

Communicating Effectively with a Range of Audiences: Audience Avatars in Engineering Design Education

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"Communicating Effectively with a Range of Audiences": Audience Avatars in Engineering Design Education

Abstract

Engineering Capstone Design courses offer immersive experiential learning opportunities, allowing students to step into the shoes of engineers. However, these courses can provide even more significant benefits by viewing them as immersive communication courses. Current literature focuses on using improv to introduce flexibility into engineering communication, incorporating communication into the engineering curriculum as a whole, and using avatars for communication education in general. However, a synthesis of these techniques is currently lacking, namely, using avatars for teaching immersive, multifaceted engineering communication in a capstone course. Such an approach can transform students into responsive, flexible, and adaptive communicators.

To facilitate this transformation, we propose a new academic practice/design intervention by introducing audience avatars in our engineering design capstone course. Our school defines effective communication as the maximization of appropriateness and responsiveness, aligning with ABET's student outcome three, which demands adaptability to diverse audiences. This paper outlines the implementation of four audience avatars in the context of an engineering design capstone course: these avatars support students' communication success by enabling deeper audience analysis and understanding of diverse audiences' competing needs, communicator preconceptions, content expectations, technical understandings, and more. Throughout the course, students must practice communicating information about their projects to project sponsors, engineering professionals, Expo judges, as well as the public. This requirement forces students to understand a range of audiences to communicate appropriately; that these audiences revolve and rotate throughout the semester forces students to practice responsiveness.

Becoming appropriate and responsive technical communicators is incredibly challenging, and the audience avatars exist to assist students through this challenge. We created four avatars; one for each category of audience students are asked to address. The avatars do not analyze the audiences for the students, but instead are designed to make the audience more "real"; enabling students to practice audience analysis with a fleshed-out representation, instead of some phantom that they cannot grapple with. These avatars enable students to ascertain audience preferences, anxieties, etc., and practice making appropriate communication decisions. By supporting students through avatars, we can help them make better and more effective communication choices. Through multiple avatars, for singular information being communicated, we teach them to be flexible and responsive communicators.

This is a WIP paper with curricular interventions introduced in Fall 2023 and recently concluded in spring 2024 semester. The preliminary impact of the proposed approach is planned to be evaluated using a combination of qualitative and quantitative research methods, which could include, pre- and post-surveys, interviews with students, faculty, sponsors, and Expo judges, as well as scores provided by Expo judges. These results will help educators assess the benefits of the approach and develop a framework to integrate effective communication teaching and practice skills within the curriculum for engineering design courses.

1. Introduction

1.1 Background

Engineering Capstone Design courses offer immersive experiential learning opportunities, including the opportunity to practice communication across a wide range of audiences. There is documented literature pointing to using improv to introduce flexibility into engineering communication, incorporating communication into the engineering curriculum, and using avatars for communication education in general. However, a synthesis of these techniques, namely, using avatars for teaching immersive, multifaceted engineering communication in a capstone course, is currently lacking. This approach can transform students into responsive, flexible, and adaptive communicators. Hence, the authors propose a curricular intervention utilizing audience avatars to teach students to be flexible and responsive communicators.

1.2 Engineering Communication Goals

To produce engineers capable of bridging the gap between technical expertise and societal impact and to align with ABET standards, the Webb Communication Program at the Woodruff School has established a guiding framework that defines our understanding of what effective communication is. Specifically, this framework names appropriateness and responsiveness as the foundation of effective communication. These are defined in the following ways:

- 1. Appropriateness: The quality of a **prepared** message that reflects its suitability in addressing the specific context, audience, and purpose, resulting in a communication that is ideally curated and positioned for maximum effectiveness.
- 2. Responsiveness: The quality of being **adaptable** and receptive to the evolving dynamics of a communication context, enabling timely and appropriate adjustments to effectively engage with the audience and changing audiences.

Appropriateness and responsiveness were selected as top learning outcomes for the Webb Communication Program because they require engineering learners to transform from engineers who follow communication guidelines to engineers equipped to make decisions about communication design.

These standards align with established understandings from the field of composition studies (a field technical and professional communication rest upon), specifically, the rhetorical situation. As Figure 1 shows, the rhetorical situation is the basic structure of any communication; it is diagramed as a triangle wherein the points are labeled with the powers at play in the communication: the communicator, the audience, and the message or purpose of the communication. Throughout the interaction, these points define and change one another. Additionally, this triangle is encircled, and the circle is labeled as context to demonstrate how context plays a vital role in what will be



Figure 1 Diagram of the rhetorical situation.

effective or ineffective in the interaction. Analyzing a communication interaction at a detailed level empowers students to make effective communication choices. This process allows them to assess and compare the factors influencing the interaction, enabling them to make informed decisions about the most appropriate communication choices for their needs. While all the points are influential players in the interaction, audience is a critical consideration and generally receives its own analytical focus: audience analysis, in which speakers assess the audience to the best of their ability to make assumptions about the audience that will enable them to design ideally appropriate communications.

1.2.1 Scenario-Based Learning

Our program recognizes that communication effectiveness hinges on the specific environment in which it occurs. We employ scenario-based learning to enhance communication learning outcomes, providing students with an immersive engineering communication experience. Scenarios serve as valuable tools, allowing students to craft communications tailored to a given situation by providing them with audiences and context to analyze. This understanding of audience and context is crucial for designing ideally appropriate communications. Additionally, students need to understand appropriateness to succeed at responsiveness because responsive communication choices are developed as students deepen their comprehension of appropriateness. Teaching and assessing responsiveness in an educational setting pose challenges due to the difficulty in standardizing practical assignments and their assessments.

However, design courses are uniquely suited to teach this aspect of the curriculum because they require students to participate in communicating their design problems, processes, and solutions to different stakeholders and interested parties. Our school's mechanical engineering capstone design course is a single-semester course offered to seniors who have taken courses on design [1] and other required engineering courses that involve background and preparation for writing and presenting technical content to technical audiences. The students at this stage have not received standardized formal training on effective communication strategies for persuading the public or people with non-engineering backgrounds. Engineers communicate in numerous genres, formats,



and modes to convey vital information to diverse types of decisionmakers. Proficient communicators in this field must be ready to adapt to the demands of their respective situations and make active, thoughtful choices. In this course, engineering students not only make technical design decisions for their class projects but are also expected to make

Figure 2 Concentric diagram demonstrating increasing analytical specificity.

communication design decisions for presenting their projects across different genres and to various audiences. Incorporating responsiveness as an assessment standard in this course aligns with our comprehensive approach to meet the ABET communication standard, challenging students not only to design static communications for diverse audiences but also to adapt to evolving needs. As Figure 2 demonstrates, situation analyses can be deepened through audience analyses and audience analyses can be furthered through audience avatars. The use of an audience avatar aids in audience analysis, helping communicators make accurate assumptions about their audience, ultimately leading to ideal communication choices.

This Work-In-Progress (WIP) paper presents an approach that the faculty of the senior capstone design course took to embed effective communication design strategies within the course curriculum, as well as its preliminary impact, as inferred through various research methods.

1.3 Research Questions

We set out to understand the efficacy of the program through the following research questions:

- 1. Do avatars help students design effective communication choices for a given audience (appropriate)?
- 2. Do avatars help students design effective communication choices for changing audiences (responsive)?

