design for – or what we design to avoid). The student was fairly comfortable with discussing this topic, and brought in some of cultural identity analysis without our prompting. Another student chose eyeglasses for her case study, and in her history and current context, noted that eyeglasses had become part of fashion. More than that, she argued that they were a symbol of "power and intelligence" associated with feminist activism. Notably, this student wore glasses, though she did not dwell on this fact in her presentation. So, again, this framing of technology in the context of cultural identity emerged, even if that was not the central focus of the assignment.

In contrast, many students wrote about histories of digital technologies (iPhone, PC, or social media, for example), and their claimed cultures and identities were largely left out of the conversation. Following the prompts, students tended to make important observations about how these technologies shaped cultural practices, and also impacted (and continue to impact) the natural world. Other students chose somewhat unexpected case studies, with topics like "the pillow" and "the t-shirt," and these cases tended to be a bit richer in detail and nuance than the digital examples. Across the board, though students' speculation about how these technologies might develop or shape the far future was less robust than expected, though this may be because 1) futuring is difficult!, and 2) we had only just introduced the idea of futuring at that point in the semester.

Taking everything in sum, I do think the revised assignment was valuable to the extent that it encouraged some important reflection about how technologies shape culture and social life; about how technologies have politics and can serve (or disrupt) systems of power or oppression. And as noted above, even without prompting, a handful of students did bring in some analysis of their own cultural identities, which was exciting to see, if also unexpected.

Future Work

Given these promising initial observations, we are currently planning to conduct a formal study of student-led case studies to better develop our methods and formally assess outcomes of this approach. During the 2025-2026 school year, the objective would be to bring this assignment section into 4-6 sections of ENGR 100, with the hope that we might recruit 1-2 colleagues to test the approach in their own sections. Assignments could be modified to better fit the project or discipline-specific content of each section, with keeping the core task of asking students to research and develop case studies of their own. Following the Winter 2026 section, we would conduct student surveys, instructor reflections, and perhaps several small focus groups where students could share their experience with the assignment sequence in greater detail. Additional funding would likely be needed to support this work; the sample size could include up to 360 students, which would require significant time and additional support for complete analysis and assessment.

Conclusion

Across all three sections, at least three conclusions emerge. First, this type of assignment takes a bit of time and deliberate scaffolding to do it well. By "do it well," we mean that the assignment and corresponding scaffolding are well-integrated into the course narrative, that the desired learning objectives and outcomes are met, and that students' come away from the assignment with a new perspective on engineering design – and perhaps also feel more connected to another as a class community. Second, course constraints (time/timing, co-instructor preferences) may present challenges to adoption in a certain contexts. We also see these constraints as opportunities to innovate and perhaps better adapt the assignment to the students and circumstances at hand. And finally, a people-first approach can enrich the nuance and depth of student work and their critical engagement with engineering.

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Appendices

Appendices include three different versions of the assignment prompt used in our study. Note that the second prompt uses tech-first language in the task statement, and the third prompt varies slightly in that it invites students to also consider the ways technologies impact future contexts. In this case, students had been asked to read and think about their relational responsibility across deep time, to design in a way that does not inequitably impact future generations.

Appendix A: Student-led Case Study Lightning Talk Assignment Prompt (Section 130)

Student-led Case Study Lightning Talk
Friday, Feb 21

Purpose

To better prepare you for engaging with upcoming case studies, this activity asks you to first create your own. As learners of a sociotechnical discipline, you must always consider the human impact of technology. We'd like you to begin developing this critical thinking process by first considering how you and communities you care about are impacted by technology.

This activity will help develop skills in research, idea synthesis, and verbal and visual communication. It is also intended to be practice at conducting and articulating a brief sociotechnical analysis of engineering design, which you will do in a more formalized way for the How It's Made poster presentation later in the semester.

Task

Reflect on your own cultural identity* and then research innovations that had a significant impact on or within that culture. Note that "significant" could mean positive or negative. After assembling your notes, you will convey your findings verbally to the rest of the class and use a large white sticky note (~25"x30") to illustrate key ideas. You will be teaching us about the technology and its cultural relevance.

You will have 5 minutes to present your lightning talk in small groups during discussion on Fri. Feb 14.

*Keep in mind that cultural identity is not simply a trait like skin color or ethnicity. Culture is a dynamic "complex and layered construct" rather than a set of fixed, inherent, and identifiable characteristics (Convertino, Levinson, & González, 2020). Gutiérrez & Rogoff (2003) provide one helpful definition of a cultural community:

> A coordinated group of people with some traditions and understandings in common, extending across several generations, with varied roles and practices and continual change among participants as well as transformation in the community's practices. For example, people draw on intergenerationally conveyed concepts, ways of talking, and belief systems that may be used and negotiated locally in communities that are often identified internally and by their neighbors in terms of ethnicity and race.

In other words, there can be and often are various cultural identities and communities within and between groups that share traits like racial or ethnic identities, but those observable characteristics themselves do not constitute culture. Everyone has a cultural identity.

What are some factors that you think contribute to your cultural identity? In what ways do you identify with a bigger community with shared values, practices, beliefs, communication, opportunities, and challenges?