1.3.1 Approach

To address the research questions, a literature review was conducted to identify the latest guidelines and framework for teaching effective communication skills to engineers in higher education. A literature study was also conducted to gain inspiration for novel approaches utilized by other educators and practitioners. Specific audience avatars were designed and shared with students during a common lecture period (spring 2024), that emphasized effective communication as appropriate and responsive. Assignments and rubric for the Expo were created and/or revised to call attention to required appropriate communication decisions. Pre- and post-intervention surveys were conducted to assess students' preconceptions about appropriateness, responsiveness, and their comfortability presenting as well as any change that occurred over the course term.

2. Literature Review

Current literature in the communication and engineering education space focuses on the need for engineers to learn communication and emphasize this through curriculum reviews and cross-sectional looks at communication across the United States [2]–[4]. Some papers suggest adding communication minors [5], others examine reducing student anxiety during public speaking [6], while yet others track the perspective of students on communication throughout their academic career [7]. However, when it comes to improving the communication pedagogy in the engineering curriculum, little coalesce on best practices has been made.

Improvisation (improv) has been recommended in multiple papers, as it is suggested to help students think on their feet and be ready and able to explain difficult concepts without much formal preparation [3], [8]–[10]. In the context of capstone design courses, most papers focus on

the design of the course, with an emphasis on design and engineering and only a cursory mention of communication [11]–[14]. Other research focuses on improving the communication and relationship between the student teams and their industry sponsors, but the primary goal in these papers is to improve the students' exposure to industry and reduce friction with the sponsors, not improve the students' communication skills in general [15]–[18]. Several papers do mention role-playing alongside their calls for improved communication pedagogy, but they do not justify this recommendation with surveys or data, nor do they examine the results of implementing role-playing in a communication course for engineers [19]–[21].

The concept of personas is common in software and design engineering, where detailed, research-based documents describing the needs, issues, and requirements of simulated users provide design considerations for engineers [22]–[25]. These personas give engineers a view of the design problem through the lens of actual users and are a common tool in design engineering practice. Personas are similarly used in business and marketing to understand customers and design marketing strategies [26], [27]. Persona development for engineering and business decision making has been studied since the early 2000s up to the present day [28]–[31]. However, these personas are only used to aid engineers to make better technical design decisions; they are not used to aid with communication decisions.

Personas are popular as communication educational tools outside the field of engineering. Maria Kopacz introduced the idea of using audience personas as a pedagogical tool for audience analysis in a 2022 paper, tying together ideas from consumer marketing, customer personas, audience analysis, and consumer narratives [32]. Her paper describes an activity in which students create personas and analyze their audience through this process. This paper is foundational to current research in using personas for teaching communication and audience analysis. However, this paper only presents persona creation as a tool and does not study its effectiveness in teaching communication.

Communication education across curriculums has embraced the use of scenario-based learning. Specifically in medical fields, scenario-based learning is used to teach students how to engage with patients to get better information from patients and to communicate medical information back more appropriately [33], [34]. Additionally, it has been embraced to increase the quality of e-Learning [35], [36] and to better engage "passive learners"[37]. Vincent D. Robles and Matthew J. Baker's "Using Case-Method Pedagogy to Facilitate Audience Awareness" demonstrates how providing students with more information about scenarios increases student confidence to "us[e] appropriate evidence and effective tone and style" (p. 204 in [38]), and the results of Falkner and Stålbrandt's study reveal that authentic learning scenarios "helped the students improve several employability skills" (p. 181 in [39]). All these studies agree that using scenario-based learning enables students to make more appropriate choices.

Concerning communication appropriateness and responsiveness, the research surveyed shows successes in pedagogical integrations. Most research we surveyed only supported appropriateness, without any consideration for responsiveness. While improv is a pedagogical application used to increase students' communication responsiveness, its integration poses a challenge for schools with large enrollments like ours. Personas help students develop

appropriateness, but research does not show them used to develop responsiveness. We build on existing successes of persona use by marrying this tool with avatars used in scenario-based learning in medical disciplines. In our school, we use the term "avatar" as opposed to "persona" to avoid confusion when referring to communication audiences as opposed to simulating end users. More importantly, when we refer to "avatars," we mean to evoke a representation of the intended audience. Our "avatars" are understood with the same definition as Kopacz's audience personas as "a unique audience analysis tool in that it relies on a detailed description of a single fictional individual as its organizing principle" including "relevant traits, habits, preferences, needs, goals, and challenges of the core audience" (p. 147 in [32]). By bringing this use of personas/avatars to engineering education, we will demonstrate how students can make both engineering and communication design decisions.

3. Intervention Development

3.1 Capstone Design Course

Almost all ABET-accredited undergraduate engineering programs require a Senior Capstone Design course for senior undergraduates to synthesize practical solutions for real-world, openended design problems. All students in this course within our school can form their teams and elect to work on industry-sponsored, entrepreneurial, or projects from local communities, organizations, etc. Students receive numerous opportunities to practice their communication skills with a wide range of audiences. The entire course is split into three five-week sprints with an interim report and presentation requirement at the end of each sprint. Students are required to meet with their faculty instructor once weekly as a team and make interim report presentations to their faculty, and their peers enrolled in the Capstone Design class every five weeks. Student teams working on external sponsored projects also hold weekly meeting with their external sponsor/client to update them on their progress and solicit feedback. At the end of the semester, students showcase their projects at the Institute-wide Capstone Design Expo, an open to public event, where experts from industry and academia are invited to judge the teams.

3.1.1 Communication with Peers

Students in the class work in teams as well as provide critiques to other teams through guided peer feedback during interim and final report presentations. Teams are encouraged to prepare a team charter and document their collaboration methodology, which outlines which tools they will use to communicate with each other, i.e., text, email, MS Teams, etc. There are several opportunities to train students to learn how to be effective in these peer to peer communications, however, our work in this paper is not focused on this specific aspect.

3.1.2 Communication with Faculty

Students present weekly updates through a combination of written and oral presentation modes. They also prepare technical reports at the end of each 5-week sprint. They are provided with a guideline document outlining the critical sections expected in the report. We decided to focus on the technical report assignment and develop an avatar that would help the students develop more effective reports, which are eventually graded by faculty.

3.1.3 Communication with Sponsors

Students working on externally-sponsored projects present weekly updates through written and oral presentations. They also communicate using other electronic means on an as-needed basis. One common feedback that the course administrators and instructors often receive is that students spend too much time on course-related assignments instead of developing the specific technical solution to their problem. Based on sponsor/client interviews, we learned that during the weekly progress update meetings, students were presenting sponsors with the exact same content they would prepare for their faculty advisor. The faculty instructors for the course are typically interested in assessing the student's ability to apply the design process, whereas the sponsor is interested in the end result. This dichotomy of expectations causes some friction and confusion between students and sponsors; demonstrating the need to develop an avatar for sponsors.

3.1.4 Communication with the Public

Students are encouraged to participate in the end-of-semester, where they have the opportunity to engage with the public. Since students from across 11 different schools within the Institute participated in the Expo, a common scoring rubric was developed. The specific rubric is presented in appendix A. They are also encouraged to utilize their professional social media presence such as LinkedIn.com to inform their networks about their project, celebrate their work/partnership with external sponsors, and spread the word about the Expo. The public communication requirement of the course led co-authors to develop public facing avatars – one specifically for an external judge and another for a non-engineering layperson.

From the above analysis, it is evident that throughout the course, students must practice communicating information about their projects to a wide range of audiences. This requirement forces students to understand a range of audiences to communicate appropriately; that these audiences revolve and rotate throughout the semester forces students to practice responsiveness.

3.2 Avatars Development Process

An effective audience avatar allows communicators to avoid pitfalls and make drafting easier. This should lead to a better communication deliverables because communicators can better understand their audiences' needs and pain points, allowing students to determine the ideal focus and style more accurately. To develop the avatars, the paper's authors (also course instructors) discussed possible scenarios and avatar qualities that would closely imitate professional engineering design communication situations. We used introspective questions to guide us into a deep analysis of the selected audiences. Significant questions from this process included:

- What is this person's primary goal?
- What are this person's key values?
- What pain points might they have (frustrations/concerns/anxieties)?
- Might anything about this interaction risk alienating this audience?
- What is this person's decision-making process?
- What challenges are they facing that relate to this interaction?

- How technical is their understanding of the content?
- How comfortable are they with technical language?
- What questions will they likely ask?

We took the answers to the questions and developed a short story about each avatar, giving them a name and a profile photo. We developed the story instead of sharing the list of answers to these questions because, while we want to help students analyze audiences to make more effective communication choices, we want students to do this analysis independently.

To help students develop responsiveness, the Capstone Design course requires students to communicate about their project to diverse audiences who have very different needs and expectations from communications. Therefore, we designed four different avatars for students to consider as they prepared for, planned, and anticipated different communication tasks. Full details of these avatars and the scenarios they represent are in appendix B and C, and a summary is provided in Table 1.

Avatar Name	Corresponding Assignment	Avatar's Role
Jon Fox	Design Report	Design Supervisor
Sarah Mitchell	Expo Presentation	Project Sponsor
Marcus Johnson	Expo Presentation	IP Lawyer
Mary Turner	Expo Teaser Video	Prospective Georgia Tech Mom
	Expo Presentation	

Table 1 Summary of course avatars and their applicable assignment roles.

Among these, Jon Fox stands as an isolated avatar, representing a specific communication task the design report. Students focus on developing appropriateness in a report tailored to Jon's unique needs and expectations within the static genre. In contrast, Sarah Mitchell, Marcus Johnson, and Mary Turner form a set of avatars linked to a communication-intensive event, the Capstone Expo. This event involves multiple communication tasks, such as an Expo teaser video, Expo design review poster, and Expo presentation. The video, as a static deliverable with the goal of being universally inclusive, prompts students to envision Mary as their target audience. On the other hand, the Expo poster and presentation pose challenges in student responsiveness. Here, students must anticipate how diverse audience members will interact with their team's Expo informational experience.

Avatar design was based on anecdotal evidence as opposed to surveys or quantitative data for expediency and intention. Our intention was not to create avatars that represented a typical average Expo attendee. Instead, our goal was for the avatars to represent possible extremes that students should consider how they would interact with. This helps students anticipate how they might respond in interactions with "difficult" audiences; hopefully enabling them to be comfortable when presenting to a wide-range of audiences, which includes average attendees.

In designing audience avatars for engineering capstone courses, diversity and inclusivity were key considerations. Each avatar was intentionally crafted to reflect a range of racial, ethnic, and ideological backgrounds, ensuring representation across various demographics. We used premium access to Canva's digital asset catalog to select photo representations of each avatar. These decisions were not modeled on any real persons, and any similarities are purely coincidental. Our aim was to not only accurately reflect the diverse demographics students are likely to encounter but also to affirm that individuals from all backgrounds have a place in engineering conversations. For instance, Jon Fox, depicted as a middle-aged white man, represents a specific demographic common in engineering leadership roles, while Sarah Mitchell, an Asian woman in her late 30s, adds diversity in gender and age. Mary Turner, a middle-aged white woman suspicious of academia, represents another demographic encountered in our state. Lastly, Marcus Johnson, a black man in his early 60s with a strong interest in ethics, introduces diversity in both race and age, providing students with exposure to a broader spectrum of perspectives. By incorporating such diverse avatars, students are better equipped to navigate communication challenges in their capstone projects, fostering cultural competence and understanding of diverse stakeholder perspectives. Additionally, this deliberate effort fosters an inclusive learning environment where all students feel seen, heard, and valued, regardless of their own backgrounds or identities.

4. Curricular Intervention

As an ongoing intervention, there were key differences between how the avatars were integrated into the course and introduced to students. In fall 2023, the avatars for the Expo were created after the communication lecture occurred; thus, they were dispersed to students via email and the course resources repository. In spring 2024, all avatars were explicitly discussed and students were given time to read them fully in class. In addition, we revised assignments and updated their evaluation rubrics to emphasize the technical and non-technical communication expectations. This section will elaborate on each of these intervention strategies.

4.1 Classroom Lecture

The avatars were introduced to students during week five of the semester in a 110-minute class session focused on how to design effective communications for the different communication tasks in the Capstone Design course. A pre-intervention survey was conducted in the spring 2024 semester at the beginning of the lecture and the details of that survey are in the later section of this paper.

- 1. This lesson began by explaining how sound design does not guarantee an audience's use or interest, and that, instead, engineers must make effective arguments for their designs by preparing appropriate communications and being responsive to audience needs.
- 2. We demonstrated how appropriateness and responsiveness can be enabled when students understand the powers at play in a communication and discussed how rhetorical situations can be analyzed to make communication design decisions.
- 3. We explained how different audiences corresponded to different communication tasks and genres, as well as how they ultimately care about different information.

Table 2 was taken from a course lecture slide. The purpose of the slide was to discuss how each assignment is a different interaction with different audiences. Therefore, these differences significantly change which communication choices would considered actionable, appropriate, and/or responsive in the given interaction.

Task	Audience	Purpose
Design	Jon Fox	Make justifications for your process and findings .
Report	Section-Level Users	
	(Faculty)	
Expo Teaser	Mary Turner	Generate interest by conveying the problem 's
Video		relatability.
Expo	Marcus Johnson	Make an argument for your solution 's innovation.
Presentation	Mary Turner	
	Sarah Mitchell	
Client	Sarah Mitchell	Clarify expectations, possibilities, and solution design.
Management	(Sponsor)	

Table 2 Table highlighting how audiences desire different messages.

4.2 Assignment Design

4.2.1 Design Reports

The avatar designed for Design reports, Jon, was first released in fall 2023 semester. The coinstructors provided feedback to enhance the avatar with additional information on the various other "real-world" stakeholders who might use specific sections of the report. They emphasized that it is important for students to write technical reports with specific sections that cater to the specific needs for certain other audiences. For example, if the team decides to pursue Intellectual Property (IP) protection, then the IP lawyer might be interested in the section on 'Existing Products and Patents' to understand the background and assess the novelty of the proposed solution. Whereas the project's sponsor might refer to this same section to know if the proposed solution might infringe any existing patents and/or if they need to gain license to practice the proposed solution. The details of these stakeholders are shown with the description of the Jon Fox avatar in appendix C.

4.2.2 Expo Teaser Video

The Expo teaser video assignment was designed to require students to practice garnering interest in engineering towards adverse or otherwise difficult audiences. This, as a standalone static assignment requires students to practice appropriateness. Additionally, by considering Mary as a particularly complicated Expo attendee, students learn to anticipate being responsive. Students were also given visual handouts (included in appendix D) that explained the avatars in detail. After reading the avatars and diagramming the forces at play for the Expo teaser interaction (Figure 3), student teams were given time to make choices on the design of their videos.