Five minutes is a very short amount of time, so don't stress over packing in all the details – just give us a helpful overview of the big ideas. Here are some guiding questions you should consider as your prepare for your talk:

- What exactly is the technology and why is it important to you?
- What was the motivation for developing this technology?
    - What's the historical context?
- Who was the target audience or user group?
- Who were the stakeholders?
- Who benefited? Who was harmed? (consider people, of course, but also environmental impacts)

Assessment

This 3-point activity will be assessed for completion. To earn completion credit, you must:

1. Submit the notes you compiled to prepare for your talk to Canvas before class on Feb 21
2. Deliver your lightning talk during class
3. Engage thoughtfully and respectfully with your classmates' lightning talks

Appendix B: Student-led Case Study Poster Assignment - Restricted Prompt (Section 270)

Case Study Series Part 2: Computing Technology Poster Presentation

Submit poster to the printer by noon on Monday, November 4 (or earlier)
Poster Fair Date/Time: Tuesday, November 5
Location: EECS Atrium
Students will present during one of the two shifts: 12-12:40 **or** 12:40-1:20

Purpose

Poster presentations are a common presentation format at conferences, academic events, job fairs, and other large professional gatherings. This assignment will give you practice with creating and presenting a poster.

The research you do individually for this assignment will inform your team's selection of a specific problem to solve for your final project. Note that this deliverable is due after the team project pitch and intro section deliverables, but you will have to have completed the research part of the assignment to finish those earlier ones. It's helpful to think of the poster in two stages:

1. Research stage (done before Oct. 31)
2. Designing and printing stage (done before Nov. 5)

Task

This is an individual assignment and listed as Task 1 on the Project Pitch and Report Introduction Assignment. Based your team's final project idea, your task is to:

1. Do background research on prior approaches to solving this problem/design challenge (consider social, environmental, and physical/technical factors). Each team member will be researching a different prior approach. The goal of this research is to inform your sociotechnical analysis of the technology involved in your final project idea.
    a. To what extent is this technology helpful and/or harmful and to whom/what?
    b. Do existing solutions to this problem have weaknesses?
2. Create a poster that communicates this nuanced analysis of your chosen technology (prior approach). Your research and analysis should gather enough information to create an informative poster and deliver a roughly 5 to 7-minute talk (i.e. this is not a lengthy research paper).
3. Print and pick up your poster. Please review these detailed instructions for getting your poster printed.
4. Present your poster during class time in the EECS atrium on Nov. 5.
5. Declare victory!

Specifications: In Discussion you will be taught about effective practices for creating and presenting technical posters. Use what you learned about concepts such as cognitive load and information scent to plan and make your poster.

Presentation Shifts

We recommend arriving at least 5 minutes early to set up.

Students presenting from 12-12:40	Students presenting from 12:40-1:20
[student names listed here]	[student names listed here]

Criteria for Success and Assessment

Visual impact and clarity: Poster has a strong "information scent" and balances informative function with cognitive load considerations. It's aesthetically pleasing, well organized, and easy to follow without needing verbal guidance.

Verbal delivery: The presentation of the poster is clear, engaging, and shows evidence of comfort and familiarity with the material without being scripted or memorized.

Sociotechnical analysis: The poster & presentation are centered on a holistic analysis that combines technical factors with economic, environmental, ethical, and/or cultural considerations.

Technical accuracy: All technical information included is correct and relevant.

Formatting & Finishing: Poster follows formatting requirements, demonstrates professionalism in writing, visuals, and design and has been checked for errors.

Assessment categories for submitted work:

Full Competency Work demonstrates full competency	50
Moderate Competency Work demonstrates moderate competency with minor areas for improvement	45
Some Competency Work demonstrates some competency but requires significant improvement	40

Little Competency Work demonstrates very little competency	35
Insufficient evidence provided It's not nothing, but there's not much here.	0-30

Note: Nov 5 is Election Day in the U.S.. Visit govote.umich.edu for information about voter registration, voting locations, ballot information, and other general voter resources. 🗳️

Appendix C: Student-led Case Study Assignment - Alternative Prompt (Section 910)

Technological Innovations – Research & Presentation Activity

Sept 19, 2024

Research & Report Out

Purpose

Today you will practice gathering information about a technological innovation or invention and then teach the class what you've learned. This activity will help develop skills in research, idea synthesis, and verbal communication. This activity is also intended to highlight the value of connecting political, cultural, and historical narratives to our learning, particularly as we develop critical analysis skills.

Task

There are three parts to this activity. Please read each part carefully:

1. Choose a technological innovation or invention to study. Research the history of this technology, including its development and the "need" or problem is was meant to solve — or, if there was no "problem," identify the "why" of its invention, if possible.

2. Explore the various ways this technology impacted people, the economy, and the environment.
    a. Be specific in terms of who or what might have been more or less positively impacted (acknowledging that technologies tend to impact people unequally across time, culture, and geography).
    b. Note positive and negative outcomes — and those that are ambiguous or somewhere in between.
    c. Identify ways in which this technology aligns with particular political, social, or cultural values/beliefs/ideals.
    d. Also note the long-term (deep time) outcomes of this innovation – identify ways these long-term outcomes/impacts have or have not been considered/addressed. The idea of "unintended consequences" may be useful to apply here.
3. After assembling your notes, you will convey your findings verbally to the rest of the class. You will be teaching us about the innovation and its cultural relevance. **You will have 5 minutes to present your findings in**

Discussion on Thursday, Sept 26 and are encouraged to prepare a visual or use the whiteboard to help you illustrate key points. **Please also provide notes (speaker notes if you create slides or a Google doc if you choose to use the whiteboard) and links to your sources. Be sure to use high quality sources!**

Five minutes is a very short amount of time, so don't stress over packing in all the details – just give us a helpful overview of the big ideas.

Assessment

Case study presentations are scored out of 100 points:

100 - thoughtful, well-researched, nuanced, and informative

75 - mostly there but not totally developed

50 - not nothing but clearly lacks effort