Students are given specific advice to only present the problem and not to divulge any aspects of their solution. This advice is



Figure 3 Diagram of video teaser interaction.

critical for students working on projects that might end up as patentable inventions, and so students mustn't inadvertently disclose their solutions to the pulpit prior to filing for their intellectual property protections. Per the Institute's guidelines, students can own their IP that results from the course if they were not hired to work on the project or collaborated with other Institute employees to develop the invention.

The TA for the class graded the Expo teaser video using the following guidelines. The TA shared detailed comments to the teams to hopefully encourage them to revise and reuse them when making the full final video for the expo.

Basic Requirements

- Is the video within 50-60 seconds?
- Is the sound quality and volume consistent?
- Is all text easy to read (size visibility, color contrast, time provided)?

Situational & Audience Requirements

- Does most of the video focus on introducing and explaining the problem?
- Is the video interesting; does it promote a desire to attend the Expo?
- Is the video designed for non-specialized audience in a way that makes them feel like they will belong at the Expo?
- Does the video attempt to connect the engineering problem to public or sympathetic concerns?

In summary, the co-authors developed four detailed avatars, developed new communications design training lecture, developed assignments and updated evaluation rubrics. The following section will present the assessment tools used and planned to be used for validating the hypothesis for the research questions driving this research study.

5 Assessment Tools

Various assessments are planned to answer the research questions and to help improve the implementation of the effective communications design modules for future semesters. Largely, our study uses student self-assessment via surveys to determine the effectiveness of avatar use on student communication confidence and educational growth. Specifically, pre- and post-intervention surveys were designed (significant questions are listed in appendix E and F) to gauge students' preconceptions and feelings about communication responsibilities and how these changed over time with the implementation of avatars and guided avatar use for communication design decisions.

5.1 Pre-Intervention Assessment

Before class, students took a short survey through Canvas to assess the students' perceptions about their ability to communicate with a wide range of audiences. The survey questions are listed in appendix E. Student responses to the questions suggested collective anxiety regarding the necessary compression of a weeks-long project to a short presentation. Responses across all three questions demonstrated that students have a deep appreciation for the need to empathize with audiences, but that doing so with limited information is difficult. For example, one respondent wrote that they, "Think about how you pictured topics and thought about your project before you gain [sic] so much knowledge on it. Essentially imagine yourself in their shoes." Concerning a key challenge when presenting to the public, a different student wrote "The time. You didn't want to waste their time, but you didn't want to gloss over something they would find important." Largely, students demonstrated a significant appreciation for the need to accommodate audiences as well as anxiety over the best process to determine ideal accommodations. To question three, "How do you ensure your communication is usable/actionable by your audience?," eight respondents specifically suggested asking people outside of the class or the field of engineering to review their communication drafts in order to prepare for public presentations. Another nicely summed up the necessity of making assumptions about our audiences with the response "I guess."

While there were some respondents who focused more on their goals as the speaker—"Getting everything I want to say said in a timely manner"—overall, the survey showed that senior-level engineering design students seem to have a sincere desire to communicate to diverse audiences, and that they know accommodation is important. However, they do not have a stable process for creating audience assumptions and using those to prepare their communications to be ideally responsive to evolving scenarios.

5.2 Post-Intervention Assessment

The post-intervention assessment was an anonymous survey administered after the fall 2023 and the Spring 2024 Expo event. This survey consisted of questions that prompted respondents to consider different aspects of the Expo and their preparedness for it. The survey responses for Fall

2023 helped the authors identify ways to reduce/reword the questions for the survey offered in Spring 2024 semester. The revised and updated questions from Spring 2024 are listed in appendix F.

Specifically, question 13 "Please explain how the avatars helped you make specific choices on the content or the format of your expo presentation" was designed to address **appropriateness**. Other questions that seek to address appropriateness were as follows. They assesses how students designed the basic structure of how audiences would experience their information.

- Question 22. Explain or share specific examples of how you or your team refereed to the **Jon Fox** Avatar to make specific communication decisions for **writing** the report or preparing the fabrication package.
- Question 23. Explain or share specific examples of how you or your team refereed to the **Jon Fox** Avatar to make specific communication decisions when preparing your class **presentations**.
- Question 24. Explain or share specific examples of how you or your team refereed to the **Sarah Mitchell** Project Sponsor Avatar to make specific communication decisions when interacting with your **sponsor**. Enter "N/A" if your project did not have a sponsor. If your project had a sponsor and did not use this Avatar then enter "Did not use."

Question 15, and its sub-questions intended to assess the validity of our hypothesis of whether the intervention helped with **responsiveness**. Figure 4 displays how this question was structured.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I was confident presenting at the expo	0	0	0	0	0
I had examples/stories prepared for each audience type	0	0	0	0	0
I was confused on how I should prepare for the expo.	0	0	0	0	0
I am confident in my ability to respond in the moment to different audiences	0	0	0	0	0
I am less anxious/worried about speaking to different types of audiences	0	0	0	0	0

How well do you agree with the following statements. Because of the communications guidance/training through audience avatars, ...

Figure 4 Visual representation of the layout of the question(s) regarding responsiveness.

In addition to above, the following questions were included in the survey to assess the responsiveness objective of the intervention.

- Question 16. Describe how you used one or more avatars to plan to alter how you responded to the expo audience in real time.
- Question 17. Did you use the **Mary Turner** avatar to help you make communication decisions while preparing your Expo Video?
- Question 18. Did the diversity of the avatars adequately help you prepare to respond to the diversity of the actual expo audience you encountered?

In the future, in additional to self-assessment, student performance on the Expo teaser video, final video for the Expo, their technical report writing assignment (based on faculty interviews) as well as their scores from the Expo will be holistically considered to assess the impact of the curricular interventions.

6 Results & Discussion

The curricular interventions described in the paper were implemented in Fall 2023 semester and then revised and reimplemented in the current spring 2024 semester. The results from the assessment tools used will be compiled for presentation at a later stage.

Our post-intervention results (from end of fall 2023) demonstrated that we needed a more explicit introduction to the avatars than what was done in fall 2023. This is clear because only two respondents or 3% (2 of 81 total respondents) said that they received Expo audience avatars as preparatory guidance; thus, only these two answered the questions that pertained to the avatars in the post-intervention survey. As mentioned in section 5.2, the survey itself was revised and administered at the end of the spring 2024 semester. A total of 46 respondents completed the survey and 23 of the respondents said "Yes" to the question, "Were you introduced to the Audience Avatars to design your communications for faculty, sponsor, expo audience, etc.?" The rest of this section summarizes the results from the spring 2024 survey.

Overall, the student responses to the survey were mixed, showing a range of responses, including adopting avatars as a communication decision-making tool and rejecting this tool. We believe the adverse attitude towards using the tool could be attributed to various factors covered under section 6.3 .Of the 23 respondents who claimed to have been introduced to the Audience Avatars, 14 respondents (roughly 60%) said "Yes" to the question, "Did you find the audience avatars helpful in your expo prep?". In addition, the preparation and confidence of students in presenting at the expo were compared between students that were introduced to the avatars and those who were not. Of the students that were not introduced to the avatars at all, 65% said they were very or extremely well prepared, with 82% saying they probably or definitely received enough guidance. Of the students that were introduced to the avatars, 74% said they were very or extremely well prepared, with 96% saying they probably or definitely received enough guidance. Below, we show how students who adopted the avatars demonstrated appropriateness and responsiveness; we use student rejection and critiques to make recommendations to pedagogical iterations.

6.1 Appropriateness

While some respondents claimed that the introduction of the avatars itself in the lecture did not help, several signaled that they did help them achieve communication appropriateness. For

example, concerning the use of Jon Fox to prepare for class presentations, one respondent wrote, "We practiced presenting to this avatar like any other person"; concerning the use of Sarah Mitchell to design communications with sponsors, one respondent wrote, "We made sure to include the solution as part of every aspect of communication." These responses demonstrate how students considered what different audiences consider necessary and appropriate engineering information and designed their communication to this standard of appropriateness.

When asked to explain how the avatars helped students make communication choices for their expo presentation's content and format, respondents wrote:

• "The avatars helped to narrow down the amount of technical content included so that someone less technical could still understand what was going on."

These comments demonstrate how students used the concept of appropriateness to be decisive about the inclusion and exclusion of content in order to enhance the overall information experience. As novices, students tend to struggle with deciding which information from the semester-long project should be prioritized. Here, the avatars helped students make informed choices as they prepared their communications by providing insight into audience expectations.

• "We tried to make a diagram on the poster to help with the pastor's wife character, and we put the financial benefits for the more results oriented [sic] people."

• "Was a good tool to make us consider all the types of people that would be at the expo." These comments also demonstrate how students used the avatars to prepare their expo communications. Empathizing with Mary Turner led a team to design a diagram to clarify their communication, and they balanced this simplification with more details about financial benefits. This is an excellent example of a student team thinking about how to maximize the appropriateness of a static communication (poster) to diverse audiences.

6.2 Responsiveness

The students' perception of the avatar helpfulness was important since this led directly to helping them prepare for the expo and deliverables. Question 12 was used to filter results from questions 17 and 18, which asked whether they used the Mary Turner avatar in making a video and whether the diversity of the avatars helped them be responsive to different audiences at the expo. Students that did not find the avatars helpful were much less likely to use the avatar for the video and to find the diversity helpful. Only 11% used the Mary Turner avatar for their video, while only 22% said the avatar diversity helped them with the expo. However, for students that did find the avatars helpful, 50% used the Mary Turner avatar for their video and 86% found the avatar diversity helpful for preparing for the expo. These results indicate that students' perception of the avatars' helpfulness greatly increases their use of the avatars in certain cases, and also helps them better prepare for the expo. The students' perception of avatar helpfulness can be increased by receiving additional feedback outside of the lecture.

When respondents who agreed that the avatars were useful were asked to "explain how the extremes that the different avatars represented helped [them] present with confidence," we received 11 responses that demonstrated students understood responsiveness. Key among those included:

• "I was able to consider these extremes before hand [sic], understand where people with the different perspectives are coming from, and learn how to relate with them and make the content important or relatable for them."

This response demonstrates both appropriateness and responsiveness; by selecting the most appropriate content for different audiences and by showing how the student considered how they might need to adapt their communications based on different and diverging audiences.

• "Helped me gauge to engage with different audience in a way that would make everyone interested."

Likewise, this response signals that the student had considered the need to analyze a changing audience to respond effectively.

When asked to describe how they "used one or more avatars to plan to alter how [they] responded to the expo audience in real time," four students wrote:

- "I used the Mary Turner avatar to make the video and poster presentation easy to understand for non-technical audience members."
- "Including or not including the technical information and how I communicated performance metrics."
- "I used the avatar of [sic] parent or regular people to practice explaining my project at a high level and easily understandable by everyone."
- "Making sure I don't use very technical language for people who are just parents and students coming to see the projects."

All these responses show students understand key communication learning objectives such as audience analysis, content decisiveness, appropriateness, and responsiveness. We can see students appreciating the need to be adaptable communicators. This is a pedagogical success because students learned not only that—as the information creators—they bear the responsibility of clear communication, but also that the use-values of the various engineering information they created will be determined differently by different audiences and this determination will be informed by the appropriateness of their communication.

6.3 Recommendations

After reviewing and analyzing the results of the survey, we have four recommendations. Many of these will need to work in tandem to be successful; however, they are separated below for clarity.

1. Facilitate Student Buy-In to ABET Communication Objective

Criteria three from ABET student outcomes is, "an ability to communicate effectively with a range of audiences." From the responses, about half of the students seem either adverse to or indifferent about their need or ability to communicate with a range of audiences, especially those outside of engineering-specific specialties. For example, common responses to survey questions about avatar use included phrases such as, "would not have used regardless" and "i [sic] would not have paid attention to the avatars regardless." While the Woodruff School has a long tradition of incorporating communication training, it has largely focused on technical writing to audiences with at least some engineering knowledge. The responses to our survey show that we need to work on changing students' receptivity to communicating to audiences without engineering knowledge, which will likely require some change in the School's culture over time.

As for more immediate results, one student noted that we should include "more requirements to use them [avatars], otherwise they'll be ignored." This is a known issue with the Capstone course. Because it has such a packed curriculum, all of the communication tasks that require students to practice communicating with audiences without engineering knowledge are optional. While these optional tasks are widely participated in, responses show that students take the communication requirements for these optional tasks less seriously. An ideal approach to solving this problem could be incorporating communications training to a wide range of audiences throughout the curriculum in several courses before the capstone design course.

2. Improve Avatar Introductions

Students posed fair critiques of the avatar introductions to the course curriculum. These critiques are fair because all of the communication training in the main lecture was siloed to one lecture period, during which we talked about all of the communication tasks and introduced all of the avatars. Because of this, the introductions can be improved to be clearer and more precise, as opposed to rushed and oversimplified. Additionally, we should improve the introduction by demonstrating how these are audience analysis tools.

Many respondents stated that the avatars should be introduced earlier and referred to when relevant throughout the course. One key recommendation we plan to implement is clearer instruction on the importance of audience analysis by providing student teams with a blank avatar template, which they will fill in with details about their specific team sponsor (or investor in case they are working on an entrepreneurial project without an explicit sponsor/client). From here, we can train students how to make communication choices for this real-life audience early in the course in a similar way the avatars are intended to be used later in the course. Due to the comment's language use, we assume one respondent included clarity he received from discussing the avatars with Dr. Jariwala; "Introduce them as adversarial and people who will negatively judge your project if their expectations are not met." This response shows how a student who had the avatars explained by a section leader came to better understand the value of the avatars.

3. Facilitate Section Instructor Buy-In to Avatar Use

Multiple respondents suggested that "having lab instructors explain them more in-depth would be helpful" and recommended we "require faculty advisor to introduce this concept to incoming students in the first meeting." Ideally, having the section/lab instructors and all Teaching Assistants refer to the audience avatars when providing feedback on oral and written presentations could help bolster the understanding of the avatars and further help us achieve programmatic communication goals. For example, one respondent mentioned, "Feedback from the avatars on our poster helped us decide what to include." This response refers to the TA's commenting practice for the draft poster, which includes adopting the avatar's perspective and voice and commenting as the avatar.

Receiving avatar-aligned feedback outside of the communications lecture increased the helpfulness of the avatars for the students. Question 7 of the survey asked whether the student had received any formal training or guidance to help prepare for the expo. The responses to this question were used to filter the results from question 12, which asked whether the students found

the avatars helpful. The results were filtered based on whether the students had received avataraligned feedback outside of class as part of their guidance or whether they had not. This included the expo audience avatars themselves and poster feedback (which included simulated avatar feedback). The non-avatar-aligned feedback included the communication lecture (where the avatars were introduced to the entire class), TA feedback on their video, discussions with their sponsor and lab instructor, and others. The results showed that 67% of students found the avatars helpful when they received additional avatar-related feedback, compared to only 40% of students who found them helpful when they did not.

4. Remove Distracting Qualities from Avatars

While Mary Turner was intended to represent a diverse perspective for students to encounter, the avatar was too distracting for students. For example, one respondent wrote that the Mary Turner avatar did not "make sense" because "she just doesn't want her kid to go to a liberal school." Another respondent was also preoccupied with Mary Turner's representation; "the Mary avatar is not useful at all. Our team had a judge from a small town and a thick southern accent but they were still interested and knowledgeable. Mary would not be a judge at the event so she doesn't need to be an avatar at all." These responses show how students got distracted from the qualities of the Mary Turner avatar to the extent that impeded learning from it in the way we intended. The Mary Turner avatar was supposed to represent an adversarial audience who needed more convincing and help appreciating the projects and learning at Georgia Tech. However, sociopolitical nature of her disposition became the wrong kind of focus for students.

Instead, we recommend altering the role this avatar serves to be reflective of a mom from a Title I school. Doing so will help us achieve the recommendation in one student's comment: "I know other students thought they were stupid or cheesy. So maybe making them more relatable to the students somehow." The Capstone Design Expo organizers invite Title I High School students to attend and interact with the presenting teams to get them excited to pursue STEM careers. These students, as minors, must bring an adult parent or guardian to the Expo. The presence and significance of this specific audience at the Expo will be communicated to future Capstone design students as they prepare for the Expo. This new avatar will still allow us many of the audience challenges the Mary Turner avatar was created to embody because this new avatar will also come to the Expo feeling a bit like an outsider who already believes the information will be too difficult to understand and irrelevant to her life.

7 Acknowledgments

The authors thank the support from The Frank K. Webb, Jr. Endowment.

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1. APPENDIX

Appendix A: Rubric designed for use by judges for the capstone design expo.



Each team will be judged on a 1 to 5 scale, 5 being the best, in the following categories: 1. Problem

Was the problem worth solving?

- 5 Presented a significant potential impact by using quantitative and/or qualitative metrics to justify the project
- 3 The project has a moderate potential impact
- 1 The project has minimal potential impact

2. Solution

Proof that the solution works

- 5 Successfully validated all critical aspects of the designed solution (through physical prototype and/or simulation)
- 3 Validated a few aspects of the solution
- 1 Conducted insufficient validation for the solution/recommendation

3. Innovation

Is the proposed solution creative?

- 5 Original, non-obvious solution/recommendation
- 3 Reapplication or recombination of existing solution
- 1 Unsurprising/obvious solution

4. Presentation Energy

Did the team exude energy to get you excited?

- 5 Incited investment in the problem/solution/project
- 3 Neutral/unnoticeable energy
- 1 Delivery detracted or inhibited audience investment

Appendix B: Reference handout for students with details on all the Expo relevant avatars

Expo Avatars







INDUSTRY EXPERT PROSPECTIVE GT COURSE SPONSOR PARENT COURSE SPONSOR Communicating to Diverse Audiences

At the Expo, you will need to be flexible in your communication so that you can respond to differing audience needs.

While you will have a beginning, middle, and end to your communication, think about how you might swap details and metaphors for different audiences.



Practice Empathy

Simplify Visual Aids

Create Levels of Detail

Focus on Common Ground

Try to segment your content to address different aspects that appeal to each avatar. For example, you can have sections that focus on practical application, technical details, and real-world impact to swap out for different audiences without needing a completely new pitch for each.

Because you have been asked to communicate to a wide range of audiences, you can imagine all of the presented audience avatars as judges for your team.



Georgia Tech College of Engineering George W. Woodruff School of Mechanical Engineering



Marcus Johnson

Intellectual Property (IP) Lawyer

Background: Holds undergraduate in ME and has over two decades experience as an IP lawyer.

Company: Works at Apple Inc. safeguarding intellectual property and patents related to cutting-edge technologies and innovative products.

Role: Represents Apple Inc. in various IP-related cases and is well-versed in tech industry IP matters.

Values: Committed to ethical practices, legal compliance, societal and environmental positive impacts, and the importance of clear and comprehensive documentation; values projects with a high level of legal awareness, where pitfalls are addressed effectively.

Annoyances: Frustrated by projects that lack originality, fail to acknowledge legal issues and potential pitfalls, or neglect to establish a clear connection to industry interests.

Primary Interest: Innovation first, Solution second.

"Excellence in problem-solving requires a keen understanding of the problem's impact, a thorough validation of solutions, and a spark of creativity that inspires innovation. Just remember to respect the boundaries of intellectual property and ethics."

Marcus believed in the power of problems that were truly worth solving, and his standards were high. He sought presentations that presented not just the problem but its potential impact, backed by compelling quantitative and qualitative evidence.

Innovation was paramount for Marcus. He wanted ideas that broke free from the ordinary and presented fresh, creative solutions. Rehashing existing concepts didn't capture his attention; he was in search of the spark of creative thinking, expecting students to demonstrate in-depth understanding of their projects, highlighting innovative solutions and their real-world applicability. Yet, he was acutely aware of the need for students to strike a delicate balance between creativity and legal compliance, and he worried that some presentations might err on the side of risking the company's intellectual property or infringing on existing patents.



Mary Turner

Stay-at-Home Mom & Pastor's Wife

Background: Rooted in her small, southern town, and has limited exposure to engineering and academia.

Role: Caring parent with a child in high school who is considering a career in engineering. She must look out for his best interests.

Values: Cherishes community values, traditions, and her son's happiness. Values practicality; seeks reassurance that her child's aspirations in engineering will give him success and harmonize with her family's core principles.

Annoyances: Annoyed by a disconnection from realworld practicality and passionless presentations. Frustrated by a lack of relatability, where presentations don't address the challenges that concern her lived experience. She is also bothered by presentations that come across as overly academic or elitist.

Primary Interest: Presentation first, Problem second.

"I want you to explore your engineering dreams with open eyes and a full heart. Your journey should take you where you want to go, but always remember where you come from, and let it guide you forward."

After viewing the engaging Georgia Tech Capstone Design Expo videos, Mary had the confidence to make the trek from Guysie, GA (~4hr drive) to the expo with the hope she and her son would be able to enjoy the presentations as non-experts.

As Mary stepped into the expo, her heart brimmed with hope and trepidation. She wanted to be able to guide her son as he prepared to make college decisions that would influence his future success and happiness. Adding to this pressure, she had an additional concern - what if the presentations were too technically complex for her to grasp?

She sought presentations she could connect to as well as a way of seeing how her son could fit into this environment. The academic atmosphere left her feeling somewhat out of place, her anxiety about understanding the presentations gnawing at her. But, as time progressed, she was drawn in by the energy and enthusiasm exuded by the student teams. They sparked excitement and engagement, which made her feel like her son's chosen path was one full of joy and importance.



Sarah Mitchell

Mid-Level Manager

Background: Holds a Bachelor's degree in engineering, has been with current company for over a decade.

Role: Results-driven manager who oversees projects in her department. Her responsibility is to ensure the success of projects, justify the allocation of resources and time, and present concise updates to her manager.

Values: Final deliverables; practical and efficient project management that communicates and justifies resource and time needs quickly.

Annoyances: Annoyed with presentations that dwell on class assignments, social impact, or an extensive explanation of the design process. She prefers presentations that get straight to the point and address her specific requirements.

Primary Interest: Solution, solution, solution.

"I appreciate your enthusiasm for design options, but we need to stay laser-focused on the practicalities and resources. Let's ensure our solutions align with the company's goals and avoid any unnecessary detours."

This semester, Sarah's company sponsored a student capstone design team, and the team she's mentored needs to meet her high expectations.

The displays and presentations at the Expo didn't distract Sarah. She was here to see the results of her collaboration with the student team and **judge other teams**. As she moved through the expo, her discerning eye quickly assessed the projects on display, filtering out presentations that didn't align with a practical and results-driven approach. Her hope was pinned on the team she had supported and mentored, and she was determined to see a final fabrication prototype and a scalable implementation plan that would meet her exacting standards.

Sarah knew she had a reputation for being demanding, but she saw herself as a guide, helping students transition from academia to the corporate world. As she ventured deeper into the expo, Sarah hoped to interact with teams that had embraced her results-driven approach and would present a solution that met her high standards.

Appendix C: Reference handout for students with details on all avatars for report and other stakeholders

REPORT & FAB PACKAGE AVATAR



Challenges

Jon has many responsibilities. Foremost is a constant need to convince executives that his team is making a tangible impact. He grapples with pressure to innovate continually and explain the significance of these innovations, while carefully justifying expenditures. Managing multiple teams necessitates clear and guick communication, urging employees to get straight to the point in their interactions. He doesn't always have complete insights into the requirements of a project or time to research the context before assigning a team.

He is hindered by unnecessary details and an overemphasis on the hows and whats of the design process. He seeks greater clarity and justification for the final results. Despite his technical expertise, he values reports that are not only technical but also offer clear recommendations and insights. His busy schedule allows him only one hour to review reports before crucial meetings with executives, emphasizing the need for efficiency and clarity in the information presented to him. Poor visuals that take time to be understood often get skipped.

JON FOX DESIGN SUPERVISOR

- Gender: Male Marital status: Married Children: 2

- Location: Atlanta
 Level of education Masters (ME)

Goals

Jon's primary goal is to provide actionable, validated solutions to problems handed down by his supervisors as well as clear recommendations for funding or further development. Because he has to meet certain company standards, Jon expects design reports to clearly articulate how the proposed product aligns with the company's strategic goals. Jon's daily efforts are often impacted by the many design teams he manages.

Needs

Reports meant for Jon should be well-organized and concise, ensuring that he reuse some content on key insights, justifications, and recommendations. He needs employees to skip basic descriptions of tools used and focus on why they were used and to swap wordy content for simple, integrated and annotated sketches. Because he risks his reputation to justify your solutions to executives, Jon needs the technical feasibility to be unguestionable; reports should demonstrate employees appropriately used the tools they selected, with clear articulations of all assumptions supporting their analysis, and evidence of solution agnostic thinking in the design process.

Burdell Design Inc., Communication Ecosystem



	Sponsor	Mfg. Engineer	IP lawyers	Marketing	Investor	Future Team	Government
Executive Summary	\checkmark	\	\	\	\	\	\
Introduction & Background			\	~	~	\	
Existing Products, Prior Art, & Applicable Patents	Potential infringement of existing patents		Background to determine novelty	Comparison with existing products	Comparison with existing products		
Codes & Standards				Interoperability with other devices, systems. etc.			Does the use of the product cause any harm to user or public health?
Customer Requirements & Engineering Design Specifications		Justification for specific design features/tolerances		Identify most relevant specifications for the end user		Compare current needs with the past specifications	
Market Research & Potential Impact	Justify project funding			Potential impact on user and market	Market viability, competition, market need		
Design Concept Ideation				Functions that the solution fulfills		Analyze the need to add/remove/augme nt functions from earlier design	
Concept Selection & Justification	Why specific decisions were made					Why specific decisions were made	
Industrial Design	Alignment with the company's brand	Justification for specific design features		How the user will interface with the product and branding specifics.			
Technical Analyses, Experimentation, & Design Performance Prediction	Justifying the solution works					Critically analyze if the solutions were adequately justified	
Mockup & Prototyping	Communicate how solution works; Refinement of the solution				Communicate how solution works	Exploration of ideas which might not have worked	
Final Design	How does the solution work?	How does the solution work?	How does the solution work?	What does the final solution look like.	Is the solution market ready, would it appeal to users, will it succeed?	How does the solution work?	
Manufacturing	How to replicate solution and what it would cost	How to fabricate the solution?			What it would cost?	How to replicate solution?	
Societal, environmental, and sustainability considerations				Find potential 'feel good" aspects of the solution			Does the realization of the product cause any harm?
Risk Assessment, Safety & Liability	Did the solution adequately consider risks and develop mitigation strategies						Did the solution adequately consider risks and develop mitigation strategies
Patent Claims & Commercialization			Is the solution unique & patentable?		Ability to deter competition		
Team Member Contributions			Identify who is the "inventor"				
Summary/Conclusions/Future Work	Project milestones and next steps			Limitations of the proposed solution	How funds would be used to develop the solution	Understand limitations of the proposed solution and explore next steps	
Fabrication Package	How to replicate solution	How to build/fabricate the solution				How to replicate the solution?	
Budget	Was it an effective use of funds?						

Video Project Problem

Due 2/19, 5pm

50-60 seconds

<u>Your team will create a project problem video as an Expo teaser.</u> You will explain the problem that is propelling your project to a <u>public audience</u> (non-engineers). Only one member per team needs to upload a video; preferred format is .mp4; and teams will receive feedback on their videos within a week. <u>Do NOT discuss any element of your solution.</u>



REACHING THE PUBLIC

- 1. Clearly state the problem your capstone project aims to solve.
- 2. Highlight the significance and real-world relevance of the problem.
- 3. Avoid technical jargon.

Choose one or more team member(s) to be on camera or use voice-over narration. Ensure your presentation is <u>clear, concise, and captivating</u>.

Use your creativity to <u>engage</u> the audience. You can include visuals, graphics, animations, or real-world examples to illustrate the problem.

KEY ELEMENTS

- Like a movie teaser, you'll <u>focus on</u> <u>the conflict, challenge, or problem</u> that must be overcome.
- Ensure good quality video, light, tone, and sound.
- Speakers should come across as confident, knowledgeable, and approachable; make viewers want to cheer for you to overcome your problem.
- If you use screen capture, practice mouse movements and control viewer's line of sight.
- Use a L or J cut to create a feeling of momentum.

RESOURCES

- Additional Instruction
- Mobile Filmmaking Techniques
- <u>Student Samples</u>
- <u>LibGuide on Video Best Practices</u>
- Podcast on Video Advice

Appendix E: Pre-lecture survey questions relevant to the study

- 1. Reflecting on your past engineering presentation (could be ME2110) to peers/faculty, what was the most challenging aspect of that experience?
- 2. Reflecting on your past engineering presentation (could be ME2210) to the public, what was the most challenging aspect of that experience?
- 3. On a scale of 1-10, how well can you explain your engineering design decisions/rationale to a non-engineer? 10 signifies extremely well.
- 4. How do you ensure your communication is usable/actionable by your audience?

Appendix F: End of semester survey

Please see next page



Communications Training in Engineering Design Education

Survey Flow

Standard: Informed Consent (2 Questions)

Branch: New Branch

lf

If By clicking the button below, you acknowledge: Your participation in the study is voluntary. You... I do not consent, I do not wish to participate. Is Selected

EndSurvey:

Standard: Basic Information (3 Questions) Standard: Communication Focus (5 Questions) Standard: Expo (1 Question)

Branch: New Branch

lf

If Did you receive any formal training/guidance to help you prepare for the expo? Pick from the mult... Expo audience avatars (Reference link) Is Selected

Or Were you introduced to the Audience Avatars to design your communications for faculty, sponsor, e... Yes Is Selected

Standard: Avatar Usefulness (6 Questions) Standard: Avatar Design (3 Questions) Standard: Avatar for Reports (4 Questions) Standard: Avatar Improvements (2 Questions)

EndSurvey:

Page Break



Start of Block: Informed Consent

Q1 Communications Training in Engineering Design Education Informed Consent Form

You are being asked to be a volunteer in a research study. This study aims to better understand student perceptions associated with the delivery and efficacy of communications training in Capstone Design courses. We hope to use this information to improve future Capstone Design courses. You may be in this study because you are currently participating or recently participated in a Capstone Design course.

Your responses will be kept completely confidential. We will comply with any applicable laws and regulations regarding confidentiality. To ensure that this research is being carried out properly, the Georgia Institute of Technology IRB may review study records. The Office of Human Research Protections may also look at study records. You must not be in an EU country, UK, or China at the time of your participation. The main risk associated with the completion of this study is the identification of the participant's personal information, which could link their identity to their opinion about this course. However, we believe this risk is minimal because the anonymous survey is not setup to collect user-identifiable data other than the team's name. The collected responses will only be reviewed for completion by researchers who do not control student grades. The principal investigator will access the collected responses only after the grades are submitted.

The study should take you around 15 minutes to complete. Your team scores from the expo will be considered another data set for this research. Your participation or lack thereof will not impact your grades. You have the right to withdraw at any point during the study. The principal investigator of this study is Dr. Amit Jariwala, who can be contacted at amit.jariwala@gatech.edu. If you have any questions about your rights as a research subject, you may contact the Georgia Institute of Technology Office of Research Integrity Assurance at IRB@gatech.edu. Thank you for participating in this study.

Q2 By clicking the button below, you acknowledge: Your participation in the study is voluntary. You are 18 years of age or older. You are aware that you may choose to terminate your participation at any time for any reason.

 \bigcirc I consent, begin the study. (1)

 \bigcirc I do not consent, I do not wish to participate. (2)



End of Block: Informed Consent

Start of Block: Basic Information



Q3 Which is your major/school?

▼ Aerospace Engineering (3) ... Other (9)

*

Q4 What was your expo table number? You can find it from <u>https://capstone.gatech.edu/expo_program</u>

Q5 How much time did your team spend on preparing presentation materials for the Expo?0 hrs (1)1-2 hrs (2)3-5 hrs (3)6-8 hrs (4)9+ hrs (5)Expo Video (1)0000

Expo Poster (2)
O

Oral Pitch (3)
O

Prototype/Demo
O

(4)
O

Page Break



End of Block: Basic Information

Start of Block: Communication Focus

Q6 How prepared/confident did you feel presenting your project prior to the expo?

0	Not well at all	(39)

- Slightly well (40)
- O Moderately well (41)
- \bigcirc Very well (42)
- \bigcirc Extremely well (43)

X

Q7 Did you receive any formal training/guidance to help you prepare for the expo? Pick from the multiple-choice options below

Expo audience avatars (Reference link) (1)
Feedback on video (4)
Feedback on posters (5)
Oral lecture on communication in class (6)
Discussion with sponsor (7)
Discussion with lab instructor (8)
Other (9)



Q8 Were you introduced to the Audience Avatars to design your communications for faculty, sponsor, expo audience, etc.?



Q9 Do you feel that you had enough/accurate guidance to prepare for the expo?



- O Probably not (36)
- O Probably yes (37)
- O Definitely yes (38)



Q10 Looking back, what additional guidance would have helped you prepare better for the expo. What would you do differently if you had another opportunity to present your same project at the expo?

End of Block: Communication Focus

Start of Block: Expo

Q11 How well do you agree with the statements:

	Strongly disagree (36)	Somewhat disagree (37)	Neither agree nor disagree (38)	Somewhat agree (39)	Strongly agree (40)
Participation in the expo helped me grow as a better engineer/designer/professional (1)	0	0	0	0	0
l enjoyed/had fun at the expo (2)	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc
The expo scoring rubric is fair for the wide range of disciplines judged at the expo (3)	0	\bigcirc	0	\bigcirc	0

End of Block: Expo

Start of Block: Avatar Usefulness

G	Georgia Tech Capstone Design Expo
Q12 Did you find the audience avatars	helpful in your expo prep?
O Yes (9)	
○ No (10)	
Display This Question:	
If Q12 = Yes	
012 Disease surplain how the system h	

Q13 Please explain how the avatars helped you make specific choices on the *content* or the *format* of your expo presentation Content: The information you included (or excluded) Format: How you arranged the information that you presented

Display This Question: lf Q12 = No

Q14 Please share what other tools you used and/or how did you prepare your expo materials to cater to a wide range of audiences.





Q15 How well do you agree with the following statements. Because of the communications guidance/training through audience avatars, ...

	Strongly disagree (43)	Somewhat disagree (44)	Neither agree nor disagree (45)	Somewhat agree (46)	Strongly agree (47)
I was confident presenting at the expo (1)	0	0	\bigcirc	\bigcirc	0
I had examples/stories prepared for each audience type (2)	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc
I was confused on how I should prepare for the expo. (3)	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc
I am confident in my ability to respond in the moment to different audiences (4)	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc
I am less anxious/worried about speaking to different types of audiences (5)	0	\bigcirc	\bigcirc	\bigcirc	\bigcirc

Q16 Describe how you used one or more avatars to plan to alter how you responded to the expo audience in real time.



Q17 Did you use the **Mary Turner** avatar to help you make communication decisions while preparing your Expo Video?

○ Yes (23)

🔾 No (24)

End of Block: Avatar Usefulness

Start of Block: Avatar Design

Q18 Did the diversity of the avatars adequately help you prepare to respond to the diversity of the actual expo audience you encountered?

Yes (23)No (24)

Display This Question: If Q18 = Yes

Q19 If yes, explain how the extremes that the different avatars represented helped you present with confidence?

Display This Question: lf Q18 = No

Q20 If no, explain what changes/improvements/additions should be made to the avatars to give you confidence when interacting with audiences with extremely diverse perspectives.



Start of Block: Avatar for Reports

Q21 Did your lab advisor refer to or encourage you to refer to the Avatars discussed during Studios?

Yes (1)
 No (2)
 Other (3) ______
 Page Break ______



Q22 Explain or share specific examples of how you or your team refereed to the **Jon Fox** Avatar to make specific communication decisions for **writing** the report or preparing the fabrication package

Q23 Explain or share specific examples of how you or your team refereed to the **Jon Fox** Avatar to make specific communication decisions when preparing your class **presentations**.

Q24 Explain or share specific examples of how you or your team refereed to the **Sarah Mitchell** Project Sponsor Avatar to make specific communication decisions when interacting with your **sponsor**. Enter "N/A" if your project did not have a sponsor. If your project had a sponsor and did not use this Avatar then enter "Did not use"

End of Block: Avatar for Reports

Start of Block: Avatar Improvements

Q25 What changes to the avatar format would make them more usable?

Q26 How do you recommend avatars be introduced to incoming students so that they would be easier to use?

End of Block: Avatar Improvements